

2016 Work Programme

<i>This Document is submitted to the GEO-XII Plenary for decision.</i>

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2016 Work Programme

1 INTRODUCTION AND BACKGROUND

The GEO Work Programme for 2016 will be the first of the new GEO decade 2016-2025. It has been developed in parallel with the new Strategic Plan in order to have the necessary implementation tool in place to ensure continuity of GEO actions in 2016.

As explicitly recommended by the Implementation Plan Working Group (IPWG), the GEO Work Programme for 2016 is of a transitional nature; in fact it bridges the first and the second GEO decades and covers a year in which GEO will have to ensure continuation of current activities, while defining new priority actions called for in the Strategic Plan and transitioning to the new implementation mechanisms proposed by IPWG.

The overall objective is to complete the transition in 2016 by consolidating the revised management framework, confirming the implementation mechanisms to be considered for each activity and developing the first “regular” Work Programme 2017-2019.

The version v3.0 of the 2016 Work Programme is attached (Appendix 1).

The Work Programme Reference Document version v3, identified by the IPWG in the new Strategic Plan, is also attached (Appendix 2)

2 THE 2016 WORK PROGRAMME

This draft of the 2016 Work Programme identifies the activities that GEO will perform in 2016. Being transitional in nature, it will ensure a smooth passage to the next GEO decade, providing to all teams currently contributing to the GEO Work Plan 2012-2015 the opportunity to continue to do so in a strengthened framework.

The Work Programme responds to, and implements, the provisions contained in the “GEO Strategic Plan 2016-2025: Implementing GEOSS”, prepared by the IPWG, which is also submitted to Plenary for approval and subsequent endorsement by Ministers through the Mexico City Declaration.

This version v3.0 has been prepared by the GEO Secretariat and:

- (i) Builds upon the inputs received by the Teams of the GEO 2012-2015 Work Plan, by the GEO Community (during and after the GEO Work Plan Symposium, held in Geneva on 5-7 May) and by the GEO Principals;
- (ii) Reflects the interactions with the current Implementation Boards and Working Groups, concerning the structure and the description of the Foundational Tasks concerning data, infrastructure, knowledge, capacity building, users’ needs and community engagement at large;
- (iii) Reflects the interaction with all the proposing Teams for Community Activities and GEO Initiatives concerning the relevant description provided;
- (iv) Reflects the consultations with the IPWG, to ensure that the Work Programme adequately covers the GEO Core Functions identified in the new Strategic Plan;

- (v) Reflects to a large extent the result of the discussions with IPWG on the definition and description of the Foundational Tasks, as well as on the mechanisms for their execution; and
- (vi) Incorporates recommendations from the Executive Committee, provided at its July 2015 meeting, to combine GEO flagships and GEO Initiatives into one category for 2016.

3 CONTENT OF VERSION V3.0

The list of the major changes from version v2.0 (issued in June 2015) and of the proposed Community Activities, GEO Initiatives and Foundational Tasks, is reported in Appendix 3; this latter list indicates if each activity has additional material included in the Work Programme Reference Document.

For Community Activities, the proposed descriptions generally meet the relevant criteria set forth by the Strategic Plan. The Secretariat is continuing to work with the proposing Teams where additional information is needed.

For GEO Initiatives, the Work Programme attempts to provide a homogeneous level of detail in their description, but there is still some lack of information to be completed for initial compliance with the Strategic Plan criteria. We have received several “statements of intent” that still need to be consolidated and substantiated. All the proposals were included, so that the teams could start working within the GEO framework and, according to the Executive Committee recommendation in point vi) above. Missing information will be provided later for review and assessment by the Programme Board.

The inclusion of proposed activities as a Community Activity or GEO Initiative reflects the Proposing Teams’ assessment, with the exception that, following Executive Committee recommendations, GEO Flagships and Initiatives be combined into one category.

For Foundational Tasks, complete descriptions are provided, as well as the definition of the expected outputs for 2016 and, for each Task, an estimation of the resources needed to produce these outputs, both Secretariat resources and external contributions.

4 NEXT STEPS FOR THE DEVELOPMENT OF THE GEO TRANSITIONAL WORK PROGRAMME FOR 2016

There is still some work to do consolidate the 2016 Work Programme, in particular to continue the integration of proposed contributions into the Programme (such as the Copernicus programme proposed by the European Commission and a number of activities proposed by China that appear to be of a national nature), to consolidate the description of the proposed activities, and to complete the definition of the teams and of the associated resources.

The essential input to validate the entire Work Programme is constituted by the confirmation from Members and Participating Organizations (POs) of the contributions that are identified in the description of the activities. We envisage direct consultations with Members and POs and among Members and POs to receive these confirmations; the Secretariat is ready and willing to support GEO Principals in this process.

To facilitate the process, the Points of Contact for each activity are enclosed. (Appendix 4)

The Secretariat, with the support of the Task teams, will issue at least one revised version v4 of the Work Programme in December after the Plenary meeting that reflects GEO Principals’ inputs and the results of Plenary deliberations.

5 CONCLUSIONS

The Plenary is asked to review and approve the proposed v3 of the 2016 Work Programme.

We expect GEO Principals to review the content, comment on the proposed activities, confirm proposed contributions and/or identify new potential contributions, as well as confirm the associated commitments.

APPENDIX 1

2016 Work Programme v3.0

GEO 2016 WORK PROGRAMME

version v3

29 September 2015

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 - GI-04 Global Observing System for Mercury and Persistent Pollutants
 - GI-05 Global Carbon Observation and Analysis System
 - GI-06 Reinforcing engagement at regional level: AfriGEOSS for Africa
 - GI-07 Ocean and society - Blue Planet
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 - GI-09 Global Wildfire Information System
 - GI-10 EO data and renewable energies
 - GI-11 Information Services for Cold Regions
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 - GI-14 GECO: the GEO Global Ecosystem Initiative
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 - GI-16 GEO-DARMA = Data Access for Risk Management (new-CEOS) *(to support the implementation of the Sendai framework 2016-2030).*
 - GI-17a Global Urban Observation and Information
 - GI-17b Global Human Settlement indicators for post-2015 international frameworks
 - GI-18 GEO and SDGs. EOs role in providing support to countries in achieving SDGs and in defining and monitoring the associated indicators.
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- 5.3 Foundational tasks description
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 - GD-01 Advancing GEOSS Data Sharing principles
 - GD-02 GCI Operations *(including access to Knowledge)*
 - GD-03 Global Observing and Information Systems *(includes systems like WIGOS, GCOS; ... And reference datasets)*
 - GD-04 GEONETCast Development and Operations
 - GD-05 GEOSS satellite Earth Observation Resources *(includes advocacy for continuity)*

GD-06	GEOSS non-space based Earth Observation Resources (<i>includes inclusion of citizens' observatories</i>) (<i>includes advocacy for continuity</i>)
GD-07	GCI Development (<i>includes development of Data Management guidelines</i>)
GD-08	SBA process: Systematic determination of user needs / observational gaps
GD-09	Knowledge Base development
GD-10	Radio-frequency protection
GD-11	Communications Networks
CD	Community Development
CD-01	Capacity Building coordination
CD-02	Reinforcing engagement at national and regional level (<i>includes EO uptake for decision making</i>)
CD-03	Assess the benefits from EOs and of their socio-economic value
SO	Secretariat Operations
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ATTACHMENT 1 – FOUNDATIONAL TASKS 2016 KEY DELIVERABLE

ATTACHMENT 2 - FOUNDATIONAL TASKS ESTIMATED RESOURCES

1. INTRODUCTION

The GEO Work Programme provides the framework for implementing agreed activities. It is organized into four major parts describing the proposed activities subdivided according to the four implementation mechanisms defined in the Strategic Plan (Figure 1).

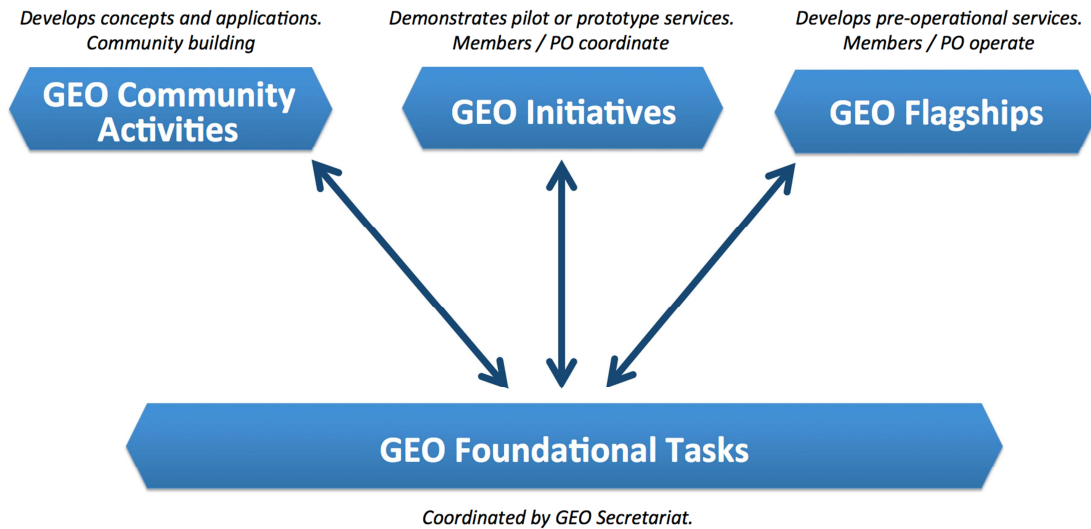


Figure 1 (from the Strategic Plan)

Each of the mechanisms serves a different purpose in attaining GEO's Strategic Objectives, allowing activities of different scale and kind to be implemented.

- **GEO Community Activities** allow stakeholders to cooperate flexibly in a bottom-up fashion and with a low initiation cost. They can include a broad variety of activities with varying degrees of coordination. GEO Community Activities may, for example, define user needs, explore new frontier applications or demonstrate technical possibilities, or agree on specific observation or analysis protocols and data exchange.
- **GEO Initiatives** allow Members and Participating Organizations to coordinate their actions and contributions towards a common objective within an agreed, yet flexible framework. They develop and implement prototype services according to GEO priorities and have identified committed resources to a certain extent. GEO Initiatives may, for example, demonstrate technical feasibilities through pilot services, or serve a user need.
- **GEO Flagships** allow Members and Participating Organizations with a policy-relevant mandate to spin-up a dedicated operational service serving common needs and/or well-defined user groups. They develop and implement near-operational services according to GEO priorities and are fully resourced. GEO Flagships may operate for as long as they are able to generate sufficient impact to attract support for their activities. Once they reach a mature, operational stage, they may be taken

up by operational organizations (e.g. GEO Participating Organizations), for their continued operation over the long term.

- **GEO Foundational Tasks** allow GEO to implement selected, often enabling, tasks to achieve GEO Strategic Objectives. These include coordination actions, gap analyses, the implementation of technical elements for accessing GEOSS, and other routine operations of the GEO Secretariat. Thus, they provide important support functions to Flagships, Initiatives, and Community Activities.

The Work Programme is supported by a “Work Programme Reference Document”(WPRD), maintained by the GEO Secretariat, which represents a compilation of the relevant Implementation Plans of GEO Flagships, GEO Initiatives and of Community activities description. It also contain important background information on overarching objectives of the actions in the Work Programme and on Monitoring and Evaluation activities.

The WPRD, because of the amount of information it will contain, will be a web-based, “electronic document” only, to allow easy consultation.

The first draft issued together with the Work Programme consists of a collection of more detailed information on the following Community Activities and GEO Initiatives, for which the proposing Teams have made additional documentation available.

CA-25	Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity-building phase
CA-32	Research Data Science Summer Schools (new-CODATA/RDA)
GI-01	GEOGLAM-Global Agricultural Monitoring and Early Warning
GI-02	GEOBON-Global Biodiversity Observation (GEO BON)
GI-03	GFOI Global Forest Observation Initiative
GI-04	Global Observing System for Mercury and Persistent Pollutants
GI-05	Global Carbon Observation and Analysis System
GI-06	Reinforcing engagement at regional level: AfriGEOSS for Africa
GI-07	Ocean and society - Blue Planet
GI-09	Global Wildfire Information System
GI-16	GEO-DARMA = Data Access for Risk Management (new-CEOS)
GI-17a	Global Urban Observation and Information
GI-17b	Global Human Settlement indicators for post-2015 international frameworks
GI-19	AmeriGEOSS (new)

2. WORK PROGRAMME DEFINITION AND EXECUTION FRAMEWORK

2.1 Reference criteria

The description of the Work Programme and of the different Implementation mechanisms proposed by the IPWG (and reported in Chapter 1) provides the reference for its development and for the definition of the overall criteria to ensure its execution.

The key requirement is for the Work Programme “to strive to optimally pursue the realization of the Strategic Objectives through implementation of GEO’s Core Functions constrained by the identifiable resources”.

The first, most important reference, which can be derived is that the Work Programme should be composed of a number of activities, well-articulated and described, that are linked during the

definition and coordinated during the execution to ensure that the GEO's Core Functions are implemented in a satisfactory way.

The second key reference is directly provided by definition of the Implementation Mechanisms, i.e. the function of the Foundational Tasks to implement often enabling activities to achieve GEO Strategic Objectives and, equally important, to provide important support functions to Flagships, Initiatives, and Community Activities.

The third reference is constituted by the increased role that IPWG recommended for the Secretariat to assume in the Work Programme execution: not only support to external contributors, as it was for the previous Work Plans, but also a central role in coordinating and implementing Foundational Tasks.

2.2 GEO "Workflows"

Starting from the criteria above, the definition of the Foundational tasks and their implementation arrangements seem to constitute the key reference to identify what one may call a "GEO Workflow", that puts in place the links among the different activities by building the working interfaces among the different teams so that they interact in a timely fashion.

The Foundational Tasks play a central role in ensuring the basic GEO "platform" is in place by

1. Directly addressing the development of key GEO elements, like GEOSS, User needs, Knowledge base, Communication and outreach, are properly developed in a coherent manner and
2. Properly interfacing and supporting the other GEO activities (Flagships, Initiatives, and Community Activities).

Implementation of each of these two key elements implies the definition of a set of arrangements, plans and working interfaces that will be better identified and progressively implemented during 2016 to become two consolidated "GEO Workflows".

A couple of examples for the first element are represented by a) the need to ensure necessary coordination between the teams developing the GCI and those developing the knowledge base and b) the systematic interface of the communication and engagement with all other teams.

An example for the second is constituted by the need to implement the interaction between the teams developing a GEO Initiative and the teams in charge of GCI development and operations, so that the Initiative could benefit from the GEOSS data and information made available through the GCI and, in turn, define the arrangements so that what is developed within that initiative is made accessible through GEOSS.

The role the Secretariat, as articulated in the Strategic Plan, is therefore twofold, to ensure the coordination among the different teams in charge of the Foundational Tasks and to provide a clear point of reference for the other GEO activities (Flagships, Initiatives, and Community Activities).

This role is consistent with the proposed estimated resources for the Foundational tasks.

4. COMMUNITY ACTIVITIES

4.1 General

GEO Community Activities enable a broad variety of activities. They allow stakeholders to cooperate flexibly in a bottom-up fashion and with a low initiation cost.

The Work Programme includes a summary description of each of the agreed activity, while more detailed description including the planned outputs/results and the resources allocated will be part of the “Work Programme Reference Document”.

4.2 Community activities description

CA-01 Global Land Cover

Objectives/motivations:

Land Cover is one of GEO’s top-priority Earth observation parameters due to its cross-cutting importance for many Societal Benefit Areas. The GEO Global Land Cover task is working to improve coordination of land cover activities around the globe. It seeks to develop an international network where GEO Members can express their needs for land cover products, contribute mapping and monitoring efforts, and support related capacity development initiatives. Through its activities, the Land Cover task aims to meet the product needs of numerous stakeholders including environmental agencies, science communities, national mapping agencies, commercial users, and UN Conventions. However, more work is needed to efficiently coordinate activities and communicate related societal benefits and evidence of policy linkages. Despite the technological and scientific advancements made in recent years, there is an impelling need for greater harmonization of land cover data and greater collaboration among the different efforts. Reducing inconsistencies between land cover products, nesting of finer-scale information within broader schemes and standardised accuracy assessments still remain major challenges.

Some key objectives of the task:

- Provide a suite of global land-cover and land-cover change datasets, based on improved and validated moderate resolution land-cover maps,
- Develop high-resolution global land-cover and land-cover change data sets, based on international community consensus and including a robust accuracy assessment,
- Develop an independent global land cover reference dataset
- Improve the use of time-series products to characterize the nature and extent of land-cover change and dynamics,
- Better understanding of land cover state and its dynamics, at global scale,
- Support policy initiatives such as those from UN Conventions and at the national level.

Leads (preliminary):

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Contributors:

Task SB-02-C1 (<http://earthobservations.org/ts.php?id=155>)

Task SB-02-C2 (<http://earthobservations.org/ts.php?id=220>)

Task SB-02-C3 (<http://earthobservations.org/ts.php?id=221>)

Activities and outputs planned for 2016:

- Reorganize Global Land Cover Task; Explore the potential to evolve into a GEO initiative
- Continue work on a GEO Global Land Cover Information Portal; connect major Global and regional Land Cover websites/portals to facilitate data sharing and accuracy assessment of land-cover products
- Further develop concept for a collaborative Global Land Cover Information Service System
- Promote latest land cover map validation good practices and advocate for independent validation databases
- Develop methodologies for land cover mapping and change monitoring at high spatial resolution

Funding sources and indicative amounts (2016):

Projects

- ESA Land Cover CCI
- Copernicus Land Monitoring Service
- EC Joint Research Centre (JRC) activities
- Chinese efforts on 30-m land cover datasets (GlobeLand30 project)

In kind

ESA GOFC-GOLD Land Cover Office (coordination work)

Financial

ESA GOFC-GOLD Land Cover Office (travel support for Project Officer)

Additional activities for 2016 (Recommended if additional resources made available):

- Conduct survey on national requirements (reporting processes to UN Conventions and monitoring of SDGs)

Future plans (activities and resources):

- Promote greater collaboration and harmonization of land cover data
- Work towards an operational process to generate global land cover
- Develop an independent global land cover reference dataset
- Support countries by developing a national-based approach for land use and land cover mapping
- Facilitate the use of Land Cover data to support and assess progress towards the Sustainable Development Goals
- Promote Land Cover data as a global indicator of change for all kinds of uses – ecosystem services, agriculture, water, health, disasters, forests, carbon etc.

CA-02 Land Cover for Africa

Objectives/motivations:

The Working Group on Land Cover for Africa is comprised of an Executive Board with representatives from the six regions in Africa and a Technical Advisory Group, which includes both International and African remote sensing and land cover experts. The purpose of the Working Group is to contribute to the development of a land cover programme which includes monitoring land cover change for Africa at medium and high resolution.

The major objectives of the Working Group are as follows:

- Evaluate the development of medium and high resolution land cover products for Africa, including the standardization of the process and the validation of the final products
- Advocate for Earth Observation data providers to adopt a policy of full and open access to their data
- Raise awareness of the availability of land use/land cover data, tools, applications, and land cover change dynamics among decision makers at multiple levels
- Build mutually beneficial partnerships with national and regional institutions to assess their land cover needs, such as products and tools, while increasing their involvement in data validation for the global land cover data product
- Build capacity within and among national and regional institutions to integrate land cover data into decision making processes
- Promote sound governance policies and activities that maximize the value and usefulness to decision makers of land cover data at multiple scales (e.g., data openness, data sharing, institutional transparency, common data standards)

Leads:

Name	Institution	GEO Member/PO
Hussein Farah	RCMRD	RCMRD
+ <i>Executive Board</i>		
Jean Parcher	US DOI	USA
Amadou Dieye	CSE	Senegal
+ <i>Technical Advisory Group</i>		

Contributors:

RCMRD, Gabon (AGEOS), Madagascar (University of Antananarivo), Morocco (Chouaïb Doukkali University), Nigeria (RECTAS), South Africa (NGI - National Geo-Spatial Information), United States (US DOI), AARSE, China (Tsinghua University), Egypt (NARSS), European Commission (JRC), GOF-C-GOLD, Kenya (ICIPE), Nigeria (NASRDA), Senegal (CSE), South Africa (CSIR, NEOSS), UNECA, UNEP, United States (NASA, USGS)

Task SB-02-C4 (<http://earthobservations.org/ts.php?id=226>)

Activities and outputs planned for 2016:

There is a need for the Working Group to streamline its activities to focus on tangible elements. In the short-term, a strategic guideline will be developed, describing the major tasks and the benefits for the African countries. The main activities for 2016 will be organized around the following areas:

Land Cover Inventory

One major accomplishment of the Working Group was to build an inventory of current land cover mapping activities in Africa. Work in 2016 will focus on further developing the Land Cover Inventory:

- Maintain the official version of the Land Cover Inventory spread sheet and review the master list for any duplicates or non-existent datasets
- Development of a web interface for the Inventory that allows the users to the AfriGEOSS webpage to access information about the available or in-work land cover datasets for specific countries or regions in Africa in a comprehensive and user-friendly way. Information about the datasets will contain description of geographic extent, data sources, acquisition dates, resolution or minimal mapping scale, methodology, format, contact details, and where possible thumbnails and download links to the dataset.

User requirements

A survey will be created and conducted with preliminary results at end of 2016 to generate knowledge about the national needs and capabilities of countries in the region. There are many different types of users and hence different user requirements. Common needs and tasks exist such as reporting on greenhouse gas inventories but country-specific needs may differ substantially. In 2017, in-country capabilities will be summarized.

Classification system

Land cover products developed at the global scale often do not meet the requirements at the country level. This has been claimed by many countries. A two-level approach is considered as an optimum, with common categories for a continental scale map and individual classes for each country. The country-specific categories should have the capability to be scaled onto the broader scheme.

It has been recognized that countries in Africa have been struggling with the implementation of the new ISO standard LCCS-3 (or Land Cover Meta Language, LCML). In 2016, knowledge about this standard will be provided to the countries and assisted in their efforts to implement the new ISO standard.

One activity is to look at what other institutions are doing and how it can be shared with the community.

Funding sources and indicative amounts (2016):

A long-term strategic plan will be developed within 2016 to attract funding by organisations and developments banks.

Financial

The task has received funding from US DOI (\$20K). DOI will also provide funding for

the results of the LC Inventory to be web-enabled.

Projects

- EC Joint Research Centre (JRC) activities
- Chinese efforts on 30-m land cover datasets

Future plans (activities and resources):

- Establish an Africa-focused Community of Practice for Land Use and Land Cover to facilitate networking among scientists and technicians and to bring together land cover data users (by country and region) and data producers
- Provide Information to governments and donors on where to focus their funding and capacity building resources
- Deliver products and information for policy making in environmental management

CA-03 Access to climate data in GEOSS

Objectives/motivations

In a world of exponential technological change and rapidly growing sophistication in climate and weather information driven in part by the ever increasing volumes of these data, GEOSS must evolve to promote not only the access to these data, but promote services that might provide greater understanding to all the components that make up the Earth System. These understandings must be advanced by climate and weather models that can improve global and regional guidance to the Vulnerability, Impact and Adaptation (VIA) communities of climate change and extreme weather events. There is a pressing demand for regional (extreme) weather and seasonal predictions to satisfy both the modelers themselves in the GEO community, and for use by emergency management personnel, policy makers and long-term city, energy, water and agricultural planners.

Due to a rapidly increasing scale of global climate simulations and the need for not only access but knowledge of the appropriate use of climate information (including reanalyses, observational data and climate simulations), new areas of collaboration using shared infrastructures and on-line services need to evolve within GEOSS and GCI. Initially, to advance these objectives, the primary focus of this activity would be a coherent cluster of 3 main themes: 1) data discoverability, 2) archive access, and 3) dissemination. Eventually, this Task will assist users of all levels of expertise to find and discover climate and weather information including access tools and visualization capabilities. These objectives will be advanced by leveraging and coordinating with selected national and international data, modeling and information access groups and efforts including WCRP, GCOS, WMO GFCS and others to explore new opportunities for enhanced coordination and synergy among GEO Stakeholders.

Leadership and Contributors

The task contributors will be sought from existing climate and weather modeling groups already actively engaged in distributed and federated climate and weather data centers and producers.

- CA-03 will work to leverage the IPCC WCRP CMIP infrastructure for access to

climate model outputs under the ESGF international collaboration;

- CA-03 will leverage GEO's advocacy for these efforts which require some ground work and resources to publish data sets on ESGF;
- New partnerships and thrust areas surrounding access to associated observational data sets under the ESGF/obs4MIPs/ana4MIPs activities will be championed within a wider (beyond climate research) community;
- WCRP would further collaborate in the GEO arena to promote additional (e.g. modeling activities) high priority activities in the new Task plan;
- The U.S. NOMADS model data access system, already a GEO contributor will advance CA-3 goal and objectives;
- Promote the wider development and use of ESGF for climate simulations at all spatial and temporal scales and Earth System domains, including regional downscaling (CORDEX), seasonal and decadal predictions and WCRP core projects model development and intercomparison initiatives;
- Collaboration with the Decadal Forecast Exchange data in that context. Links with contributions from the Copernicus C3S;
- Promote product development and collaborations within the geo-science communities (ocean, weather, and climate) to foster inter-disciplinary research to study multiple earth systems using collections of distributed data under a sustainable GCI system architecture;
- Advance GEO collaborations and linkages to NASA's CREATE (reanalysis clearinghouse); and Reanalysis.org;
- Promote and advance middleware capabilities for access tools such as THREDDS Data Server from Unidata in the U.S. under the ESGF framework;
- Implement multi-model and ensemble based access tools to provide a new level of access to probabilistic information rather than deterministic.

Activities and outputs planned for 2016

- Identify outreach opportunities to enhance the understanding and usability of climate and weather model output;
- Develop a new CA-03 Task Plan and identify and coordinate this plan with select contributors;
- Establish interfaces between CA-03 and GFCS;
- Develop an implementation strategy and a work plan for a GEO interface to the Earth System Grid Federation (ESGF) within or servicing for GEOSS users;

Funding sources and indicative amounts (2016)

- In kind ESGF program through NOMADS ESGF node implementation (.15FTE) and WCRP leadership/activities;
- In kind NOMADS federation and access services support (0.10FTE);
- In kind NASA CREATE reanalysis access capability (0.10FTE).

Future plans (activities and resources)

An effective international federated and distributed data service requires coordination of data infrastructure and data management principles extending beyond organizational boundaries of any individual center. The fundamental data management issue that CA-03 will address is how GEO institutions can organize their distributed data resources into a cohesive presence, then interface this with GCI to allow the users to make better, informed decisions about how nature will impact their future, either in their life or in their business decisions. Activities listed in "Leadership and Contributor's" will be advanced by engaging stakeholders and creating new and more formal agreements with related activities such as GFCS.

CA-04 Strengthen collaboration between GEO and GFCS

General description

Foster the use of climate data in decision making (GFCS and adaptation)

CA-05 TIGGE (Thorpex Interactive Grand global Ensemble) evolution into a Global Interactive Forecast System (GIFS)

The objective will be to continue to develop a one stop shop for accessing a multi-model forecasting system.

The TIGGE (THORPEX Interactive Grand Global Ensemble) archive continues to be an invaluable resource for research in ensemble forecasting.

Although the THORPEX programme concluded at the end of 2014, data providers agreed to continue to contribute to TIGGE and ECMWF agreed to continue as Data Provider and Archive Centre (the National Center for Atmospheric Research (NCAR) ceased its role as a TIGGE Archive Centre at the end of THORPEX).

TIGGE data is expected to make a major contribution to the WMO THORPEX legacy projects on Polar Prediction (PPP) and High Impact Weather Project (HIWeather).

The TIGGE archive now contains nine years of multi-model ensemble data comprising 1.25 petabytes, both from ten global models, totalling more than 4.6 billion fields at the disposal of the community.

ECMWF also continues to maintain the TIGGE-LAM archive of limited-area model ensemble forecasts for Europe. Output from eight systems is being ingested in the TIGGE-LAM archive daily, namely COSMO-LEPS, ALADIN-LAEF, COSMO-DE-EPS, DMIHRLAM, GLAMEPS, HUNEPS, MOGREPS, PEARP.

The new WWRP (World Weather Research Programme) working group on Predictability, Dynamics and Ensemble Forecasting (PDEF) will support the THORPEX legacy projects, including S2S (Subseasonal to Seasonal project) and PPP (Polar Prediction Project).

The Terms of Reference of the PDEF include:

1. To advance the science of dynamical meteorology and predictability research
2. To improve ensemble predictions
3. To support WWRP projects
4. To promote the use of TIGGE and TIGGE-LAM and other ensemble data-sets

TIGGE would naturally feed into the development of a Global Interactive Forecast System (GIFS) to coordinate advance warnings and forecasts of high impact weather events to mitigate loss of life and property, to be developed through voluntary contributions of national, regional, and international organizations.

CA-06 EO data in mineral and non-renewable energy resources

Description:

The exploitation of mineral resources, including non-renewable energy resources, has played a significant role in the development of many countries all over the world. The industry has been, and continues to be an important contributor to both national and regional economies and is critical to national defense. Mining, and the industries it supports, is among the basin building blocks of a modern society.

The benefit of exploitation to those countries has been many, but has come at a cost to the environment. Early mining operations have left a historical legacy of negative environmental impacts that affect our perception of mining. As countries have matured, there has been increasing recognition that environmental protection is as fundamental to a healthy economy and society as is development. The challenge is to simultaneously

promote both economic growth and environmental protection.

Social impacts of mineral resource exploitation are complex and controversial. It can generate wealth, while triggering significant disruptions. A project can generate employment, transport infrastructure, education facilities and increase goods and services availability in remote poor areas; however these benefits might be unequally shared. Social tensions and conflict, sometimes riots, can rise from affected communities.

Recent initiatives for more responsible and sustainable practices in mineral resources exploitation reflect a trend in better addressing the societal acceptability issues of mining. This include international (e.g. European Industrial Partnership on Raw Materials EIP-RM) and national mineral policy strategies, responsible mining initiatives by exploiting companies, green mining initiatives, etc.

Earth Observation (EO), possibly including dedicated citizen observatories, offers a unique opportunity and varieties of methods and tools to collect and process spatial information to monitor and assess each phase of the mining cycle, from exploration to exploitation and closure. It can contribute to help improving raw material policy and better exploiting mineral resources from the territory of mineral supplying countries, as well as to demonstrate how to improve their capacity in implementing new exploitation sites for the benefit of the society.

EO has proven valuable contribution in delivering objective, reliable, affordable, undisputable information and documentation at site level, hence fostering a better dialogue between the relevant stakeholders, from national to local levels (SB-05-C2, EU FP7 projects EO-MINERS and ImpactMin).

Non-renewable energy resources (fossil fuels) and critical metals for e.g. solar panels and windmills typically fall into the energy value chain and are hence relevant to the Energy CoP.

Mineral resources however lack dedicated EO system or program and currently use EO systems and programs from other SBAs. Global coverage by high-spectral resolution sensors in particular is currently not available.

Leads and Contributors

Role	Member or PO	Implementing Entity	Contact Name	Email Address
Lead (PoC)	France	BRGM	Stéphane Chevrel	s.chevrel@brgm.fr
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Activities and outputs planned for 2016:

Overarching activities of the EO data and mineral resources will include:

1. Develop tools and Information for the Resource Assessment, Monitoring and Forecasting of Geological Resources (including mineral and fossil resources, raw material and groundwater)
2. Develop tools for impact monitoring of mining operations
3. Identify and foster implementation of strategic measures for the competitive, reliable and sustainable management of geo-resources exploitation and treatment of re-usable materials

These activities could consist in:

- 1.a.: The definition, or refinement, of a set of area-specific essential variables to be validated by the CoP and GEO in view of measuring and monitoring the status of mineral resources assessment and exploitation
- 1.b.: The definition of methodologies and tools to map these essential variable from existing and future sensors, including citizen observatories
- 1.c.: A global mineral mapping program using existing (ASTER) or future (EnMap) missions, on the model of the Australian Mineral Map performed by CSIRO using ASTER imagery
- 1.d.: A global mining waste inventory program by adapting e.g. the PECOMINES project methodology to currently available sensors (Landsat TM, Sentinel -2) and/or future missions (EnMap); also connected with point 3.
- 1.e.: Contacts with CEOS for the design of future high spectral resolution missions in support of the above objectives
- 2.a.: Further development of integrated EO-based products to meet stakeholder requirements and engagement at regional (mining basin) to site levels
- 2.b.: Foster their use in responsible mining initiatives, both at governments and company levels
- 2.c.: Develop methodologies and tools for illegal mining activities monitoring
- 3.a.: Develop methodologies for mapping secondary resources from identified mining wastes

Development of close interactions with other GEO societal issues will be part of the community activities e.g. cold regions (increasing activity in mineral resources

exploration and exploitation in these regions), global observing system for mercury (in connection with illegal mining), water (impact of mineral resource exploitation on water quality and resource),...

CA-07 Integrated Water-cycle Products and Services

1. Overview

This activity is dedicated to improving the ability of Earth Observations to serve the management of water at the policy and tactical levels. To do this, this task seeks to ensure that all the relevant data of the entire water cycle, which were treated as separate entities are being collected, that they are integrated, analyzed and disseminated to all who need them and that the capabilities and training for people in all countries and organizations to utilize this information for the benefit of society are being developed.

This activity provides a coordination function and a framework within which divergent elements can work together. Beyond this internal coordination the water task provides coordination for the interactions between water and other SBA. The activity brings together in-situ data with satellite data in areas where they were not previously combined in producing products (soil moisture, groundwater, snow). It also looks for integration between variables and looks at how information services can be developed across national borders and globally.

This activity develops integrated and sustained information systems and services needed for water, disaster, agriculture, and energy and health management. This activity also coordinates other water-related community activities or initiatives, such as Water quality, clouds and water vapor, great lakes, cold regions. This in order to develop a comprehensive water-cycle decision making system.

The GEO Water Cycle Integrator (WCI) will consider integration across functions (data collection, assimilation, modeling, visualization, decision support), across SBAs and across scales from continents to basins and from supercomputers to laptops.

2. Leads and contributors

Lead : Rick Lawford, Morgan University.

Principal contributors are coming from the IGWCO. Some are listed here:

US (NASA, NOAA, and to a lesser extent USGS, EPA, USAID), Japan (JAXA, University of Tokyo), China, European Commission, France (CNES), - Germany (DLR, GTN-H), WMO, WCRP (GEWEX, CliC), CEOS, Australia, Austria, Belgium, Canada, Columbia, Chile, Estonia, European Space Agency, Indonesia, India, Kenya, Korea, Mexico, Nepal, Nigeria Norway, Pakistan, Panama, Philippines, Russia, South Africa, Sweden, Switzerland, Tunisia, United Kingdom, Viet Nam, FAO, UNESCO, UNEP, IEEE, IISD.

3. 2016 Activities

This CA is a continuation of the former GEO Water task, following activities are planned, but not limited to 2016:

- Promotion of the integration of different types of observations to produce products that will be more reliable because they build on the strengths of different observational systems.
- Promotion of integration across functions (data collection, assimilation, modeling, visualization, decision support), across SBAs and across scales from continents to

basins and from supercomputers to laptops, by using the GEO Water Cycle Integrator (WCI).

- Integrated precipitation data sets and products are being used to develop warnings of extreme precipitation events, for validating models and for assessing water availability.
- Evapotranspiration products for agricultural areas are being used to monitor the use of irrigation water during the growing season on a farm by farm basis over the western USA.
- New soil moisture products are being used to monitor water use for irrigation. In some countries, governments have replaced expensive in-situ monitoring with satellite data.
- Guidance to NHMS managers on the international priorities for network expansion for hydrometric networks.
- Data inputs and estimates for groundwater resource assessments
- Consistent International data sets are facilitating research and assessments in the Great Lakes Basin (see separate activity).
- The GEOSS Water Cycle Integrator (WCI) that provides a framework for the assessment and analysis of water resources. It has been used to study flood protection, plan reservoir and dam operations and has analyzed the health effects of heavy precipitation on poor societies with limited drainage systems.
- The end-to-end approach has been used to document biodiversity water security index and the human water security index and provide insights on how investments in water infrastructure is changing the balance between these two objectives.
- Unique data sets are available for the study of Asia.
- The mechanics for directly transferring streamflow data to the GRDC have been developed and tested. A special aspect of the studies providing input to this analysis is the Water Services project which is providing standard formats for the transfer of hydrometric data.

4. 2016 Resources

The funding sources for this activity include:

- Research funding agencies which fund projects of finite duration
- Operational agencies which provide in-kind support (such as short periods of time) for projects that are on-going.
- Activities that are carried out by volunteers who work in agencies but are not provided with time to work on their activities so they do the work on their own time.

It should be noted that Japan through JAXA and the University of Tokyo and NASA provide support for the coordination of the Water activity.

5. Additional activities for 2016.

Recommended if additional resources made available: no one identified yet.

6. Future Plans

Future plans will be defined according to the GEOSS Water Strategy report 2014.

CA-08 Water Vapor and Clouds (and Aerosol and Precipitation)

1. Overview

The primary objective of this activity is to develop an observation strategy to improve the synergistic understanding between water vapor and clouds, and if feasible, aerosols

and precipitation. Traditionally, observing strategies (both from the ground and from space) focus on primarily a single parameter or exploit sensors that fulfill operational requirements or test out new technologies to enhance the understanding of a particular phenomenon. Some specific programs (e.g., WCRP/GEWEX, NASA EOS program, etc.) have attempted to tie together several parameters, but generally from an independent stand point in terms of organizational structure and on climate time scales (where the linkages between the physical processes are not the priority but developing climate forcings and water cycle balances are).

In order to gain an understanding of the physical processes that are related to water vapor, clouds, aerosols and precipitation, a new observation paradigm needs to be established that focuses on the physical processes rather just on the final quantity (i.e., cloud particle size distributions and not just cloud amount, etc.).

4Outputs (Deliverables): To convene a workshop and/or town hall type discussion (at a scientific meeting venue) to develop concrete plans for an improved observation strategy. This could be held before the end of 2016. It's possible that the town hall discussion (if this is the proper mechanism to initiate this) could be held e.g., at the 2016 AGU meeting to flesh out the initiative concept that would then lead to a more focused workshop in 2017.

2. Leads and contributors

Lead: Ralph Ferraro, NOAA/NESDIS, College Park, MD USA.

Contributors: Rick Lawford, Dominique Berod, Bob Kuligowski

3. 2016 Activities

Regardless of if we hold a town hall meeting first, then a workshop, a meeting that brings together the right mix of scientists, decision makers, satellite operators, international program officers, etc. needs to be properly considered. This meeting would not just be another science meeting but would look specifically at required measurements needed to advance the current state of understanding between the atmospheric water cycle variables. We would have to first look closely on activities already in motion within GEO, CEOS and CGMS since all of these groups are producing recommendations very similar on the observing system and may have actions already in motion – we want to leverage what is in the works and not reinvent anything. But we would also have to be realistic and examine planned operational ground and satellite missions for the next decade or two, and then perhaps fill in observational voids through research programs. A key would be then to coordinate the observation strategy to gain the synergistic information needed.

4. 2016 Resources

No direct funding, all contributors will provide in-kind support from their host organization. NOAA and/or CICS-MD will provide institutional resources to host (potential) workshop on topic and to send R. Ferraro to relevant meetings.

5. Additional activities for 2016.

no one identified yet.

6. Future Plans

Depend on the workshop to be held in 2016.

1. Overview

Objectives for the Activity: In the 2016 Transitional GEO Work Plan the primary focus for precipitation is on providing data sets and associated information for use in other areas of the Work Plan.

Ensure users have access to stable, state-of-the-art, characterized, global precipitation datasets.

Outputs (Deliverables) Expected and Anticipated Date of Completion: In the 2012-2015 GEO Work Plan the primary focus for precipitation is on providing data sets and associated information for use in other areas of the Work Plan.

2. Leads and contributors

Lead : George Huffman: george.j.huffman@nasa.gov, GFSC, NASA, Greenbelt, MD

Contributors : JAXA, NASA

3. 2016 Activities

1. The CGMS/International Precipitation Working Group (CGMS/IPWG) will continue to update tables of publicly available, routinely produced, (quasi-)global, and long-term precipitation data sets. See <http://www.isac.cnr.it/~ipwg/data/datasets.html>. The present algorithm description pages and an “Introduction to Global Precipitation Algorithms and Data Sets” will also be updated.

2. U.S. and Japanese teams for the joint U.S./Japanese satellite mission Global Precipitation Measurement will release improved algorithms for combined-sensor products (Integrated Multi-satellite Retrievals for GPM [IMERG] and Global Satellite Map of Precipitation [GSMaP], respectively) that take advantage of GPM and CEOS-PC data.

3. The U.S. GPM User Workshop, several JAXA workshops, and the CGMS/IPWG biennial meeting will include training sessions for data users drawn from the U.S., East Asia, and Europe/Africa, respectively. The first will include on-line sessions in English and Spanish that are intended for a wide international audience.

4. The new Goddard Earth Sciences Data and Information Services Center (GES DISC) service providing averaged precipitation over areas described by a generic Graphical Information System (GIS)-standard shape file will be evaluated for more-general use.

5. The IPWG is working to create a central repository for, and routinely update graphics from, the validation statistics computed for its validation sites in Australia, Japan, the continental U.S., South America, Western Europe, and South Africa.

6. IGWCO will work with the appropriate GEO foundational task to increase precipitation dataset availability.

7. One or more white papers on the future of the microwave constellation will be written with cooperative efforts from CGMS/IPWG, IGWCO, and CEOS-PVC

4. 2016 Resources

NASA and JAXA are the primary supporters of this work through in-kind contributions.

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

The CGMS/IPWG is investigating leading a summer school on precipitation in 2017. Resources are not yet identified, and would include funding for the venue, computer resources, honoraria for the speakers, and travel/per diem for eligible students.

CA-10 Evapotranspiration (and Evaporation)

1. **Overview**

Objectives for the Activity: Improve global evapotranspiration products for vegetated land surfaces, and also for lakes and rivers, deserts, urban areas and snow-covered land-areas.

Outputs (Deliverables) Expected and Anticipated Date of Completion:

Measurements of evapotranspiration (ET) are important for understanding the influence of the plant canopy on the water vapour content of the atmosphere and for estimating the rate of plant growth. FLUXNET provides in-situ eddy correlation estimates from flux towers, which tend to be concentrated in developed countries, while satellites and Land Data Assimilation Systems (LDAS) provides model estimates of evapotranspiration without strong validation in more remote areas. In terms of global products the Global Energy and Water Cycle Exchanges (GEWEX) project has launched LANDFLUX to estimate evapotranspiration from models and satellite data for a grid covering the land areas of the world. Added to these efforts are regional and national methods for producing evapotranspiration estimates for use in irrigation planning and water use monitoring.

2. **Leads and contributors**

Lead: NASA Forrest Melton: forrest.s.melton@nasa.gov

3. **2016 Activities**

An ET workshop will be held at the World Bank sponsored by the National Aeronautic and Space Agency (NASA). Other activities in 2016 that will continue are:

1. The need for an archive of flux measurements of ET for satellite validation purposes will be reviewed.
2. GEWEX LandFlux will provide a terrestrial ET data product covering the period of SRB v3 (Surface Radiation Budget, version 3) of 1984 – 2006 at 3-hourly and 1-degree spatially, or over the period and resolution of SRB v4 if available.
3. The expansion and continuation of NASA sponsored workshops to transfer remote sensing based ET approaches to state and regional water resources and geospatial groups.
4. Development of an ET training course using satellite data

4. **2016 Resources**

5. **Additional activities for 2016.**

No one identified yet.

6. **Future Plans**

CA-11 Soil Moisture

1. **Overview**

Objectives for the Activity: Develop a global soil-moisture product and services for climate, water management applications and agricultural advisory services.

Soil moisture is a critical variable because it affects the partitioning of rainfall into infiltration and runoff as well as the partitioning of energy between sensible and latent heat that is transported into the atmosphere. When water is retained in some soils, it creates a reserve of water for plant growth thereby promoting plant productivity during the growing season.

The ESA SMOS (Soil Moisture and Ocean Salinity) mission has measured soil moisture over the Earth's land masses and salinity over the oceans since 2010 and its data continue to contribute to furthering our knowledge of the role of soil moisture in the Earth's water cycle. This global coverage has been supplemented by the launch of NASA's SMAP (Soil Moisture Active Passive) in early 2015. Similarly, a number of active sensors provide high-resolution observations that can either be used for the downscaling of the SMOS/SMAP/AMSR2 observations, and eventually provide direct estimates of soil moisture at a very high resolution. The development and services of a global in-situ data archive are made available for validation of satellite products and for other applications. The harmonization of the different spatio-temporal scales of the various products are a challenge and needs to be addressed.

Outputs (Deliverables) Expected and Anticipated Date of Completion:

Within GEO, the soil moisture focus has been on the development of a global soil moisture network and a data archive. This effort has been advanced by hosting workshops to promote the development of a global in-situ soil moisture monitoring network that could provide validation data for the ESA SMOS mission and the NASA Soil Moisture Active and Passive for Weather and Water Cycle Processes (SMAP) mission. Since soil moisture data must be archived to be of use, a global archive has been organized at the University of Vienna.

In terms of developing validation data sets for the understanding of climate change and the impacts on frozen soils JAMSTEC in collaboration with Russian institutes continues to monitor land surface processes in Siberia/Mongolia Region (Tiksi, Yakutsk, Ulaanbaatar). Observations of radiation, temperature, humidity, soil moisture and temperature, snow cover, thaw depth data, vegetation physiology facilitate our Understanding of the enhanced wetting and resultant effect to frozen ground and vegetation.

2. Leads and contributors

Lead: Forrest Melton: forrest.s.melton@nasa.gov

Contributor: Chris Rüdiger, Monash University, chris.rudiger@monash.edu

3. 2016 Activities

During the period of the 2016 work plan this activity will:

1. Continue to build the global soil moisture network and a data archive at Vienna University of Technology as well as establish other nodes of the network (currently one node in the USA under consideration)
2. Promote the development and adoption of standard data measurement, collection and archiving protocols for soil moisture data.
3. Develop projects that will test and show the benefits of satellite soil moisture data products at different spatial and temporal scales.

4. Develop projects that will test procedures and data interpretation steps for the use of SMAP products when they become available.

4. 2016 Resources

The activities are primarily carried out on a volunteer basis by colleagues employed at universities. The data center at the Technical University in Vienna has been receiving funding from ESA for some of its operations.

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

CA-12 River Discharge

1. Overview

Objectives for the Activity: Integrate, in a phased approach, dedicated river gauging networks of existing hydrological stations into a global runoff observation network. Make the data available through the GEOSS Common Infrastructure using standardized formats.

Outputs (Deliverables) Expected and Anticipated Date of Completion:

Information on surface water is crucial for the management of water resources in basically all socio-economic and environmental domains. River gauge levels and discharge/runoff are critical observations for flow forecasting including floods and evaluating the hydrologic impacts of drought. They are highly relevant for the detection of climate variability and change. Through its links with the Global Terrestrial Network - Hydrology (GTN-H), the World Meteorological Organization (WMO), and Global Climate Observing System (GCOS), GEO strives to improve the network of hydrologic measurements and encourage more extensive use of these data. Efforts in this domain have focused on obtaining data from a core network of 380 major global runoff stations which monitor continental freshwater fluxes into the world's oceans. In addition, satellite data are being used to produce experimental lake level data sets. The continued establishment of Hydrological Information Systems in regions and large transboundary river basins through WMO's flagship programme "World Hydrological Cycle Observing System" (WHYCOS) contributes to improved forecasting and water management capabilities of participating countries. Complementary to river flow forecasting, the establishment of regional Flash Flood Guidance Systems will be further expanded.

2. Leads and contributors

Lead: Julius Whellens-Mensah: jwellens-mensah@wmo.int

Contributor: Wolfgang Grabs, Grabs@bafg.de

3. 2016 Activities

In the 2016 time frame GEO will focus on:

1. developing a proposal to seek upgrades to the hydrometric network and to promote the development of integrated data products.
2. undertaking technical activities related to the calibration and rating curves for select rivers and storage volume changes for large lakes and reservoirs

- primarily through WMO's Global Runoff Data Centre (GRDC).
- 3. further promoting the sharing of hydrological data and information.
- 4. developing a proto-type data base of surface water storage that will simulate the data that could be provided by a satellite measuring water levels.
- 5. continuing the planning and implementation of regional and basin-wide projects under WHYCOS.
- 6. continuing to provide guidance, technical services and capacity building through the WMO-GWP Associated Programme on Flood Management (APFM) developing a data base of surface water storage that will simulate the data that could be provided by a satellite measuring water levels

4. 2016 Resources

Staff support for this effort comes from the WMO office budget.

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

CA-13 Groundwater

1. Overview

Objectives for the Activity: Coordinate Global Groundwater Monitoring Network (GGMN) for a periodic assessment of global groundwater resources:

Obtain in-situ groundwater data and incorporate it into the IGRAC data base to support the calibration and validation of satellite groundwater products.

Outputs (Deliverables) Expected and Anticipated Date of Completion:

Groundwater resources are vital for drinking water supply, irrigation, the sustainability of wetlands and rivers as well as many other important issues, including climate change adaptation. The state of groundwater resources needs to be monitored regularly to provide the basis for the assessment and prediction of their quantity and quality. Hence, water management decisions rely strongly on availability and quality of monitoring data.

There is however, a lack of information on groundwater monitoring at regional and global scale, hampering assessment and informed water management internationally. Therefore IGRAC decided to establish the Global Groundwater Monitoring Network (GGMN). The GGMN consists of two components: the GGMN People Network and the GGMN Portal (a web-based software application).

Groundwater specialists, who are members of the GGMN People Network, can access the country-dedicated workspace of the portal. This 'maintenance mode' allows users to upload, interpolate, aggregate and analyze the groundwater data from their country and to optimize the inputs from the network for assessments.

2. Leads and contributors

Lead: Neno Kukuric: Neno.Kukuric@un-igrac.org ;

Laura del Val Alonso: laura.delvalalonso@un-igrac.org

3. 2016 Activities

Activities over the 2016 time frame:

- Entering agreements with national focal points, ensuring continuous efforts and contributions;
- Continuous acquisition and uploading of new country data which is made freely available online;
- Participation in development of international groundwater specific protocol for automatic data sharing among online systems.

4. 2016 Resources

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

CA-14 GEO Water Quality

1. Overview

The objectives for the activity aim to develop international operational water quality information systems based on Earth observation with a focus on the developing world.

2. Leads and contributors

The lead is by Steven Greb, Wisconsin DNR. Contributors are coming from the newly built water quality community of practice, including NOAA, CSIRO, ICES, NERC, BfG, UNEP, EC, eawag, RAMSAR, Odermatt & Brockmann, several universities etc.

3. 2016 Activities

Main actions will be:

- a. Continue to develop the organizational structure of the Community of Practice
- b. Review of current and future project contributions to GEO WQ goals
- c. Update of Web page and hosting Webinar series
- d. Proposal for an Inland Water Quality Essential Climate Variable to GCOS
- e. Draft and maintain a biannual Water Quality research agenda to national and international agencies
- f. Formation of working group on definition of global products: publication draft ready for submission
- g. Demonstration project of one global-scale WQ product
- h. User Work Plan agreed and published

Outputs are timely, consistent, accurate and fit-for -purpose water quality data products and information to support water resource management and decision making in coastal and inland waters.

4. 2016 Resources

There is currently no general direct funding for support of the CA. Two exceptions are the Swiss Federal Institute of Aquatic Science and Technology support of the web page and GEO Secretariat support of telecons, meeting facilities. All other support (time, travel) is supported by in-kind contributions.

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

Currently, the WQ CoP is reviewing the outcomes of the GEO Water Quality Summit. With the long-term goal (10 year) to develop an international operational water quality

information system based on Earth observation, the CoP is developing a strategic and action plan to obtain this goal. This will be detailed in 2016.

CA-15 Water Cycle Capacity Building

1. Overview

The needs being addressed in this activity are primarily training needs with training events being held regularly especially in Asia but also in Latin America. In Asia and Africa the efforts also include the development and implementation of tools through the AWCI, AfWCCI, TIGER and SERVIR systems. This activity provides information on new technologies, low cost systems, personal and institutional capacity building, development of collaborations and projects in the use of new technologies.

2. Leads and contributors

The Lead is by Angelica Gutierrez-Magness (NOAA).

Partners include USA (NOAA, NASA, USAID), Japan (JICA, University of Tokyo), Chile (Universidad de la Serena), Colombia (Escuela Naval Almirante Padilla, IDEAM, National University), Mexico (University of Baja California - UBC), Argentina (Universidad Nacional del Sur-Bahia Blanca), APN, European Space Agency, European Commission, Canada (IISD), ESA, IEEE, UNESCO, the Netherlands (ITC), Kenya, Mexico, Nepal, Pakistan, Panama, Peru, Viet Nam.

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3. 2016 Activities

1. Water Cycle Integrator (WCI)

- Continue development of WCI workbenches under the leadership of the University of Tokyo (DIAS) and JAXA in further AWCI countries and seeking ODA support for such activities.
- Continue capacity building activities for maximizing utilization of DIAS data and tools (training workshops and courses).
- Pursuing ODA proposals for system developments in AfWCCI countries/basins and expanding DIAS datasets and functions to cover African region.
- Improving and expanding DIAS tools for Water-Climate workbenches (CMIP5 GCM output data analysis tool).

2. GEO for the Millennial Generation. This is a pilot project sponsored by the University of La Serena (Chile) and seeks the incorporation of remote sensing activities into High School education. Ricardo Cabezas-Cartes, CIEHLYC's co-

chair is the leader of this activity.

3. GEO-CIEHLYC coordinates some of the training activities for GEONETCast. Countries acquiring the system provide funding and in-kind contributions.

4. 2016 Resources

There is no separate funding for these activities although JICA and APN have supported some of the training activities in Asia, USAID and NASA have supported the implementation of SERVIR systems, and Colombia has supported the implementation and training of GEONETCast in the country. The GEO Secretariat has provided the necessary support for the Webinars. NASA, NOAA, the GEOSec, and government organizations of the Americas Caucus have provided funding and in-kind contributions for CIEHLYC's activities.

The University of La Serena-Chile sponsors the Millennia's generation project, which includes travel expenses for 5 international trainers.

For the Water Cycle Integrator (WCI) there is in-kind contribution from the following organizations: (1) MEXT, Japan (support to DIAS); (2) JICA SATREPS program (Myanmar); (3) JAXA – in kind – satellite data and associated services; and (4) UTokyo – in kind – expertise, tool development, training courses.

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

In 2017, CIEHLYC plans to have the third Water-Cycle Capacity Building week again in Latin America; location to be determined. Activities to obtain the necessary funding will start on mid 2016.

The future plans for (WCI) are mainly to continue in development of WCI workbenches and flood early warning systems based on WCI principles in AWCI countries and AfWCCI basins. The intention is to seek ODA support for such implementation and provide continued education services on the DIAS capabilities and promoting its exploitation.

CA-16 Global Drought Information System (GDIS)

1. Overview

Drought is a ubiquitous feature of the global water cycle that has tremendous societal and economic impacts throughout the world. It involves a broad array of physical processes and time scales encompassing the atmosphere, hydrosphere, land surface, cryosphere, and biosphere. As such, advancing our ability to predict drought requires improvements in modeling and observations encompassing all components of the physical climate system as well as improved knowledge of its impacts and interactions with human activities. Global climate change may affect drought frequency, spatial extent, and duration, and the Global Drought Information System provides the means to monitor these changes over time of drought at the global level. Since drought is affected by climate change at the global level, GDIS assists in international coordination to help accelerate progress. Major advances in the drought prediction problem will require a interdisciplinary program that cuts across each continent, the atmosphere, and connecting oceanic basins.

2. Leads and contributors

Lead: Will Pozzi, USA

Contributors: WMO, WCRP, ECMWF, NASA among others.

3. 2016 Activities

Global Drought Information System Components

1. Global Drought Monitoring
 - a. The main focus will be completion of drought coverage over each continent within the Global Drought Monitor (GDM), utilizing a bottom-up approach where each region contributes to GDM, combined with a moderate number of overarching global monitoring products and brief Global Drought Monitor bulletin.
 - b. GDM will display Current Conditions and Interactive Map section on a global scale
2. GDIS Pilot Development

The main goal of developing GDIS pilot areas is the fill-in areas of the Global Drought Monitor that are not yet covered by a regional analysis. There are already regional products such as the North American Drought Monitor, the European Drought Observatory, the African Flood and Drought Monitor, and the Monitor from Australia. Within each of the pilot areas will be assembled near Real time Information including in-situ data, satellite data, Land Data Assimilation systems (global and regional) and drought Information, including multi model ensemble (MME) forecasts of precipitation and drought indices, as well as Hydroclimate prediction by driving land surface models to obtain soil moisture and runoff (streamflow).
3. Drought Forecasting
 - a. Contribution of GDIS partners (WCRP, ECMWF, etc) with a top-down approach where global forecast is made of drought-related variables, and local/regional authorities translate that into a local/regional drought forecast
 - b. How to interpret output for user groups within each region (or pilot area) (possibly need national interpreters)
 - c. Refine and improve drought-specific natural hazard forecasts and outlooks being prepared through the regional climate centres, as part of the roll-out of the Global Framework on Climate Services (GFCS)
 - d. Improve drought-related forecasts for drought as contributing factor to World Food Program, FEWS-Net, and other food security organizations.
4. Drought Research
 - a. Develop case studies and other drought research products to develop national and international collaborations to study the mechanisms and predictability of high profile drought and heat wave events
 - b. Develop a Drought Catalogue
5. Information system development (through the drought portal) to connect pilot information, to exchange data, drought information and feedbacks ;
 - a. Develop one-stop shop for drought information.
 - b. Use the current GDIS website to display data, drought forecasts, satellite, links to other information such as drought management (GDIS Component 5) and post information from pilot areas
 - c. Develop capacity building events with GDIS partners
 - d. Ensure pilot users understand data outputs and how to use them for drought forecasts and monitoring
6. Develop partnerships among institutions in the regional to form a working group for data provider, drought portal representatives, and local pilot region representatives to actively participate in the pilots;
 - a. Ensure that pilots and the GDIS share common understanding and trust
 - b. Understand what the pilot needs and develop products with the pilot region

- and with assistance of the GDIS community region.
- c. Develop evaluation products for verification and user approval

4. 2016 Resources

In kind contributions

5. Additional activities for 2016.

No one identified.

6. Future Plans

Continue existing activities.

CA-17 GEO Great Lakes Activity

1. Overview

Objectives for the Activity: facilitate data management in the Great Lakes basin: discoverable, transparent and interoperable data across the border.

Outputs (Deliverables)

Increased awareness of GEOSS Metadata registry by 31 March 2017.

Development of a Great Lakes-wide Data Management Plan for the sharing of and access to binational Great Lakes data and information by 31 March 2017

2. Leads and contributors

Lead : Norm Granneman (USA) and Gail Faveri (Canada)

(Gail.Faveri@ec.gc.ca)

Some contributors :

Jessica Lucido, US Geological Survey,
Wendy Leger, Environment Canada,
Kelli Page, Great Lakes Observing System,
Nancy Stadler-Salt, Environment Canada,
Tad Slawecki, LimnoTech,
John Allis, US Army Corps of Engineers,
Mark Burrows, International Joint Commission,

3. 2016 Activities

USGS and Environment Canada both believe that the GEO GL can form the nucleus for the proposed data management network. A first step is the development of a Great Lakes-wide data management plan. The data management plan would include guidance on:

4. information architecture requirements for ensuring critical technology standards across the Great Lakes region
5. information management protocols for allowing data search, retrieval, distribution and use
6. information management governance for ensuring on-going storage, maintenance and updating of data and information over the long-term

The data management plan cannot be developed in isolation, but rather requires the input and contributions of agencies and organizations across the Great Lakes-St. Lawrence River system, covering the southern portion of the provinces of Quebec and Ontario of Canada and the near lake portions of Wisconsin, Illinois, Ohio, Pennsylvania, New York,

Minnesota and most of Michigan of the United States of America. Coordination with the International Joint Commission and agencies implementing the binational Great Lakes Water Quality Agreement is planned. The purpose is to have individuals identified to help facilitate and coordinate the collaborative development of a Great Lakes-wide binational data management plan. The resulting collaborative Data Management Plan is an essential component of a comprehensive data management network which will be used by management agencies that oversee the Great Lakes.

The development of a collaborative data management plan would comprise the following five tasks:

7. Facilitation and coordination support to work with partners in determining the needs and priorities and to coordinate between the science community and the Information Management technical community
8. An analysis of the current state of Great Lakes data and information and data management protocols (what's available, what's not, what's coordinated binationally, what's not, what data is maintained, what's not etc.)
9. a virtual on-line workshop to discuss user needs and a vision for data management in the Great Lakes system
10. A second face to face workshop to bring together data management specialists to discuss architecture and protocols, what's possible and what's not.
11. An initial data management plan that provides guidance to partner agencies on directions and actions they can take to help support a binational data management plan.

4. 2016 Resources

Seeking \$80k US to hire a facilitator (hopefully from Great Lakes Restoration Initiative funds)

Seeking \$20k CDN to pay for face to face workshop (hopefully from International Joint Commission funds)

In-kind contributions of 0.1 PY from each member agency

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

- Continuing staffed position (\$80k) providing ongoing support for the following:
- information architecture requirements for ensuring critical technology standards across the Great Lakes region
- information management protocols for allowing data search, retrieval, distribution and use
- information management governance for ensuring on-going storage, maintenance and updating of data and information over the long-term

CA-18 Water Cycle Integrator (WCI)

1. Overview

Objectives for the Activity: Develop a GEOSS Water Cycle Integrator (WCI) to provide holistic coordination of water cycle information, including integration of observations, research, modeling, and analysis; cross-SBA applications;

management systems; and a sustained educational framework.

A GEOSS Water Cycle Integrator (WCI), is being developed by building on the experiences of the Coordinated Enhanced Observing Period (CEOP) of WCRP/GEWEX and GEOSS Asian Water Cycle Initiative (AWCI) data integration activities. Climate change impacts, as reported by IPCC AR4, showed the need for such a system that can bring together data and model outputs to assess the causes of these impacts in all parts of the world. The application of a comprehensive integrated and coordinated data analysis system of the WCI to current and future issues would ensure benefits are created for society.

Development of the WCI would rely on CEOS leadership in developing integrated satellite observation of water cycle products and in coordinating linkages with the following areas: atmosphere, ocean, cryosphere, ecosystem, carbon, agriculture, and forestry. A water cycle science integrator would draw on collaboration between WCRP, CEOS, and the national and regional numerical weather prediction centers.

GEOSS relies on integrated systems to meet all of the expectations for delivering data from many different sources for use in its nine Societal Benefit Areas. The requirements include systems for integrating observation, modeling, and data management systems, a system for converging observation systems worldwide, and a system for coordinating the nine Societal Benefit Areas. WCI will be an important step in the process.

Outputs (Deliverables) Expected and Anticipated Date of Completion:

The WCI will be an extension of DIAS, which is a complement of Japan's Earth Observation and Ocean Exploration system that contributes to national security by addressing global environmental and energy security issues. This system addresses the challenges of a large increase in the volume of Earth Observation data by developing a core system for data integration and analysis that includes the supporting functions of life-cycle data management, data search, information exploration, scientific analysis, and partial data downloading. The WCI will build on this system by improving data interoperability, developing a system for identifying the relationship between data across SBAs by using ontology on technical terms and ideas and geography, and acquiring database information from various sources by developing a cross-sectoral search engine for various databases.

At present, the Asian countries cooperatively integrate data from Earth Observation satellites and in-situ networks with other types of data, including numerical weather prediction model outputs, geographical information, and socio-economic data, to generate information for making sound water resources management decisions. A similar system is being planned for Africa. The Water Cycle Integrator will support these developments and meet the information needs for agricultural production, ecosystem conservation, ocean circulation, and fishery resources management. Furthermore it will provide users in different countries with the tools they need to access, analyze and integrate many different types of data.

2. Leads and contributors

Lead: Toshio Koike; tkoike@hydra.t.u-tokyo.ac.jp

3. 2016 Activities

The development of a prototype system under the leadership of the University of Tokyo and JAXA

The implementation of the system for a number of basins in Africa in conjunction with IWRM principles.

4. 2016 Resources

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

CA-19 E2E Water Indicators

1. Overview

Objectives for the Activity: Develop end-to-end state of the water-cycle indicators. Provide an operational global data compendium organized as a set of electronic maps, and representing a definitive, comprehensive, and up-to-date picture of the state of hydrological systems and affiliated water resources, their accessibility and use by society.

Goal: The overall goal of the Global Water-E2E project is to provide an operational global data compendia based on assimilated water cycle variables and toolsets organized as a set of electronic maps and representing to the highest degree possible a definitive, comprehensive, and up-to-date picture of the state of the hydrologic systems and affiliated world water resources, their accessibility and use by society.

The growing pressure on the problem of maintaining an adequate assessment capability for the state of this important strategic resource especially in light of widespread closure of ground-based hydrographic monitoring networks and archives, outdated and incomplete water use statistics, and lack of global and regional syntheses. This lack of information bears important implications for identifying regions of the globe where water-related stress is highly variable and/or growing, where sector-specific inefficiencies can be readily identified, and where suitable interventions (and investments in) integrated water management could be used to prevent or ease these crises.

Satellite and other Earth system data streams have the potential to fill some of these gaps; indeed, in many parts of the world these data and information sets represent the only practical means to assess water system state. Yet the continuity of in-situ and satellite-based systems remains a problem, partly due to the evolution over time of sensor specifications, but especially due to anticipated gaps in the records resulting from delays and cancellations of planned space-based missions and the continued operation or even expansion of conventional terrestrial observing systems. The development of a global water resources assessment component of Global Earth Observation System of Systems (GEOSS) is seen as an essential step to ensure consistent planning and implementation of integrated observational systems with high societal relevancy.

The GlobalWater-E2E(GW-E2E) project capitalizes on the early success of a three-year Pilot Study on Indicators (PSI), executed on behalf of the World Water Assessment Programme (WWAP), and representing an early testbed for

operational global water resource assessment. The WWAP-PSI, designed jointly by the CUNY Environmental Crossroads Initiative, the US Army Corps of Engineers Institute for Water Resources, WWAP staff and consultants, and the WWAP Expert Group on Indicators, is now functional. It capitalizes on new environmental surveillance capabilities from the Earth system sciences, and represents a unique conjunction of (i) state-of-the-global-water-system indicator efforts organized under the auspices of the Global Water System Project (GWSP) plus (ii) data collection and provision efforts coordinated under the Global Terrestrial Network for Hydrology (GTN-H), involving several U.N. agencies and affiliates.

Outputs (Deliverables) Expected and Anticipated Date of Completion:

Deliverables: The primary deliverables of the GW-E2E project are:

1. Integrated water cycle data sets, data assimilation schemes, geospatial models, and other tools to serve needs of theme-based user communities. Extended operational components of the WWAP-PSI up until 2015 (mean states, trends in water availability (total annual renewable water resource; seasonal cross-border and internal TARWR), use, sectoral efficiencies), geospatial with country-level summaries.
2. An ongoing consultative process under the umbrella of GEOSS and involving the GW-E2E developers and contributing constituencies (WWAP, GTN-H, FAO, GWSP, GEWEX, WMO-GRDC) to further expand the content and analysis functionality of the original PSI system.
3. Posting of timely assessments on the state of global water resources.

2. Leads and contributors

Lead: Charles J. Vörösmarty, CUNY Environmental CrossRoads Initiative, City University of New York (United States); cvorosmarty@ccny.cuny.edu .

3. 2016 Activities

A review of the Global Water E2E plans will be undertaken to review priorities in the light of new global priorities such as Future Earth, Sustainable Development Goals and the Water-Energy-Food Nexus.

4. 2016 Resources

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

CA-20 EarthH2Observe

1. Overview

EarthH2Observe will integrate available earth observations from different missions, in-situ datasets from various sources, and state-of-art models to construct a consistent **Global Water Resources Reanalysis (WRR) dataset** of sufficient length (at least 30 years). The resulting reanalysis will boost the availability of information on freshwater resources worldwide, and will allow for improved insight on the status and existing pressures on global water availability in all

components of the water cycle, subsequently supporting efficient water management and decision-making. The WRR will support a range of applications, at various scales and settings (i.e. from local and regional to the pan-European and global levels, from data-rich to data-poor areas), significantly enhancing the capabilities of the research, policy and business communities to evaluate water resources across catchments all over the globe, identify water stress, detect hotspots, deepen the knowledge in trans-boundary catchments, determine water related risks, and plan targeted actions. The usability and operational value of the developed outputs will be verified and demonstrated in a number of case-studies across the world, covering multiple continents, with a variety of hydrological, climatological and governance conditions: Spain, Morocco, Estonia, Ethiopia, Colombia, Australia, New Zealand and Bangladesh.

Information about the E2O project can be found at: <http://www.earth2observe.eu/>

Outputs (Deliverables) Expected and Anticipated Date of Completion:

It is the objective to validate the EO-products based on end-user needs and metrics ensuring the value of the project's final datasets for local and regional decision-making. We also want to demonstrate the usefulness of the integrated water resources time series at the operational level in regional and local case studies. In order to achieve this, stakeholder workshops and end user need workshops will be organized.

Before Dec. 2015, an initial earthH2Observe data portal will be running, towards the end of the project the final version of the portal will be available (connected to / via GEOSS). In 2016 efforts will be made in getting user feedback on the system, making people aware of how to use the system, linking the system to GEOSS functions and developing links with the GEO Data-core library.

The following table provides an overview of the water related datasets that will be developed within the earthH2Observe project, together with the base-line datasets where they originate from. Not all these products will be available by December 2015.

Table 1: Water related datasets in earth2observe

Hydrological component	Description	Time-Coverage	Resolution	Base-line / source
Precipitation	Algorithm for low intensity rainfall and snowfall at mid-high latitudes	1999-current (since ATOVS availability)	16 km on a satellite overpass basis	AMSU-B MHS ATMS GPM
Precipitation	Various PMW-based rainfall datasets (merging, morphing, rapid update) at high resolution for input into estimation error analyses	10+ years of available PMW data	0.25 arc deg Regional application (Europe, Continental US, East Africa)	TRMM, SSM/I, AMSU,A
Precipitation	High spatial resolution precipitation dataset	2008-current (since X-SAR data availability)	1x1 km ² (on a satellite overpass basis)	COSMO SkyMed TerraSAR-X plus SEVIRI / LandsatTM / MODIS

Precipitation	Retrieval of bias and resolution effect correction of satellite rainfall for heavy rainfall over complex terrain	2002-current	10 km & hourly resolutions HyMeX and Blue Nile study areas	Multi-satellite merged satellite products (TRMM 3B42-RT, NOAA CMORPH, Meteosat SEVIRI)
Precipitation	Modeling passive microwave rainfall estimation error accounting for surface wetness	10+ years of available PM data	0.25 arcdeg Regional application (Europe, US, East Africa)	Available PM (TRMM, SSM/I) rainfall products
Soil moisture	Extended ESA's CCI soil moisture dataset including uncertainty and quality information	30+ years (1979 to 2010)	0.25 arc deg	GCOM AMSR-2 MetOp-B CCI Soil Moisture data
Evaporation	Extended evaporation dataset GLEAM	25+years	0.25 arc deg	
Surface water	Long-term water level fluctuations in natural (unregulated) lakes/reservoirs	25+years	n/a	ENVISAT ERS GEOSAT Topex Poseidon
Surface water	Retrieval of global scale wetland dynamics			GIEMS
Surface water	Climatology of surface water extent (floods)	10 years	1km	Envisat ASAR DFO flood maps MODIS Sentinel-1
River Discharge	River discharge archive for a selection of large river basins			GRDC AMSR TRMM
Groundwater	Improved Equilibrium Water Table	static(global)	1km (global)	GLDAS UN-FAO soil map
Groundwater	Improved HR Regional Equilibrium Water Table (New Zealand)	regional	50m	national DTM Regional Recharge data In-situ GW level Regional Soil Maps
Groundwater	Satellite derived groundwater recharge	regional		CCI ?? GLEAM P, Sentinel-1 MOD16 ET ET
Groundwater	Processed GRACE data to be used for model validation			GRACE/CSR UT Austin
Snow	Improved satellite snowfall retrieval			AMSU-B CloudSat GPM
Snow	Snow extent (SE) and Snow Water Equivalent (SWE)	2000-2012	SE: 1 km SWE: 25 km	Globsnow IMS CryoLand MSG METOP MODIS SEVIRI
Water Quality	Improvement of lake water quality retrieval of high coloured dissolved organic matter using the "Boreal Lakes" and cyanobacteria using the "Eutrophic lakes" processors as baselines	MERIS 2002-2012 OLCI 2015? - MSI 2015? -	MERIS/OLCI 300m MSI 10-60m	Envisat Sentinel 2 Sentinel 3 In-situ data MERIS MSI OLCI
All	Water resources re-analysis	+3 decades	0.5 degrees or higher	CryoLand, GLOBSNOW, IMS, ESA-CCI soil moisture, ESA River and

				Lake systems
Snow, runoff, rainfall, potential / actual evapotranspiration, fog, melt water, water stress, mean terrain-corrected wind speed and direction, water storage, river flow, soil erosion, water use, human footprint, per capita water availability		1950-2000+ climate change scenarios(2050s,2080s)	1 ha or 1km, global	www.policysupport.org and geodata.policysupport.org

2. Leads and contributors

Lead: J. Schellekens (jaap.schellekens@deltares.nl)

3. 2016 Activities

4. 2016 Resources

This project has received funding from the European Union's Seventh Programme for research, technological development and demonstration under grant agreement No 603608

Total Cost: 11,327,917 €

EC Contribution: 8,869,787 €

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

The project will ensure the results will become part of the GEOSS Data-CORE encyclopedia, connecting to the GEOSS Water Cycle Integrator (WCI) initiatives and openly providing and sharing the datasets developed in the project. Before Dec. 2015, an initial earth2Observe data portal will be running, towards the end of the project the final version of the portal will be available (connected to / via GEOSS).

The data in the table above (Table 2) will be available on opendap in NetCDF and shared by the GEOSS Data-Core. The products will be available in a tier 1 product (meaning it is not the final version) in 2015. We strongly advise on good communication between GEO and earth2Observe regarding what should and should not be shared to the Data-CORE at that stage.

CA-21 Total Water Prediction: Observations Infrastructure

1. Overview

Total Water Prediction (TWP) establishes a framework to deliver the NOAA's next generation water prediction and service delivery capability. This framework leverages significant advances in science and technology to address water challenges that heretofore have been too big or too complex. For the first time, TWP is integrating big data, data and system interoperability, Earth System modeling and high performance computing to provide "street-level" water predictions to the Nation – delivering water forecasts to millions who have not received them before, at high-resolution scales that are relevant to day-to-day decisions of virtually every citizen. Through TWP, every stream reach in the United States will be forecasted, revolutionizing the world of water prediction. However, to be fully successful this "high performance hydrology" will need to evolve into a massive consumer of Earth observations, both to constrain the intensive modeling through data assimilation and to validate the model to understand uncertainties and build confidence in prediction skill at very high resolutions. Existing observation frameworks need to be shored up and in some cases rescued, and innovative new observation frameworks are needed to fill critical gaps. TWP is built on the National Hydrologic Dataset Plus, a vector network of 2.7 million stream reaches across the country. On average, a stream reach is about 1 km in length and has a catchment area of 2-3 km². This is the fundamental national hydro "fabric" for TWP, and to resolve this network TWP is currently modeling the continental United States at two resolutions (1 km and 250 m). Nested hyper-resolution capabilities are planned for TWP, which will be based on a much finer fabric derived from LIDAR terrain data, which will allow much higher resolution modeling of flash floods, urban hydrology and flood inundation. Over the next few years, this fabric will grow to extend nationwide through the USGS 3D Elevation Program, which is aimed at providing national 2-m resolution terrain data with the associated hydrologic network derived from that terrain resolution. Thus, TWP modeling is now resolving individual stream reaches and catchments, and is moving towards resolving small hillslopes, urban hydrologic features, and true "street-level" prediction. Water modeling at these resolutions is computationally intensive and demands supercomputing; NOAA's High Performance Computing assets are major enablers of TWP. In this environment, interoperability becomes a critical issue, so TWP has adopted an Earth System Modeling Framework compliant architecture to develop and operate TWP. Adhering to such standards increases the efficiency and flexibility of transitioning science and technology advancements into the TWP framework. It also facilitates the use of NOAA's broad array of meteorological data for driving TWP models. The convergence of the Internet, microchip technology, and big databases have led to the vision of a tightly integrated, planet-wide grid of computing, information, networking, sensor and digital resources commonly known as "cyberinfrastructure". Many Federal agencies are moving in this direction, and TWP is a good example of NOAA's use of Cyberinfrastructure to deliver high impact environmental intelligence. While it is clear that supercomputing, interoperability and other factors associated with the cyberinfrastructure vision are enabling the next generation of water prediction through TWP, it is unclear how (or if) the observations universe that is relevant to TWP is keeping pace. Relevant water observing systems are disaggregated and fall under the purview of several different Federal agencies. Many major and critical water observing systems have been declining in recent years. Currently, TWP must access most observations in very much the same ways that were in use a decade or two ago, and access to many observation datasets is obtuse. Water-related observations (i.e. not just observations of water specifically, but of myriad Earth parameters that are relevant to hydrologic processes) are equally important and have similar issues. In many cases, observation data important to TWP are declining, difficult to discover and access, use legacy formats, and in general have not improved significantly in many years. Moreover,

there are very significant data gaps where innovation would be welcome. Technologies such as sensor webs and others could be part of the next generation of water monitoring to form massive observation networks that could be readily consumed by TWP.

2. Leads and contributors

Lead: NOAA. Potential partners include USGS, USACE, FEMA, the International Boundary Waters Commission, Environment Canada, Brazil, and others.

3. 2016 Activities

4. 2016 Resources

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

CA-22 Linking water tasks with wider societal benefit areas and the post-2015 global development framework.

1. Overview

Objectives for the Activity: This is to support the GEO transitional work plan and aims to provide links across societal benefit areas. It does this by using the framework of Sustainable Development Goals (SDGs) and other frameworks such as Future Earth and the Ramsar convention. The framework for SDGs with its associated targets provides an unprecedented political framework which for the first time, has led to the recognition of the importance of earth observations the global development community as an essential element for implementing the SDGs. These opportunities will be elaborated in the development of indicators, where linkages between societal benefits is high on the agenda. This community activity will contribute to this within the GEO context by combining water observations and data with other data sources to produce integrated products, including co-designed products, for use by targeted audiences in other sectors. It will also contribute to the data and information needs of the Future Earth W-E-F activity, the Sustainable Water Futures Programme and the Ramsar convention.

Outputs:

Water and the Water-Energy-Food (W-E-F) Nexus:

It is expected that the effort will contribute to the development of a knowledge platform, a W-E-F Community of Practice and the incorporation of Earth Observations in a Future Earth research plan on W-E-F issues.

Water and Biodiversity/Ecosystems: SWOS will develop an operational wetland monitoring service and service portal targeted at key policy frameworks and users at different levels. This activity is a major contribution to the development of the Global Wetland Observation System and therefore builds an important link between the GEO Biodiversity, Ecosystems and Water SBAs.

Water and the Sustainable Development Goals (SDGs): This effort will develop a plan for using Earth Observations in support of monitoring of the water targets found in the SDGs.

2. Leads and contributors

Lead : Richard Lawford, Morgan State University, USA and Adrian Strauch, University of Bonn, Germany.

Some contributors :

Integrated Information and the Water-Energy-Food (W-E-F) Nexus:

Contact: Richard Lawford, Morgan State University, richard.lawford@morgan.edu

Contributors:

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Contributors:

Richard Lawford, Morgan State University, richard.lawford@morgan.edu

3. 2016 Activities

Water and the Water-Energy-Food (W-E-F) Nexus: Integrated Information and the Water-Energy-Food (W-E-F) Nexus (Contact: richard.lawford@morgan.edu)

During 2016, two workshops will be held as part of the Future Earth initiative named “Integrated information and improved governance for sustainability in the WEF Nexus.” This GEO activity will identify the research and data needs arising for these workshops and develop plans to provide the data sets and tools needed to analyze the issues that face these the W-E-F Nexus in different parts of the world. It will also explore the role of Earth observations in establishing the connections between the W-E-F Nexus with land and environmental issues. Information gaps will be identified for the national and transboundary basin scales. Discussion will be held on the co-design of solutions and products that will be needed to fill these gaps. The development of products and knowledge of the use of these products in managing the W-E-F Nexus will contribute to our knowledge of the GEO services and expand GEO’s role in showing the value of Earth Observations in managing integrated resource programs. These efforts will also contribute to a data management system for Future Earth’s Sustainable Water Futures Programme.

Water and Biodiversity/Ecosystems: Satellite-based Wetland Observation Service (SWOS) (Contact: Adrian Strauch, adrian.strauch@uni-bonn.de) SWOS is a Horizon 2020 Project and a consortium of 13 partners comprised of academia, private companies, national environmental agencies and international NGOs. Funding for the project started in June 2015 and will last until May 2018. The objectives of SWOS are to develop an operational wetland monitoring service targeted at key policy frameworks and users at different levels (from local to global). Further, it will provide a SWOS Service Portal that will offer a unique entry point to easily locate, access, and connect wetland information and that includes visualization and analysis tools. The project focuses on using new possibilities that are offered by the Sentinel satellites and will build on existing approaches and methods to link new data sources with already existing wetland related data and information. The diverse consortium and tight links to the stakeholder and user communities will ensure that

developed products and services are directly tailored to user-needs.

SWOS activities are tightly linked to GEO and aim to contribute to the further development of the GEOSS. For example, SWOS will be a major contribution to the Global Wetland Observation System that is being planned and coordinated by GEO BON together with other partners. As it entails data and information from different domains (e.g. ecology, biodiversity, hydrology) SWOS crosses borders between disciplines and is a GEO cross-SBA activity linking GEO water, ecosystems and biodiversity.

In January 2016 a user requirements workshop will be held by SWOS and a first prototype of the SWOS service and portal is expected to be finished at the end of 2016.

Sustainable Development Goals: (Contact: hossainr@who.int and sushel.uninnayar@nasa.gov): A global monitoring framework is being set up by UN and other agencies to support the water SDGs, which has three main components: drinking water, sanitation and hygiene (WASH), wastewater and water quality and water resources management. The latter aims to protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes. The global monitoring community is building an integrated water monitoring framework with data sources from earth observations, completing those from surveys, regulatory frameworks and other administrative sources, as well as new and novel sources including big data. Earth Observations have been demonstrated to fill gaps for indicators to monitoring sustainability of developments in the sector. In addition, EO can be used to estimate in a cost effective manner aspects of water availability and water quality. Finally derived properties such as population density can be a cross-cutting tool to see how population dynamics interplay with developments.

4. 2016 Resources

Integrated information and W-E-F Nexus Security: The workshops are funded by Future Earth/ Belmont Forum through the Sustainable Water Futures program. The workshops will be supported for \$60,000 with logistical support coming from the hosts of the upcoming workshops including RHM in Japan and a yet to be determined host for the final workshop.

Water and Ecosystems/Biodiversity: The SWOS project has a total budget through Horizon 2020 of approximately 5 Million Euro for its runtime from 2015 to 2018.

Water information and the Sustainable Development Goals: This water SDG activity within GEO currently has no funding and is carried out by people who have funding in kind or do not have specific funding targeted for this activity. Through WHO this project has links with GEMI which will serve as one of its stakeholders.

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

In addition to the process of individual scientists seeking funding for individual initiatives, it is anticipated that the GEO Members will be committed to make resources available for the above activities. The details of the Water and Ecosystems/Biodiversity activity (SWOS) will continue until at least May 2018 and are expected to funnel into the establishment of a long term wetland monitoring service. The activity related to integrated information and W-E-F Nexus Security will last until the end of 2016 and may

be renewed at that time. Activities related to SDGs are being considered as a GEO foundational task and are expected to play a pivotal role as the next GEO implementation plan. As water provides an excellent example of the development of linkages with other societal benefit areas and the global development community, including the SDG framework, it is envisioned that in addition to specific funding provided for individual projects by research and space agencies some dedicated funding would also be made available.

CA-23 Space and Security

The main ambition in the Space and Security domain is the protection of freedom and security of citizens. Fully in line with well-known societal challenges such as the Horizon 2020 “Secure Societies”, the Space and Security domain can include themes such as:

- to enhance the resilience of our society against natural and man-made disasters;
- to develop novel solutions for the protection of critical infrastructures;
- to improve border security;
- to support security policies in civilian tasks ranging from civil protection to humanitarian relief.

A major activity in supporting the primary aims of the Space and Security domain is the provision of geospatial products and services, mainly resulting from satellite data. In fact Earth Observation data are currently showing an unprecedented scenario in terms of variety (different sensors are in orbit on several governmental and commercial satellites), volume (data received each day from satellites are on the order of terabytes), velocity (24/7 information can be made available to users requiring fast responses), veracity (decision making and operations require reliable sources) and value (information to be provided have to be clear and useful).

CA-24 Earth Observation in Cultural Heritage documentation

Overview

Cultural heritage is a testimony of past human activity, and, as such, cultural heritage objects exhibit great variety in their nature, size and complexity; from small artefacts and museum items to cultural landscapes, from historic buildings and ancient monuments to city centres and archaeological sites (Patias, 2007).

Cultural heritage around the globe suffers from wars, natural disasters and human negligence. The importance of cultural heritage documentation is well recognized and there is an increasing pressure to document our heritage both nationally and internationally. This has alerted international organizations to the need for issuing guidelines describing the standards for documentation.

Charters, resolutions and declarations by international organisations underline the importance of documentation of cultural heritage for the purposes of conservation works, management, appraisal, assessment of the structural condition, archiving, publication and research. Important ones include the International Council on Monuments and Sites, ICOMOS and UNESCO, including the famous Venice Charter, The International Charter for the Conservation and Restoration of Monuments and Sites, 1964, (UNESCO, 2005).

Only recently new nominated WH sites are proposed with some cartographic information included in the nomination file request. Terrestrial, aerial or satellite imagery are rarely included. The problem is even worst when we consider World Heritage sites nominated some years ago. Most of them they do not have proper cartography with detailed buffer zones indicated, etc.

Recent high resolutions satellite imagery provides the means to easily map areas in large scales. Archive map and photographs are lacked. Although UNESCO provides now some minor specifications these specifications are not at all considered for old inscribed sites. Only if these detailed specifications are provided as well as about how remotely sensed data can be used to derive such cartography can the UNESCO request to the countries to provide improved cartography for the UNESCO World Heritage database.

Especially in times of either natural disasters or conflicts, the safeguarding of CH diversity almost mandates the use of EO images. Recent prominent examples are the Unesco's Observatory for the Safeguarding of Syria's Cultural Heritage [URL1], or UNESCO/UNITAR-UNOSAT teaming to Protect Cultural Heritage with the Latest Geo-Spatial Technologies [URL2].

Earth Observation can highly accelerate the documentation of CH, while engaging multi-disciplinary societies (eg. archaeologists, architects, historians, librarians, etc) in GEO activities, not previously interested. A quick search at the Google Trends reveal the simple fact that the terms "cultural heritage" and "cartography" are much more frequently used by the public than the more technical and less popular term "earth observation".

The importance and global coverage of CH sites does not need much argumentation. We will only note the international institutional interest like the specific interest of UNESCO [URL3], the existence and activities of the CIPA [URL4] (a joint venture of ISPRS and ICOMOS), the extended activities in CH and EO of ISPRS [URL5], the cartographic activities of ICA [URL6] or the extended list of trans-domain projects supported by COST [URL7].

Moreover, the proposal is well in line with the GEO Objectives and the related challenged SBAs, such as: Air pollution, Man-caused hazards, Natural disasters, Climate change, etc.

Leads and Contributors

Lead: Prof. Petros Patias, GR, <http://perslab.topo.auth.gr/about-el/>

Contributors: Chen Jun, Orhan Altan, Lena Halounová, Andreas Georgopoulos, Fulvio Rinaudo, Mario Santana, Ana Almagro Vidal, Michael Doneus, Evangelos Livieratos, João Martins, Heinz Saler, José Luís Lerma, Wang Xinyuan

Key partner organizations: The International Society for Photogrammetry & Remote Sensing (ISPRS), The International Committee for Documentation of Cultural Heritage (CIPA), International Council on Monuments and Sites (ICOMOS), The International Cartographic Association (ICA), COST Trans-Domain Actions, University of Karlsruhe, University of Valencia, Chinese Academy of Sciences

2016 ACTIVITIES AND OUTPUTS

Planned Activity	Output	Place / Date	User involvement Funding source	Geogr. coverage
Dedicated website for the activity	Dissemination	To be announced in the CIPA Symposium in Tapei, Taiwan	AUTH, CIPA, ISPRS	Global

		31/8 – 5/9 2015 http://www.cipa2015.org/	Funded by AUTH	
Exchange of know-how, experiences and ideas, invitation to get involved	Dissemination	To be announced in COST-i2MHB meeting in Spain 27-28 January 2016 http://www.cost.eu/COST_Actions/TDP/Actions/TD1406	AUTH, COST Funded by COST	European
<u>Special Session</u> SpS7 - GEO: Earth Observation and Societal Benefits: Global issues and best practices	Capacity building	Prague, CZ 12-19 July, 2016 http://www.isprs2016-prague.com/program/scientific-program-sessions/special-sessions	ISPRS, GEO Funded by ISPRS	Global
Summer school	Training Capacity building	Valencia, Spain Summer, 2016	3 EU universities, Funded by Baden-Württemberg Stipendium BWS	Germany, Spain, Greece

Future plans

In general the envisaged Activities include:

- Mobilize multi-disciplinary communities in EO
- Provide a forum to international organizations, scientists, stakeholders and wide public
- Exchange of know-how, experiences and ideas
- Showcase best practices
- Promote innovation in use of EO/GEOSS to CH activities
- Connect CH to other SBAs
- Provide expertise in extreme/rapid calamities to international organizations
- Capitalize on previously financed activities/projects
- Organize expert meetings, dissemination info-days, capacity building workshops together with other organizations (eg. UNESCO, ICOMOS, ICCROM, ISPRS, CIPA etc)

References

ICOMOS, 2005. ICOMOS Charters, Resolutions and Declarations.
<http://www.international.icomos.org/charters.htm>

Patias, P. 2007, "Cultural Heritage Documentation", Chapter 9 in "Applications of 3D measurement from images", J. Fryer, H. Mitchell, J. Chandler, editors, pp. 225-250,

[Whittle Publishing Co., ISBN 10: 1-870325-69-9, ISBN 13: 978-1-870325-69-1.](#)

[URL1]: UNESCO Observatory for the Safeguarding of Syria's Cultural Heritage
<http://whc.unesco.org/en/news/1135/>

[URL2]: UNESCO and UNITAR-UNOSAT Team Up to Protect Cultural Heritage with the Latest Geo-Spatial Technologies <http://www.unitar.org/unesco-and-unitar-unosat-team-protect-cultural-heritage-latest-geo-spatial-technologies>

[URL3]: UNESCO Space for Heritage
<http://www.unesco.org/science/remotesensing/?lang=en>

[URL4]: CIPA - The International Committee for Documentation of Cultural Heritage
<http://cipa.icomos.org/>

[URL5]: ISPRS - The International Society for Photogrammetry and Remote Sensing
<http://www.isprs.org>

[URL6]: ICA - The International Cartographic Association <http://icaci.org/>

[URL7]: COST Trans-Domain Actions
http://www.cost.eu/COST_Actions/TDP/Actions, eg.:

- [TD1406 | Innovation in Intelligent Management of Heritage Buildings \(i2MHB\) | 06 May 2015 - 05 May 2019](#)
 - [TD1403 | Big Data Era in Sky and Earth Observation \(BIG-SKY-EARTH\) | 13 January 2015 - 12 January 2019](#)
 - [TD1308 | Origins and evolution of life on Earth and in the Universe \(ORIGINS\) | 15 May 2014 - 14 May 2018](#)
 - [TD1202 | Mapping and the citizen sensor | 28 November 2012 - 27 November 2016](#)
- [TD1201 | Colour and Space in Cultural Heritage \(COSCH\) | 07 November 2012 - 06 November 2016](#)

CA-25 Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity-building phase

Overview

Understanding the abundance and spatial distribution of chemical elements in the Earth's near-surface environment is critical for many human endeavours ranging from locating our future mineral resources to monitoring changes in the chemistry of the Earth caused by natural processes or human activities. There is worldwide concern about the potentially damaging effects of chemicals in the environment on the health of humans, animals, agriculture and ecosystems. Economic and population growth are increasing rapidly, exacerbating such problems as land degradation and pollution from uncontrolled urbanisation, industrialisation, intensive agricultural practices and over-exploitation of aquifers. These and other problems are having an impact on the geochemistry of the Earth's surface and the sustainability of its life-support systems from the local to the global scale. On the other hand, there is also worldwide concern about securing mineral and energy resources to meet the demand of our growing population. Understanding the geochemistry of the Earth's surface is vital in locating these resources and in exploiting them in an environmentally responsible manner.

Systematic geochemical mapping is the best method available to assess and provide a basis for monitoring changes in the levels of chemical elements at the Earth's surface.

Geochemical maps have traditionally been valuable in addressing a whole range of environmental problems, as well as for identifying potential mineral resources at the local to national scale. The present proposal is to develop for Africa a land base multi-element geochemical baseline database for mineral resource and environmental management according to the specifications of IGCP 259 "*International Geochemical Mapping*" (Darnley et al., 1995).

This project proposal for Africa is within the vision of GEO "*To realise a future wherein decisions and actions, for the benefit of humankind, are informed by coordinated, comprehensive and sustained Earth observations and information*". It also will be an important contribution to AfriGEOSS (2014), and the IUGS initiative "*Resourcing Future Generations*" (IUGS, 2014).

Objectives and motivations

To develop a land base multi-element geochemical baseline database for mineral resource and environmental management.

Africa is the world's second-largest and second-most-populous continent. Its area, including adjacent islands, is 30,221,532 km². According to Wikipedia, Africa consists of 54 sovereign states and 10 non-sovereign territories (https://en.wikipedia.org/wiki/List_of_sovereign_states_and_dependent_territories_in_Africa#Sovereign_states). In order for Africa to develop its vast mineral resources, and also to safeguard its environment, it urgently needs a harmonised geochemical baseline database for planning and decision-making. To develop such a database it is necessary to start a capacity-building programme for training professional applied geochemists from all African countries.

Leads and Contributors

Leads: David B. Smith, Xueqiu Wang, Alecos Demetriades, Anna Ladenberger, Aberra Mogessie, Beneah Odhiambo and Gabi Schneider

Contributing partners: EuroGeoSurveys, IUGS/IAGC Task Group on Global Geochemical Baselines, UNESCO International Research Centre on Global-scale Geochemistry, Geological Society of Africa and Organisation of African Geological Surveys.

2016 Activities

- Capacity-building: Organisation of capacity-building workshops in global geochemical baseline mapping at central locations in Northern, Eastern, Southern, Western and Central Africa. The workshops will comprise indoor lectures in applied geochemistry, including data processing and map plotting, and training in the field (selection of sampling sites, and sampling).
- User involvement: Participation of applied geochemists from all African countries.
- Geographical coverage: The whole African continent.

2016 Resources: EUR300,000 (indicative amount)

Future plans

To develop a geochemical baseline database for the entire African continent through systematic sampling and chemical analysis according to the specifications of IGCP 259 "*International Geochemical Mapping*" (Darnley et al., 1995) We propose using only one

sample medium, depending on terrain type, namely overbank or floodplain or catchment basin sediment, which is generally alluvial (or agricultural soil).

The framework for the sampling is the Global Geochemical Reference Network (GRN) established by IGCP 259 (Darnley et al., 1995). The GRN consists of about 5000 grid cells, each approximately 160 x 160 km in size (area 25,600 km²). The 54 countries in Africa are covered by approximately 1500 GRN grid cells (see Figure 1). Five sites are identified within each cell for a total of 7500 sample sites for the continent (approximately 1 site per 4000 km²).

Sample media:

- Overbank sediment (alluvial soil) in mountainous and hilly terrains, and
- Floodplain or catchment basin sediment (alluvial soil) in desert, savanna and plain terrains.

At each site, two samples will be collected, a top and a bottom. The top (surface) sample will be collected from 0-25 cm, and the bottom (deeper) 25-cm thick sample below a depth of 75 cm. Thus, the total number of samples will be in the order of 15,000.

Duplicate field samples will be collected from at least 3 per cent of the sampling sites, giving a total of 225 duplicated field sites, with a total of about 450 samples.

The samples, after preparation at a central facility in Africa, will be analysed for 76 elements at the laboratories of the China Geological Survey (UNESCO International Research Centre on Global-scale Geochemistry). Splits of each sample will be archived and stored for future investigations at either a central facility within Africa or at a facility designated by each participating African country.

To monitor the quality of geochemical data, five large standard samples with different element concentrations (low to high) will be prepared.

The cost of sampling and sample preparation for the whole African continent, and preparation of the five standard samples, is approximately in the order of 5 million Euro.

The cost of laboratory chemical analysis for 76 elements is approximately 3 million Euro, which may be funded by China.

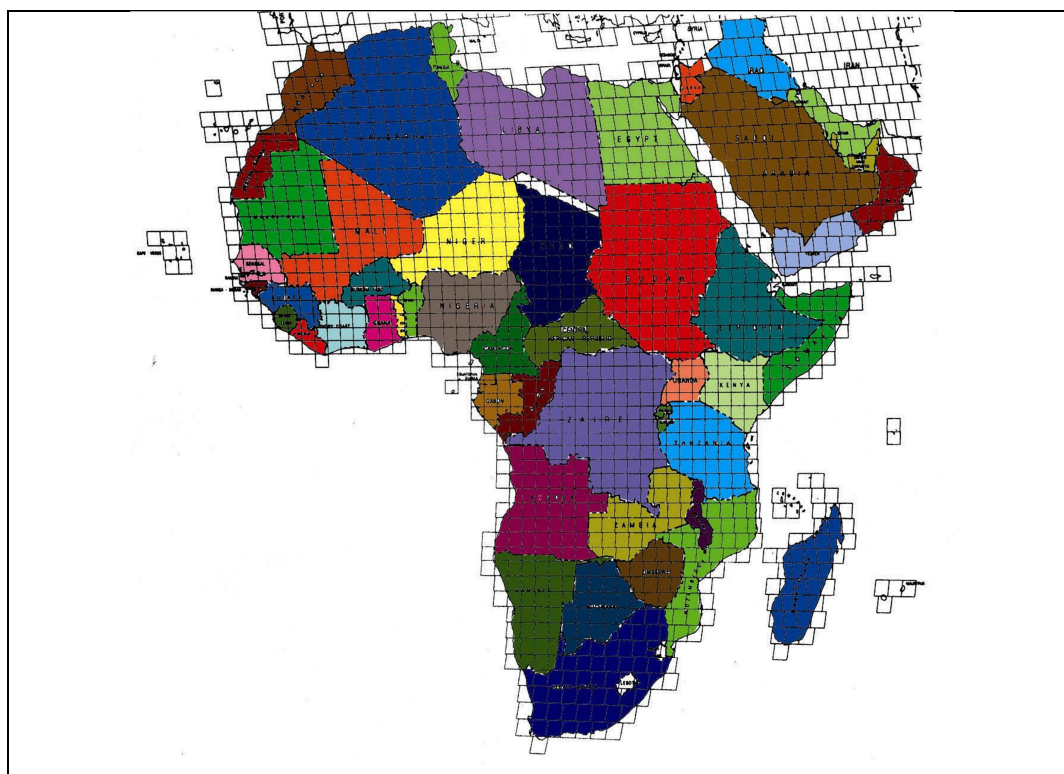


Figure 1. Map of Africa showing the GRN grid cells of 160 x 160 km.

References

- AfriGEOSS, 2014. GEO-X — 15-16 January 2014: AfriGEOSS - Approach, Progress and Way forward. Group on Earth Observations, Document 11, 5 pp., https://www.earthobservations.org/documents/afrigeo/geo_x_AfriGEOSS_Approach_Progress_Way_Forward.pdf.
- Darnley, A.G., Björklund, A., Bølviken, B., Gustavsson, N., Koval, P.V., Plant, J.A., Steinfeld, A., Tauchid, M., Xie, X., Garrett, R.G. & Hall, G.E.M., 1995. A global geochemical database for environmental and resource management. Final report of IGCP Project 259. Earth Sciences, 19, UNESCO Publishing, Paris, 122 pp., http://www.globalgeochemicalbaselines.eu/wp-content/uploads/2012/07/Blue_Book_GGD_IGCP259.pdf.
- IUGS, 2014. Resourcing Future Generations - White Paper: Mineral Resources and Future Supply. International Union of Geological Sciences, 38 pp., <https://www.geolsoc.org.uk/~media/shared/documents/RFG/White%20Paper%20pdf.pdf?la=en>

CA-26 Towards Chinese tsunami mitigation system under GEO framework

1. Overview

Deterministic Tsunami Hazard Analysis (DTHA) is a simple way to qualitatively assess the tsunami hazard for an interested site which has been widely used in China. However, the method for evaluating tsunami hazard in China now is starting to shift from DTHA to Probabilistic Tsunami Hazard Analysis (PTHA). We need a Chinese PTHA method by following the regular seismic hazard analysis methods in China and gave the detailed

description of framework. Furthermore, PTHA with the identification of all possible uncertainties in tsunami source parameters will be considered in following step. It is necessary to include the uncertainties associated with PTHA calculations in the processes of generation, propagation and runup.

China Tsunami Early Warning Center, now attached to Chinese National Marine Environmental Forecasting Center of State Oceanic Administration, is collaborating with U.S. Pacific Marine Environmental Laboratory (PMEL) on building real-time tsunami forecasting system in South China Sea. China Earthquake Networks consists of quite a number of seismic stations and SOA manages more than 100 marine gauges.

2. Leads and contributors

Lead : WEN Ruizhi, Institute of Engineering Mechanics, China Earthquake Administration, China

Contributors : State Oceanic Administration of China, Japanese Metrological Agency, U.S. Pacific Marine Environmental Laboratory (PMEL)

3. 2016 Activities

The research is endeavoring (1) Chinese historical tsunami event catalogue, (2) tsunami numerical tsunami modeling, (3) tsunami hazard analysis methodology and (4) tsunami early warning system.

2016 will be dedicated to the plan compiling Chinese historical tsunami event catalogue

4. 2016 Resources

Some of above works are supported by China National Natural Science Fund No. 51278473.

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

Second year: tsunami numerical modeling, tsunami hazard analysis methodology.

Third year: framework for tsunami early warning system.

CA-27 Foster Utilization of Earth Observation Remote Sensing and In Situ Data for All Phases of Disaster Risk Management

1. Overview

The *Sendai Framework for Disaster Risk Reduction 2015-2030* includes two articles with explicit references to satellite Earth observation and several articles that refer to topics for which satellite observations are needed (e.g., geospatial information or risk maps). This activity aims at improving disaster risk management and reduction by providing timely risk information relevant to the full cycle of disaster management (mitigation, preparedness, warning, response and recovery) and will be used directly by the end user community including the decision makers that have to take appropriate resilience and Disaster Risk Reduction (DRR) measures. Through this activity, the delivery of risk information will be improved through the consolidation of the delivery process for the data (from EO providers) and information (from practitioners), for three Pilots – Floods, Seismic Hazards, and Volcanoes. These Pilots, which were successfully started under the GEO 2012-2015 Work Plan and will continue through 2017, have

produced several risk products and been used in the scope of the Geohazards Supersites Natural Laboratories (GSNL). This activity will further implement the current strategies to better contribute to all phases of DRM in response to the needs of the user community while also exploring the possibility of partnership with other DRM stakeholders, enlarging the concept of the Pilots (single and multi-hazard, limited geographical areas, etc.) and also considering other potential Pilots.

2. Leads and contributors

Lead : space community: CEOS (JAXA, ESA, ASI, CNES, CSA, DLR, NASA, NOAA, USGS)

Ivan Petiteville (CEOS) (or Kerry Sawyer ?)

In situ community: UNOOSA, UNITAR, UNEP, EC (JRC)

Contributors : China, Germany, France, Italy, Japan, U.S., IEEE

3. 2016 Activities

Following actions are planned, but not limited to 2016:

- Improve disaster risk management and reduction by providing timely remotely sensed and *in situ* information relevant to the full cycle of disaster management (mitigation, preparedness, warning, response, and recovery).
- Work in parallel with *International Charter: Space and Major Disasters*, Sentinel Asia, Copernicus Emergency Management Services, and SERVIR.
- Implement the current strategy from the CEOS Agencies to better contribute to all phases of disaster risk management (DRM), in response to the needs of the user community.
- Promote timely and reliable access to *in situ* data required in emergency events.
- Coordinate efforts towards a more timely dissemination of information from globally coordinated systems for monitoring, predicting, risk assessment, early warning, mitigating, and responding to hazards at local, national, regional, and global levels.
- Demonstrate the validity of regional end-to-end systems through multi-actions single hazard pilot demonstrators with an initial focus on Floods, Seismic Hazards, and Volcanoes with direct involvement of the user community; explore the possibility of enlarging the concept of the Pilots (single and multi-hazard, limited geographical areas, etc.) and assess feasibility of developing other Pilots.
- Demonstrate the validity of multi-hazard Pilots such as the Recovery Observatory (multi-year activity which aims to analyze recovery of severely damaged areas after the *International Charter: Space and Major Disasters* data provision period ends.
- Improve the quality of risk information generated by the Pilots by combining space data with relevant *in situ* data.

4. 2016 Resources

In kind contributions

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

Continuation of 2016.

CA-28 Global Flood Risk Monitoring

1. Overview

Develop, test and apply methods to utilize satellite remote sensing and other Earth observations with models and maps to estimate location, intensity and duration of floods globally in real-time and a durable monitoring system of flood risk with climate change. An initial operational capability could be established with the appropriate community and global framework within a few years.

Further achievements and milestones will align with data sharing and integration of models, tools and new Earth observing networks. This would involve observation of flood inundation (e.g., via MODIS, VIIRS, and other sensors) and use of satellite precipitation information (e.g. via GPM) and hydrological models. Since the mid-1970s, U.S. satellite observation gathered an exceptionally valuable but still largely unharvested record of flood inundation world-wide. Commencing in late 1999, the two NASA MODIS sensors also obtained daily surveillance, year after year, of all of the Earth's flood waters; this archival record is now supplemented by frequent repeat, wide-swath ground-imaging sensors aboard NPO Suomi. Such combined EO data can be compared to the record of earthquake seismicity provided by seismographic stations; they provide the only objective characterization of many extreme, damaging flood events. This globally consistent information of past events should be deployed to its maximum utility in defining areas of flood risk, and be used as well during new floods to assist with their characterization. In the developing nations, the remote sensing archive provides the immediate opportunity, even without hydrological data infrastructure, to directly identify hazardous land areas. When coupled with U.S. satellite data-driven global hydrological models, there is also the opportunity for early prediction and characterization of flood inundation in near real time. As climate changes, flood statistics change and achieving results in this effort over the next several years will be critical. While hazard evaluation has for many decades proceeded using assumed stationarity of flood frequency distributions. New floods-of-record at any location thereby present a well-known dilemma to policy makers and to hydrologists: immediately include the new extreme flood in the flow series, and thus increase the size of the regulatory floodplain, or use the pre-flood flow records to label the exceptional new event as, for example, "the 1000 year flood" (e.g., Colorado Front Range, 2013). The remote sensing record also includes defended floodplains where levees have failed, sometimes even during relatively common floods. So remote sensing identifies the engineering failures, not only the natural flood event. We can use the powerful observations (of actual floods) as well as increasingly accurate satellite data-driven global hydrological models to accommodate floods in their changing climate and changing environment context, and address flood hazard and exceedance risk probabilities quite directly: by putting into routine operational use the observed record of inundation from actual floods, that have been obtained and are being obtained by orbital Earth observation systems.

2. Leads and contributors

The U.S. lead is NASA.

Potential contributors include NOAA, the U.S. Agency for International Development's (USAID) Office of U.S. Foreign Disaster Assistance (OFDA), the U.S. Geological Survey (USGS), the Federal Emergency Management Agency (FEMA), the Centers for Disease Control and Prevention (CDC), the U.S. Army Corp of Engineers (USACE), the National Center for Atmospheric Research and other academic partners, the Global

Flood Partnership, the Joint Research Center of the European Commission (through their Global Disaster Alert and Coordination System), the Committee on Earth Observation Satellites (CEOS), the World Food Programme, the International Red Cross/Red Crescent, the World Bank, the Latin American Development Bank, United Nations Development Programme, UNEP, UNESCO, national hydro-metrological organizations and the World Meteorological Organization's (WMO) state emergency management and water management agencies, as well as private sector partners (e.g. Google, Coca Cola, and the insurance sector), and various non-governmental organizations.

3. 2016 Activities

Planning and starting of actions

4. 2016 Resources

In kind contributions

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

Depend on results 2016.

CA-29 Using Geospatial Data to Identify and Monitor Ecosystem Service and Track in a Natural Capital – Ecosystems Accounts Framework

1. Overview

Identify challenges, (1 year) and develop protocols to using available geospatial data streams to identify and track ecosystem services at various spatial scales (2-3 years). Identify gaps in geospatial data and determine the feasibility of filling any gaps (1-3 years). It should help Agencies to address the soon to be released OMB directive on incorporating Ecosystem Services in decision making.

2. Leads and contributors

The U.S. lead is the State Department. Potential partners include NOAA, NASA, USGS, the World Bank, the European Commission, Columbia, Mexico, the UN Statistical Commission, the UN Initiative on Global Geospatial Information Management (GGIM), the Australian Statistical Bureau, the UK Natural Capital Committee, the European Forest Institute, Statistics Netherlands, the European Space Agency, Botswana, the Philippines, Rwanda, and academic partners.

3. 2016 Activities

Identify challenges and initial gaps in geospatial data, (1 year)

4. 2016 Resources

In kind contributions

5. Additional activities for 2016.

No one identified yet.

6. Future Plans

(2-3 years). Develop protocols to using available geospatial data streams to identify and track ecosystem services at various spatial scales and continue to identify gaps in geospatial data and determine the feasibility of filling them.

CA-30 Harmful Algal Bloom (HAB) Early Warning System

1. Overview

HABs can have considerable impacts on ecosystems, public health (by affecting water supplies and recreational bodies of water), and the economy. HABs produce a toxin that can cause illnesses in humans such as gastrointestinal illness (nausea, diarrhea, cramps), eye and skin irritation, and liver damage (with chronic exposure) and can also be a danger to pets. Furthermore, their presence can be an indication of increased pollution, such as agricultural or nutrient runoff. HABs can produce toxins that are a danger to public health through consumption of contaminated fish and shellfish, or through aerolized toxins. HABs also deter recreational and economic activities such as fishing and tourism. When HABs (and ABs) die, they trigger an increase in oxygen demand resulting in a depletion of oxygen in water and can cause fish die-off. HABs are on the rise globally and recent studies show that with climate change, the seasonal windows of onset and duration of blooms are likely to expand as ocean temperatures warm.

A USGEO effort to develop a domestic or U.S.-based HAB Early Warning System by 2020 would be very beneficial. One critical element of this system could be the provision of a warning system with a 24-hour lead-time. This warning system would be highly synergistic with studies/initiatives such as the EPA-led / NASA-funded study (Schaeffer PI) to characterize cyanobacteria blooms in U.S. aquatic systems and the Lake Erie hyperspectral airborne campaign led by NASA Glenn Research Center, and the NOAA Ecological Forecasting Roadmap HAB forecasting effort and related HABs bulletin. An extensive bloom of toxic algae along the U.S. West Coast (extending from Santa Barbara, California to Alaska) has been occurring since May, and is being tracked by NOAA-led researchers. In 2014, the city of Toledo, Ohio was without water for several days as a cautionary procedure due to concerns about contamination of the drinking water supply from a HAB.

2. Lead and contributors

The U.S. lead is NOAA.

The United States would like to partner with other countries to share best practices and methods through the GEO network.

3. Future Plans

The goal would be to establish an operational HAB early warning system by 2020.

C-31 For Global Mangrove Monitoring

Overview

The overall goal of this project is to

- (i) update the global mangrove database of 2000 to 2015,
- (ii) back-cast it to 1990 and 1980 and
- (iii) perform change analysis to identify rates, patterns, causes and consequences (e.g., carbon stock change) of mangrove forest cover change of the world.

In 2011, USGS prepared the most comprehensive, accurate, and consistent mangrove database of the world using Landsat 30 m spatial resolution satellite data for the year 2000. The data is freely available from a number of organizations including Google, the World Resource Institute's Global Forest Watch, UNEP-World Conservation Monitoring Centre, CIESIN, and USGS. The data has been cited more than 500 times since its publication in 2011. The data is being used from local scales to global scales

because the data is globally consistent and locally relevant. Although, extremely useful, the 2000 data is becoming increasingly dated. The United States proposes to update the global mangrove database for the year 2015. The next step will be back-casting for the year 1990 and 1980 and perform change analyses to identify the rates, patterns, causes and consequences of the changes. The United States will monitor both natural and anthropogenic changes. Mangrove could serve as an indicator of climate change and we will monitor both landward and seaward expansion. The mangrove and change database will be extremely useful for a number of applications including identification of priority mangrove conservation areas, identification of mangrove restoration areas, and enumeration of blue carbon sequestration potential.

Leads and contributors

The U.S. lead is USGS.

CA-32 Research Data Science Summer Schools (new-CODATA/RDA)

1. Overview

The ever-accelerating volume and variety of data being generated is having a huge impact of a wide variety of research disciplines, from the sciences to the humanities: the international, collective ability to create, share and analyse vast quantities of data is having a profound, transformative effect. What can justly be called the 'Data Revolution' offers many opportunities coupled with significant challenges. Prominent among these is the need to develop the necessary professions and skills. There is a recognised need for individuals with the combination of skills necessary to optimise use of the new data sets. Such individuals may have a variety of different titles: Data Scientist, Data Engineer, Data Analyst, Data Visualiser, Data Curator. All of them are essential in making the most of the data generated.

Contemporary research – particularly when addressing the most significant, transdisciplinary research challenges – cannot effectively be done without a range of skills relating to data. This includes the principles and practice of Open Science and research data management and curation, the use of a range of data platforms and infrastructures, large scale analysis, statistics, visualisation and modelling techniques, software development and annotation, etc, etc. The ensemble of these skills, we define as 'Research Data Science'.

Modern Research Data skills are common to all disciplines and training in 'Research Data Science' needs to take this into account. For example, all disciplines need to ensure that research is reproducible and that provenance is documented reliably and this requires a transformation in practice and the promotion of 'Research Data Science' skills.

It is strategic priority for both CODATA and the Research Data Alliance to build capacity and to develop skills, training young researchers in the principles of Research Data Science. Particular attention is paid to the needs of young researchers in low and middle income countries (LMICs). It is important that Open Data and Open Science benefit research in LMICs and the unequal ability to exploit these developments does not become another lamentable aspect of the 'digital divide'. On the contrary, it has been argued that the 'Data Revolution' provides a notable opportunity for reducing that divide in a number of respects.

This activity relates most specifically to the GEO Strategic Objective of ‘Engage’ and the ‘Capacity Building’ activity therein. The promotion and development of data science skills, as described here, is an important component of capacity building and essential to the greater use and reuse of earth observation data to meet Societal Benefit Areas.

The vision for the schools a series of data science short courses that use a quality assured set of reusable material, are supported by online delivery and are quality controlled and accredited by an appropriate body or bodies so that they can count towards students post-graduate qualifications. The CODATA-RDA Working Group is seeking to put the mechanisms for these important features in place.

The CODATA-RDA Research Data Science Summer Schools will:

- address a recognised need for Research Data Science skills across disciplines;
- follow an accredited curriculum;
- provide a pathway from a broad introductory course for all researchers (Vanilla) through more advanced and specialised courses (Flavours and Toppings);
- be reproducible: all materials will be online with Open licences;
- be scalable: emphasis will be placed on Training New Teachers (TNT) and building sustainable partnerships.

2. Leads and Contributors

CODATA and RDA

For all the schools, the CODATA-RDA Working Group is collaborating with a wide number of partners and to the greatest degree possible re-using available materials.

3. 2016 Activities

1) Vanilla School

The first school, named ‘Vanilla’ by analogy to the most basic flavour of ice cream, will provide a bedrock of introductory material, common to all research disciplines, and upon which more advanced schools can build. This school is designed to run for up to two weeks, for what the participants will gain, see the Reference Document. The programme will be run in partnership with the Software and Data Carpentry communities and the UK’s Digital Curation Centre. Other partnerships are being explored.

The first full Vanilla School will take place on 1-12 August 2016 at the International Centre for Theoretical Physics, Trieste.

2) Flavoured Schools

Schools following Vanilla will be more advanced and specialised, refined as required to the ‘Research Data Science’ needs of particular disciplines. Such ‘flavoured’ schools, which will run for 1 or 2 weeks, will allow a student to have a more specialised knowledge in Data Science, as it is applied in a more specific, disciplinary research context. A flavoured school will not necessarily run directly after a Vanilla school and may be held in a completely different location.

Discussions are ongoing on schools on:

- ‘Extreme Data’ in collaboration with [CERN](#) and the [SKA](#);
- Bioinformatics with [Elixir](#), [H3Africa](#) and [Goblet](#);
- Geospatial Data with NASA, ESA and [GEO](#);
- Library Science with the [RDA Libraries for Research Data Interest Group](#) (including representatives of [LIBER](#), [COAR](#), [Purdue University Library](#) and the [University of Goettingen Library](#)); and
- Agricultural Science with the [RDA Interest Group on Agricultural Data](#) (including representatives of the [UN Food and Agriculture Organisation \(FAO\)](#), the [Indian Statistical Institute](#) and [INRA](#), as well as [CODATA Kenya](#) and the [Jomo Kenyatta University of Agriculture and Technology \(JKUAT\)](#)).

The first more advanced Flavoured School is likely to take place over one week in the Spring of 2016 at the University of Cape Town.

4. 2016 Resources

- 1) The first full introductory or Vanilla course will take place from 1-12 August 2016 at the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy. As host, and following their general practice, the ICTP will provide accommodation and subsistence for up to 120 students. The ICTP has committed 15K euros, TWAS 10K euros and CODATA at least 5K euros to support student travel. The current funding from ICTP, TWAS and CODATA will be prioritized for participants from LMICs. The Working Group is looking for additional support from partner organizations, funders and sponsors. Thanks to the hosting support, funds will be used entirely for student and instructor travel.
- 2) Resources for Flavoured Schools will be confirmed with the confirmation of the schools.

5. Additional activities for 2016 (recommended if additional resources made available)

6. Future Plans

The Working Group is liaising with a number of partners to host schools in future years. The initiative builds on events held by CODATA in [Beijing](#), [Nairobi](#) and [Bangalore](#). As well as the various organisations mentioned, the WG is exploring whether the regional offices of the [International Council of Science](#) and [The World Academy of Science](#) can host schools from 2017.

Strong emphasis will be placed on Training New Teachers. Specific components and accreditation for participants wishing to instruct on and lead future schools will be established.

CA-33 Building capacity for Forest Biodiversity in Asia and the Pacific Region (new-Indian Institutions)

1. General Description

Based on recommendations of the 4th May Workshop, the GEO Strategic Plan

(2016 – 2025) includes country capacity building as a Core Function of GEO. Accordingly, the 2016 Work Programme has identified a Foundational Task on Capacity Building Coordination, with an aim to facilitate and coordinate capacity building activities in GEO. It is envisaged that the actual capacity building activities will be undertaken within the three proposed implementation mechanisms, i.e. GEO Community Activities, GEO Initiatives and GEO Flagships. This proposal falls under the third category (viz. GEO Flagship) with the goal of country capacity building in the Asia Pacific Region, taking the societal benefit area of “Biodiversity and Ecosystem Sustainability” as an example. The **Forest Biodiversity in Asia and the Pacific Region** is most endangered compared to other continents due to high demographic pressure. The project will develop appropriate approach to enhance Regional capacity to undertake coordinated forest assessments, contribute to GEOSS and use the information to develop policy, strategies and programmes.

2. Task Leadership and Contributors

The host country resource persons are listed in Table 1. In addition to them, experts will be nominated by GEO Secretariat, as needed.

Table 1: Resource Persons in GEO CCB Programme in the Asia Pacific Region

Resource Persons	Address of Implementing Agencies	Contact Numbers / email
Dr.S. P. S. Kushwaha	Dean, Indian Institute of Remote Sensing (IIRS), 4 Kalidas Road, Dehradun, India	+911352744583 spskushwaha@gmail.com
<i>Director CSSTEAP (Affiliated to UN)</i>	UN Centres for Space Science And Technology Education for Asia and the Pacific at IIRS, Dehradun, India	+911352740787/0737 cssteap@iirs.gov.in
Dr. Anmol Kumar	Director General, Forest Survey of India 23 Kaulagarh road, Dehradun, India	+918006423005
Dr. K. D. Singh ¹	Academy of Forest and Environmental Sciences, FRI Campus, Dehradun, India	+919810974026 karndeo_singh@hotmail.com

Note 1: The contact person for correspondence is: Dr. K. D. Singh. K-30 Hauz Khas Enclave, New Delhi 110016. Mobile number and email is same as given above.

3. Implementation arrangements: The Academy of Forest and Environmental Sciences

will make implementation arrangements in consultation with other institutions viz. IIRS, FSI and UN Centre for Space Science and Technology Education in Asia and the Pacific (CSSTEAP). Dehradun, which will host capacity building training course. The Centre was established in India in November, 1995 and is hosted by IIRS, Department of Space.

4. Contributors responsibilities/activities:

The Indian Institute of Remote Sensing (IIRS) will provide the **Secretariat** and core Faculty. IIRS is among the advanced institutions in Training, Research & Development in the field of remote sensing and GIS in the region and has done pioneering contribution by implementing Projects in all biomes of India. FSI has the national mandate for operational implementation of two-yearly country-wide forest cover monitoring, undertaking national forest inventory and assessment of trees outside forests on a sampling basis. It has close linkages with State Forest Departments, who are responsible for conservation and sustainable management of forests under state control. The Academy of Forest and Environment is an independent scientific organization dedicated to enhance all aspects of knowledge for sustainable management and conservation of forests and promotion of cross-institutional cooperation.

5. Activities and outputs for 2016

Depending on availability of training slot, one Regional Training Workshop of 3 week duration would be organized at UN Centres for Space Science and Technology Education for Asia and the Pacific in close association with the Indian Remote Sensing Institute (IIRS), Dehradun, during which a simple (but comprehensive) monitoring system based on remote sensing and limited field assessment will be elaborated for feasible application at country / Regional levels. A strategic work plan will be prepared for national / regional biodiversity monitoring in the framework of GEOSS with updated write up on methodologies. Side by side national and GEO network of experts will assist in exchange of information on capacity building in the framework of GEOSS. The knowledge gained on strategy for capacity building will be a major outcome.

6. Estimation of the associated resources (at individual activity level).

5 CANDIDATE GEO INITIATIVES

5.1 General

As identified in the Introduction, GEO Initiatives and GEO Flagships develop and implement prototype services according to GEO priorities. They allow Members and Participating Organizations to coordinate their actions and contributions towards a common objective within an agreed, yet flexible framework. They require the same type of programmatic definition and resource commitment, but the GEO Flagships, in addition to all criteria used for GEO Initiatives, must also meet the following ones:

- Policy mandate from international treaty, convention, programme, or strongly articulated policy obtained;
- Substantial activity in terms of resources and partners involved;
- Information service or product pre- or near-operationally provided;
- User needs satisfied to a significant degree;
- Specific user institutions fully engaged, including mechanisms to enable steering and feedback by these, e.g. an active role in a Steering Board;
- Implementation Plan (see 2.2), including also perspective(s) for operationalization;

The Work Programme includes a summary description of each of the agreed Initiative, as well as a summary of the committed resources, while more detailed description in terms of individual implementation plans are included the “Work Programme Reference Document”.

5.2 Process to confirm inclusion of a GEO Initiative or a GEO Flagship in the Work Programme

When providing a proposal to develop a GEO activity, the proposing teams will use the criteria defined by the GEO Strategic Plan 2016-2025 to identify what implementation mechanism (Initiative or Flagship) is applicable to their proposal.

Activities proposals are normally accepted for inclusion in the Work Programme as an Initiative or a Flagship by the GEO Programme Board based on the assessment of the documentation produced (in most cases a dedicated Implementation Plans) against the criteria mentioned above. (the complete criteria are included in the relevant Annex to the draft GEO Strategic Plan).

Considering the transitional nature of the 2016 Work Programme and the fact that the Programme Board will be established by the next Plenary, at the earliest, the Executive Committee has recommended to provisionally list all proposed Flagships and Initiatives “Candidate Initiatives”. They will be assessed by the Programme Board, once in place, and proposed for inclusion in the appropriate category. This approach is based on the timely provision in 2016 of the requested information about the plan of the activities and the associated committed resources.

It is important to note that the first five initiatives described below, namely

- GEOGLAM-Global Agricultural Monitoring and Early Warning
- GEOBON-Global Biodiversity Observation
- GFOI Global Forest Observation Initiative
- Global Observing System for Mercury and Persistent Organic Pollutants (PoPs)
- Global Carbon Observation and Analysis System,

have proposed themselves as GEO Flagship, after having read the applicable criteria, implicitly committing to provide a complete implementation Plan in the near future.

5.3 GEO Initiatives description

This preliminary list of GEO Initiatives is based on the inputs received by the Community.

GI-01 GEOGLAM-Global Agricultural Monitoring and Early Warning

1. Overview

The task comprises 7 components:

1. Monthly production of a Global Crop Monitor bulletin (for wheat, maize, rice and soya) and delivery to AMIS Secretariat (Agricultural Market Information System);
2. Development of a Global Rangelands and Grasslands Monitoring System (RAPP, Rangeland and Pasture Productivity)
3. Development of an Early Warning Crop Monitor (EWCM) in charge of monitoring crops in countries subject to periodic food security crises
4. Coordination of Capacity Building activities to enable new countries to develop EO-based crop monitoring activities
5. Coordination of the international Joint Experiment for Crop Assessment & Monitoring (JECAM), to coordinate R&D activities to improve crop monitoring methods
6. Keeping close links with Committee of Earth Observations Satellite (CEOS) to maintain an efficient access to EO imageries
7. Ensure delivery of EO-based information for agricultural monitoring in developing countries through the GeoNetCast network

2. Activities for 2016

The plans for 2016 and onwards include dedicated additional efforts addressing components 2, 3 and 4, namely:

- The RAPP (Rangeland and Pasture Productivity) Activity, through accurate forecasts of pasture and rangelands productivity and variability, aims at an improved global understanding of risk across all pastoral landscapes as impacted by climate and land use change.
- The Early Warning Crop Monitor (EWCM) intends to coordinate an open, timely and accurate monitoring of agricultural production in chronically food deficit countries to better anticipate food crises (users: FAO, WFP, UN-HLTF, aid agencies...)
- Capacity Building activities in new countries will allow these countries to benefit from EO-based information to better monitor their agricultural production, and therefore make better decisions in their agricultural planning.

GI-02 GEOBON-Global Biodiversity Observation

Overview

GEO BON's mission is to improve the acquisition, coordination and delivery of observations of biodiversity and ecosystem services to users, including monitoring of changes in marine, freshwater, and terrestrial ecosystems. GEO BON encompasses all scales of biodiversity, including genes, species, populations and ecosystems, across multiple dimensions such as composition and function. GEO BON has working groups dedicated to specific challenges and several sub-global and thematic biodiversity observation networks. GEO BON has close links with major space agencies and integrating remotely sensed and *in situ* measurements is an important function.

GEO BON's vision is by 2025, to be a robust, extensive and interoperable biodiversity

observation network covering the major biomes of the globe. The observations derived from this network should contribute to effective and timely conservation, sustainable use, mitigation and adaptation decisions regarding the world's biodiversity and the ecosystem services it provides.

GEO BON's major user communities are **national governments** that are setting up or enhancing biodiversity observation systems, the Convention on Biological Diversity (**CBD**) and other international agreements that define strategies requiring biodiversity monitoring, the **scientific community**, which needs biodiversity observations for model development, and the *Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)* which requires biodiversity data, information and knowledge for international assessments.

2016 Activities

- Development of the “Essential Biodiversity Variables (**EBVs**)”, which are a minimum set of variables that capture the major dimensions of biodiversity change. **EBVs** provide guidance to observation systems at all scales by helping to prioritize observations and identify standard methods for data collection and processing. Also, because they lie between raw observations and indicators (which are used by decision makers), they isolate the indicators from advances in observation science and technology. EBVs will thus enable a more harmonized biodiversity monitoring system that is both efficient and focussed on user needs.
- Development of “**BON in a Box**“, which is a regionally customizable online toolkit for facilitating the start-up or enhancement of biodiversity observation systems. **BON in a BOX** gives nations, regions and others a common and scientifically sound set of biodiversity variables, monitoring methods and guidelines, mapping software, and data management, analysis, discovery and reporting tools and platforms, thereby increasing capacity and the power to detect important biodiversity trends and their underlying mechanisms.
- Facilitating development of and coordinating regional and thematic Biodiversity Observation Networks (BONs) such as the following:
Operational networks:
 - o The Asia Pacific BON (**AP BON**) is an example of a regional network. It includes most of the countries in the Asia Pacific Region and, via working groups and annual meetings it coordinates many of the biodiversity activities in the region.
 - o The Circumpolar Biodiversity Monitoring Program (CBMP or **Arctic BON**) is an international network (involving eight ‘Arctic’ countries) of scientists, governments, indigenous organizations and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources. Launched in 2005, the CBMP has developed and is implementing pan-Arctic biodiversity monitoring plans for marine, coastal, terrestrial and freshwater ecosystems. The CBMP is endorsed by the Arctic Council and the CBD and is an official network of GEO BON.

Developing Networks:

- The GEO BON Marine Biodiversity Observation Network (MBON) is an example of a thematic network. The ambition is to create a series of interoperable regional marine networks and thus create a global network of marine biodiversity observation systems, with the first phase being a “Pole to Pole MBON in the Americas” and then moving gradually to a global coverage.
- The Global Wetland Observation System (**GWOS**), developing observations and data for the Ramsar convention, is another thematic BON. GWOS development is currently funded through the EU H2020 project **SWOS** (Satellite based Wetland Observation System) in collaboration with GEO BON following the concept of Essential Biodiversity Variables.
- The GEO BON Global System of Ecosystem Observatories (GSEO) is a developing network of field site networks focused on harmonization and coordination. Core networks within it include the Long-Term Ecosystem Research (*LTER*) network, and A Long-Term Biodiversity, Ecosystem and Awareness Research Network (*ALTER* Net).

It should be noted that GEO BON will prepare, in the summer of 2016, a new detailed implementation plan for the years 2017-2019. The implementation plans presented here are mostly derived from the 2014-2016 GEO BON Strategic Plan.

2016 Resources

Calculating in-kind contribution as well as projects dedicated to GEO BON by the many GEO BON partners is a challenge, as many partners don't specifically calculate their time spent for GEO BON activities. Therefore, we calculated only the major activities and added estimates from the key partners. All together, more than 16M€ (including estimated in-kind contributions) will be invested in GEO BON activities in 2016.

The GEO BON Secretariat is hosted by the **German Centre for Integrative Biodiversity Research (iDiv)** in Leipzig, Germany which supports the GEO BON Secretariat with an annual budget of 135k€ for personnel costs and 50k€ running budget. **NASA** provides in-kind expertise to GEO and GEO BON, including a full time secondment to the GEO Secretariat, and NASA also supports the marine biodiversity observation network MBON with about USD5M in 2016. In addition, **Polar Knowledge Canada** supports the Vice-Chair position for GEO BON which is equivalent to 4 person-months (PM) in 2016. Furthermore, the **Global Biodiversity Information Facility (GBIF)** provides an in-kind contribution of 1 PM annually and **Map of Life (MoL)** provides 15PM annually to GEO BON activities. A breakdown of the resources applied to the key GEO BON activities follows (most of these are estimated).

- **EBV development:** 36 PM (funding provided by iDiv/Germany)
- **BON in a Box development:** 15 PM in 2016
- **Coordinating development of National, Regional, and Thematic BONs:** 4 PM in 2016
- **Asia Pacific BON:** 11 k€ in 2016 (funded by Japan Ministry of Environment for APBON activities)

- **Circumpolar Biodiversity Observation Program:** 1900 k€ in 2016 for their activities
- **Marine Biodiversity Observation Network (MBON):** USD6M + 135PM
- **Global System of Ecosystem Observatories (GSEO):** 90 PM in 2016
- **Global Wetland Observing System:** 115 PM in 2016 (Development of the EU SWOS project)

Recommended activities (recommended if additional resources are made available)

Of course, all GEO BON activities could benefit from additional resources as most of them depend on short term funding from projects and on in-kind contributions which are done on a best-effort basis. Additional funding, on the order of 10s of k€, would particularly benefit the BON in a Box toolkit by helping to bring the Latin America version to an operational status. Development of Essential Biodiversity Variables would also benefit from additional resources.

GI-03 GFOI Global Forest Observation Initiative

Overview

Robust national forest monitoring based on objective observations and measurements is widely accepted as a pre-requisite for countries to participate in international agreements and incentive mechanisms related to forest carbon. To operate efficiently and sustainably, National Forest Monitoring Systems (NFMS) require a continuous, timely and affordable supply of observations.

The Global Forest Observations Initiative (GFOI) aims to foster the sustained availability of observations for national forest monitoring systems as well as to support governments that are establishing national systems by providing a platform for coordinating observations, providing assistance and guidance on utilising observations, developing accepted methods and protocols, and promoting on going research and development; working with national governments that report into international forest assessments such as the national greenhouse gas inventories reported to the UN Framework Convention on Climate Change (UNFCCC) using methods of the Intergovernmental Panel on Climate Change (IPCC). National Forest Monitoring Systems also have direct influence on decision-making in other fields such as resource management and agriculture.

Leaders and Contributors

GFOI is led by: Australia, Norway, the USA (USGS/SilvaCarbon), SilvaCarbon, The Food and Agriculture Organization of the United Nations (FAO), and the Committee on Earth Observation Satellites (CEOS). The involvement of CEOS is led by the European Space Agency (ESA), with management support provided by Australia. Other national space agencies engaged to date include those of Argentina (CONAE), Brazil (INPE), Canada (CSA), China (CRESDA, NRSCC), France (CNES), Germany (DLR), Japan (JAXA) and the USA (NASA/USGS).

The work of GFOI is undertaken by five components: Methods & Guidance, Space Data, Capacity Building, R&D, and Administration and Coordination (the GFOI Office).

In the period 2011 – 2015, the CEOS SDCG has prepared and coordinated: the initial

implementation of a coordinated global baseline data acquisition strategy for EO data (Element 1) involving a number of space-based ‘core’ data that can be used and shared free-of-charge for GFOI purposes; a coordinated strategy for national data acquisitions (Element 2) which accommodates countries that have specific technical requirements or heritage and experience on working with a particular EO data source or type; and a data acquisition and supply strategy in support of GFOI R&D activities (Element 3). The SDCG for GFOI has produced a Three-Year Work Plan for 2015 – 2017, which was recently endorsed by CEOS. The Work Plan has been prepared to map out the activities of the SDCG covering the finalisation and implementation of the space data supply for GFOI.

The first version of the GFOI Methods & Guidance Documentation was released in January 2014 and has been applied in a range of countries including, but not limited to Ghana, Columbia, Cambodia, Fiji, Kenya, Papua New Guinea, facilitated by the UN-REDD programme, SilvaCarbon, the World Bank Forest Carbon Partnership Fund and bilateral programmes. Training materials, decision support tools and rapid response guidance modules have been developed to support the MGD since its publication.

Since 2011 the US Government SilvaCarbon Program has been developing capacity in all aspects of forest monitoring in four regions (Latin America, SE Asia, Central America and Central Africa), and 25 countries across those regions. SilvaCarbon has developed bilateral work plans with 10 of these countries focusing on their forest inventories and remote need sensing needs. User engagement is typically through the Capacity Building component and handled by SilvaCarbon and FAO, although individual governments such as Australia and Norway have their own focused programmes with partner countries (eg Indonesia and Kenya) for the development of national capacity.

Significant achievements and contributions of the GFOI R&D Component are the release of the 'Review of Priority Research & Development Topics' (Dec, 2013); completion of a 'Landscaping Study' (July, 2014) that maps out priority R&D topics against the interests of potential research and partner organisations and identifies possible funding sources for them; organisation of three expert workshops that provided a forum for identifying actions to progress specific R&D topics towards operational use (including sensor interoperability (June, 2014), forest degradation (Oct, 2014) and vegetation biomass estimation (Feb, 2015); and support to the (parallel) development of the SDCG Element-3 Strategy, which is a coordinated multi-sensor data acquisition strategy dedicated to supporting GFOI priority R&D.

The **GFOI Office** provides the necessary management functions to ensure coordination and communication across the range of stakeholders including advisory, leadership and “parent” bodies, the participating science and technology community, the forest countries GFOI wishes to serve, the UN bodies intended as recipients of forest country reports, potential donors, etc. The **GFOI Lead Team** has responsibility for project implementation and strategy and a larger **Advisory Committee** exists to provide a broad base of experience and advice for GFOI activities.

GFOI is unique in that it directly engages and brings together space data providers (CEOS agencies), forest monitoring/remote sensing experts (MGD, Capacity Building), and in-

country partners (FAO, SilvaCarbon) in support of countries and their NFMS/MRV ambitions.

Activities 2016-17

Building upon a substantial body of foundational and initial implementation work completed since 2011, in the period 2015-17 each of the GFOI components will be working to improve existing outputs and to build new capacity in the following directions:

- **Space Data:** Continued coordination of data streams and the addition of new data streams and products to ensure multiple annual global coverages of the world's forested areas by 2016; continued development of data services tools and Pilots for data acquisition planning, data storage, data processing and delivery of tailored data packages (such as cloud computing based tools and Data Cubes); expansion of R&D data supply and coordination, including provision of space data supporting the priority activities outlined in the GFOI R&D Plan, and implementation of an effective private sector engagement mechanism; development of the SDCG Global Data Flows Study which will evaluate alternate solutions for reducing barriers to effectively accessing and using satellite data; and closer integration with MGD and Capacity Building activities.
- **Methods and Guidance:** Development of basic methodological guidance documents in several languages; translation of methodology into a hands-on user-driven MGD Web Application, which will target MRV in-country technical specialists, present material tuned to individual needs based on guidance presented in the MGD, and provide linkages between pillars of GFOI such as available tools and training materials; continued generation of MGD Rapid Response Modules and Training Materials to respond to new technologies and emerging reporting approaches; and production of MGD Version 2.0 as an update and improvement on V1.0, increasing its ease of use for non-specialists.
- **Capacity Building:** Continued GFOI regional capacity building workshops with increased MGD integration, based on regional capacity building needs and requests from countries; development of a bilateral capacity building plan for 10 countries to support specific MRV technical capacity needs; increased contributions to the MGD; preparation of training materials; and hosting of the Second GFOI Capacity Building Summit to assess progress on the *Manual for Best Practices to Implement Capacity in REDD+ Countries*, which was recommended as an outcome of the first Summit.
- **R&D:** R&D component management; initialisation and coordination of R&D activities in parallel with SDCG Element-3 strategy implementation; manage participating (external) research teams and reporting; coordinate Expert workshops and organise a GFOI Science meeting; update the GFOI Review of Priority R&D Topics and R&D Plan; contribute to the update of the GFOI MGD and the REDD Sourcebook.

All of these tasks will be underpinned by strong component coordination from the GFOI Office, which is working with GFOI's partners to address country engagement as a priority. The GFOI Office is in the process of moving from Geneva to a home within FAO

HQ in Rome to promote its transition to operations.

GI-04 Global Observing System for Mercury and Persistent Organic Pollutants (PoPs)

Overview

The task HE-02 "Tracking Pollutants" was established as a part of the 2009-2011 work plan of the Group on Earth Observations (GEO) and, through the establishment of coordinated global observation network for mercury and POPs, was meant to support the international conventions on toxic compounds (i.e. Stockholm Convention (SC), UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP)) and on-going international programmes (e.g. UNEP Mercury Program, Global Monitoring Plan (GMP) of SC on POPs, European Monitoring and Evaluation Programme (EMEP)).

The task includes two major components:

- The Global Mercury Observation System (GMOS) is a worldwide observation system for the measurement of atmospheric mercury in ambient air and precipitation samples. GMOS includes ground-based monitoring stations, shipboard measurements over the Pacific and Atlantic Oceans and European Seas, as well as aircraft-based measurements. All data are made available through an ad-hoc, scalable and user-friendly infrastructure.
- The network to measure baseline data for the various POPs (including the eleven new POPs listed in the SC in 2009, 2011, and 2013); including the Data Warehouse (GMP DWH) (www.pops-gmp.org), registered for access through the GEOSS portal.

Previous achievements have also resulted in the availability of data and reports through the GEO Portal. In particular:

- The GMP DWH together with the GENASIS primary database have been registered under the GEOSS portal
- www.pops-gmp.org
- www.genasis.cz
- Data from the 2nd GMP regional reports publicly available. The GMOS SDI has been registered under the GEOSS portal
- <http://www.geoportal.org>
- <http://www.eurogeoss-broker.eu/>

User engagement

The primary stakeholders are: parties to the Stockholm, Minamata and other Conventions, governments, IGOs, NGOs; the scientific community in related fields shares the interest within the scope of the project and could contribute to gathering information and mobilizing social groups; the civil society in general, benefitting

from communication of risks associated with POPs and Hg releases, contamination and exposure.

Partners

- Italy - CNR (Nicola Pirrone)
- UNEP (Katarina Magulova) Mercury Programme, the Hemispheric Transport of Air Pollutants Task Force (TF HTAP);
- Czech Republic, Masaryk University (Jana Klanova)
- CARIBIC, Germany
- GEF – Global Environmental Facility of the World Bank
- European Monitoring and Evaluation Program (EMEP);
- MercNet/AMNet initiative in USA;
- CAMNet in Canada, and other international monitoring and modeling efforts.
- RECETOX

Activities for 2016

The overarching goal of the task GF-04 (Global Observing System for Mercury and Persistent Organic Pollutants (POPs) for 2016-2017 is to further develop the global observation systems for mercury and POPs by harmonizing standard operating procedures for monitoring of these substances in air, precipitation, surface water, soil, sediments, vegetation, and biota and support open access and sharing of standardized data. Specific objectives include:

- To increase the availability and quality of Earth observation data and information needed to track chemical pollutants and anticipate changes to the environment;
- To harmonize standard operating procedures for monitoring priority pollutants, such as POPs and Hg, and their compounds in air, atmospheric deposition, water, soil, sediments, vegetation and biota.
- To understand temporal and spatial patterns of chemical pollutants transport and deposition to, and evasion from, terrestrial and aquatic ecosystems;
- To support the validation of regional and global atmospheric pollutant models for use in evaluations of different policy options;
- To evaluate the effectiveness of international efforts to reduce releases of pollutants.
- To deliver specific documents and reports as requested by the users identified above.
- Capacity building and training to assist regions in implementing new features of the GMP and filling existing data gaps (i.e. by means of the annual summer schools)

Resources and annual budget(s)

In-kind (human resources)

- Secretariat staff time; Staff time of the regional organization groups and global coordination group members, strategic partners.

Financial

- Resources from small projects of the Stockholm Convention Secretariat, contributions from strategic partners, contributions of the participating countries through resources necessary to operate the contributing POPs monitoring programmes (Canada, Czech Republic).

Other

- GEF medium sized projects on analytical procedures for new POPs, capacity building for the implementation of the GMP in the regions.
- H2020 ERA-NET Projects, UNEP, projects funded in US, Japan, China as well as other national funded projects.

GI-05 Global Carbon Observation and Analysis System

Overview:

Climate change is one of the most important challenges that humanity will have to address in the coming decades. The Intergovernmental Panel on Climate Change (IPCC) has concluded that a large part of the observed rise of global temperature is very likely due to increasing greenhouse gases (GHG) in the atmosphere, driven by man-made emissions overtaking the natural cycles of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). The perturbed global biogeochemical cycles of these greenhouse gases are a major driving force of current and future climate change. The primary agents of these perturbations are fossil fuel combustion and modifications of global vegetation through land use change, in particular deforestation. Deeper understanding of the driving forces of climate change requires full quantification of the GHG cycles. Regional GHG flux patterns, tipping-points and vulnerabilities can be assessed by long-term, high precision in-situ observations in the atmosphere and at the ocean and land surface. They are complemented by in-situ and satellite observations of carbon pools as well as total column observations from satellites. CEOS (Committee on Earth Observation Satellites) has responded to the GEO Carbon Strategy and provided coordination to all the national and regional satellite agencies; GCP (Global Carbon Project) has provided annual updates of the global carbon budget and coordinating many global and regional efforts, in particular by establishing the mean carbon balance of large regions in the RECCAP (Regional Carbon Cycle Assessment and Processes) project.

A GEO Carbon and GHG Flagship will contribute to the implementation of the next GEO Strategic Plan for the period 2016-2025. The flagship will address important issues needed to build a connected and interoperable global network for carbon cycle (CC) and greenhouse gas (GHG) observations in the atmospheric, terrestrial ecosystem and oceanic domains.

In particular the GCGF will address these questions:

- What kind of carbon cycle and GHG observations are urgently needed to support the Sustainable Development Goal: "Take urgent action to combat climate change and its impacts" (and partly the Goal: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss")?
- Where are we coming from, i.e. what are the most important recent achievements in terms of science and infrastructural capacity?

- Where do we want to go, i.e. what remains to be done in the framework of GEO for the next 10 years? In particular, how can we ensure that achieved capacities can be fully explored for multiple needs and not just for the specific circumstances they were developed for?
- Who will be the important data providers, integrators and users?
- How can a sustainable structure be achieved? What is fundamental, what is desirable, what would be nice to have but not essential?
- What are the most urgent needs for integration between different information sources and across methodologies, between different regional networks and from data providers to users? What is the intent of integration? Blending? Coupling? Transforming? How do we assess integration methods in light of relevant objectives? How can different data sources and modeling approaches be used to evaluate our understanding of processes and their emergent properties?

The main objectives of this flagship are:

- to provide more inclusive coordination among the main actors monitoring carbon cycle and GHG at global level;
- to further develop inter-operability between satellite observations; in-situ infrastructures and integration networks by
 - Data harmonization (data and metadata formats),
 - Further development of full and open data sharing,
 - Long-term sustainability of data centers and model result repositories,
 - Understanding and quantifying scale issues and process information across in-situ measurements and satellite platforms;
- to support the development of Model Data Fusion to improve parameter optimization;
- to envisage a GEO role in organising and backing intercomparison exercises;
- to establishing standard datasets for synthesis and dissemination of policy-relevant information on global carbon cycle and GHG:
 - to raise awareness and promote data use e.g. towards UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA);
 - to liaise science with policy and provide decision makers with timely and more reliable policy-relevant information
- to coordinate the periodic update and supply of comprehensive carbon budgets (covering also less studied region/ecosystems, and unknown sources, with progressively reduced uncertainty) at different levels (global, regional, domains, etc.) and integrating different approaches;
- to provide knowledge that assures the quality of national inventories and to secure the effectiveness of UNFCCC.

Other objectives for the GEO flagship process:

- to support for sustaining, developing and exploiting existing as well as promoting new observing platforms and infrastructures;
- to harmonize existing protocols for biogeochemical data collection and analysis,

as well as full and open sharing;

- to contribute data to cost-benefit analyses that show the costs of better informed actions versus inaction;
- Promote further consistency of observations and specification of uncertainty that is fully traceable and accepted by the community.

2016 Activities:

An Implementation Plan will be developed in 2016.

The first step is to decide task's titles and contents, and the working structure. The main building blocks could be the following:

- Define the elements for an optimal global carbon observing system, including the needed infrastructure
- Collect and harmonize (to make them interoperable) all the possible available observations (in different domains, from different platforms, etc.) from past series to the currently operational networks
- Improve assimilation systems and modelling efforts to ingest and process these observations and provide relevant products
- Deliver new information products, tailored to the final users (particularly decision makers)
- Develop and maintain an information portal, fully linked to the GEO portal, where all these data, information and products are visualized and freely shared
- Assess the cost and benefits of an improved global carbon observing system

2016 Resources:

To be written

GI-06 Reinforcing engagement at regional level: AfriGEOSS for Africa

Overview

The development and uptake of Earth observation (EO) data, information and knowledge is critical to improving the socio-economic status of the African continent. The Group on Earth Observations (GEO) Member States and Participating Organizations in Africa recognize the need to improve and coordinate observation systems across the Societal Benefit Areas. Strong advocacy of open data-sharing policies and practices, as well as for the increased use of EO data and information, are the foundation of moving forward in these vital areas. Similarly, focusing significant effort on building both human and technological capabilities will ensure that all parts of the African continent can benefit from better access to, and understanding and use of, EO data, information and services.

AfriGEOSS is an emerging GEO initiative to enhance Africa's capacity to produce, manage and use Earth observations, while enabling the Region's participation in, and contribution to, GEOSS. The AfriGEOSS initiative is providing the necessary framework for countries and organisations to access and leverage on-going bilateral and multilateral EO initiatives across Africa, thereby creating synergies and minimising duplication.

Objectives

- Coordinate and bring together relevant stakeholders, institutions and agencies

- across Africa that are involved in GEO and other Earth observation activities;
- Provide a platform for countries to participate in GEO and to contribute to GEOSS;
- Assist in knowledge sharing and global collaboration;
- Identify challenges, gaps and opportunities for African contributions to GEOSS;
- Leverage existing capacities and planned assets and resources; and
- Advocate for the uptake of Earth observation in decision-making processes in Africa.

In the two years since its endorsement by the GEO Plenary, AfriGEOSS has resulted in increased:

- GEO Membership of African countries;
- African participation in GEO Boards and Working Groups;
- Participation in Africa caucus teleconferences and activities;
- African attendance at GEO events and official meetings;
- Participation in training courses (regional and international);
- Response and participation in Calls for Proposals; and
- Sharing of lessons learnt in the development of AfriGEOSS with AmeriGEOSS

2016 Activities and Outputs

In its Implementation Plan, AfriGEOSS identified six key Activity Areas, i.e.:

- Continental and Regional Coordination
 - o Re-establish strong contacts with the current GEO Principals and enlarge the GEO partnership in Africa;
 - o Establish national GEOs, including appointment of national focal points;
 - o **Outputs:** 1) strengthened national participation in GEO 2) increased GEO Membership in Africa;
- User Needs and Applications
 - o Establish Coordination Team/s with Action Plan/s, including resources, for relevant Societal Benefit Areas, such as the Working Group on Land Cover for Africa;
 - o Develop an extensive inventory of current and planned initiatives and available resources. The audit of what is happening in Africa will contribute to a map of on-going activities related to the AfriGEOSS objectives and assist in managing overlaps, identifying gaps and opportunities, as well as leveraging resources to meet objectives;
 - o Link existing initiatives, not yet connected to GEO, to the GEO Work Programme, clearly indicating contributions to GEOSS;
 - o **Outputs:** 1) Coordination Team/s and Action Plans in place; 2) inventory of current projects & initiatives; 3) Increased African participation in GEO Work Programme.
- Data and Infrastructure
 - o Strengthen the work of the current Coordination Team with the development of a long-term action plan;
 - o Finalise proposed mechanism for EO data dissemination in Africa;
 - o **Outputs:** 2016 and beyond action plan
 - o **Contributors:** Egypt (NARSS), Ghana (GSSTI), Nigeria (NARSDA),

South Africa (SANSA) and RCMRD

- Human Capital Development
 - o Establish Coordination Team with Action Plan including resources for the implementation of the Action Plan;
 - o **Outputs:** 1) Coordination team and action plan in place;
- Resource Contributors Coordination
 - o Establish Coordination Team with Action Plan including resources to implement the Action Plan;
 - o Coordinate with upcoming initiatives to ensure Africa receives full benefit from, and makes a contribution to, GEO Initiatives and Flagships;
 - o **Outputs:** 1) Coordination team and action plan in place; 2) Increased African participation in relevant GEO Initiatives and Flagships;
- Communication and Outreach
 - o Establish Coordination Team with Action Plan including resources to implement the Action Plan;
 - o Maintenance and update of the AfriGEOSS website;
 - o Continuously share information with the community through AfriGEOSS Alerts;
 - o Hold an AfriGEOSS Symposium;
 - o AfriGEOSS exhibition and side event at AARSE 2016;
 - o AfriGEOSS exhibition at GEO-XIII Plenary;
 - o **Outputs:** 1) Promotion of AfriGEOSS and Earth observations
 - o **Contributors:** AARSE, South Africa, Uganda

The work of the AfriGEOSS team will be supported by regularly teleconferences of the Coordination Teams and face-to-face meetings. The AfriGEOSS Steering Committee is envisaged to meet face-to-face at least once in 2016.

2016 Resources

- A full-time Project Officer based at the GEO Secretariat, till September 2016 will support the AfriGEOSS initiative through a secondment by South Africa;
- In-kind, human resources, contributions making up the Coordination Teams;
- Financial resources;

Additional activities for 2016 (Recommended if additional resources made available)

GI-07 Ocean and society - Blue Planet
. Overview

The GEO Strategic Plan 2016-2025 identifies eight societal benefit areas. The oceans play a vital role in every one: Disaster Resilience; Food Security and Sustainable Agriculture; Water Resources; Energy and Mineral Resources; Public Health Surveillance; Biodiversity and Ecosystem Sustainability; Sustainable Urban Development; and Infrastructure and Transportation. For example, ocean-related hazards such as tsunamis, storm surges, and extreme waves require ocean observations for early warning systems and to prepare for and mitigate the effects of disasters. Because of their role in climate,

ocean observations also provide important information for the forecasts of precipitation and drought, the source of replenishment of water supplies, and of climate events that can lead to public health incidents or changes in energy demand. Ocean biological observations are critical in monitoring the health of ocean ecosystems and biodiversity, and the way ecosystem services are being impacted by a changing environment. They are also important in managing fisheries and aquaculture. In addition, observations of the ocean are critical for monitoring climate variability and change, and for generating forecasts and projections of climate that can be used in climate services. Ocean observations help improve predictions of longer-range forecasts of weather. Finally, oceans impinge on various cross-cutting initiatives in GEO, such as system architecture and capacity building.

Although various successful marine activities were conducted under earlier GEO Tasks in previous Work Plans, they were uncoordinated and often overlooked. In short, oceans did not receive the prominence they deserved. Furthermore, the distribution of the tasks in multiple SBAs did not facilitate integration and synergy between elements. The Partnership for Observation of the Global Oceans (POGO) worked hard to have this situation reversed, so that oceans would be accorded their proper place in the GEO arena. In addition, from a communications point of view, it was felt that speaking with a common voice for the oceans would be more effective than fragmented messages. The creation of the “Oceans and Society: Blue Planet” Task was started by the Partnership for Observation of the Global Oceans (POGO) in 2011, to coordinate all the existing ocean observation programmes within GEO, to add new ones to the GEO portfolio, and to create synergies between them. The Task was developed further over the past few years by POGO, in collaboration with other marine interests, notably the Committee on Earth Observing Satellites (CEOS), the Global Ocean Data Assimilation Experiment (GODAE) OceanView and the Global Ocean Observing System (GOOS). Blue Planet will build on its initial success as a Task in the GEO 2012-2015 Work Plan, in galvanising the ocean observing community and enhancing the visibility of ocean observations within GEO. In its next phase, it will add value to the work already being carried out, by developing synergies between its different components and with other parts of the GEO Work Programme, and by strengthening its focus on delivering products and services to the user communities. This was agreed at the 2nd Blue Planet Symposium, which was hosted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Cairns, Australia, from 27 to 29 May 2015.

In summary, Blue Planet is the ideal facilitator to enhance the coordination among the different global initiatives relevant to ocean observations and is also the ideal place to identify and reach actual end users and jointly work with them to understand and address their needs. We believe Blue Planet, through GEO, provides the right framework for creating synergies among different groups and, most importantly, linking them with policy makers.

2. Activities for 2016 (and beyond)

Blue Planet envisions an informed society that recognises the oceans' crucial role in Earth's life-support system and is committed to stewardship of the oceans for a healthy, safe and prosperous future for all. Blue Planet's Mission is to advance and exploit synergies among the many observational programmes devoted to ocean, coastal and inland waters; to improve engagement with a variety of users for enhancing the timeliness, quality and range of services delivered; and to raise awareness of the societal benefits of ocean observations at the public and policy levels.

"Oceans and Society: Blue Planet" will add value to existing observational programmes by:

- Facilitating and encouraging collaboration among them for mutual benefit, and with the broader Earth observation community;
- Improving their connections with the users of ocean observation-derived products, information and knowledge;
- Enhancing their impact within the Group on Earth Observations and other intergovernmental arenas; and
- Promoting their communication with decision makers and with the general public regarding the societal benefits of ocean observations.

Through 2016 and beyond, Blue Planet seeks to create an end-to-end service that (1) builds the capacity required for ocean observations, (2) collects data from observations, (3) manages the data and makes them widely available, and (4) transforms the data into information, products and services to be used by a variety of stakeholders for the benefit of society. This requires a close collaboration between the different partners contributing to Blue Planet. In particular, POGO, International Oceanographic Data and Information Exchange (IODE) and Scientific Committee on Oceanic Research (SCOR) play a significant role in developing the capacity required to expand ocean observations worldwide. GOOS and POGO are responsible for a large fraction of the deployment and coordination of observing systems in the open ocean; CEOS is responsible for coordination of global space-based observation of ocean and coastal zones across 31 space agencies; and CZCP focuses on the coastal zone. GODAE Ocean View coordinates the ocean forecasting efforts.

Finally, although progress has been made, there is much more work to be done to galvanise the ocean observing community, to highlight the importance of the ocean observations for policymakers and for society-at-large, and to bring products and services to users that are tailored to their needs. We already know how to observe the ocean in all its aspects, including physics, chemistry, geology, and to a lesser extent biology, at the required time and space scales. We have the ability to sample the remotest parts of the oceans, from pole to pole and into the deepest ocean trenches. However, the sustained network of coastal and deep-sea observations is unevenly distributed, and has serious gaps. There is therefore an urgent need for the scientific community to agree, for example, on the variables that need to be measured (Essential Ocean Variables) and to implement these in a systematic, sustained and globally-distributed manner. Thus, in its new phase, the Blue Planet Initiative will have a stronger focus on user engagement and will facilitate the two-way communication between data and information providers and various user

communities, by 1) identifying the users for different types and sources of data and information, (2) actively seeking their feedback on what they need and how and in what format it should be delivered to them, and (3) sharing information, advice and best practices on user engagement within the Blue Planet community. This coordination and advisory role will be taken on by a dedicated User Engagement group/component within the new structure.

3. Committed Resources and annual budget(s)

Project

- GMES marine services (MyOcean II)
- Deep Ocean Observing Strategy
- Tropical Pacific Observing System 2020 Project
- AtlantOS
- International Quiet Ocean Experiment
- The NSF-Funded RCN on Ocean Observations

In-kind (human resources)

- For overall coordination:
 - o Blue Planet Secretariats hosted by NOAA and CSIRO
 - o POGO Secretariat
- CEOS Secretariat(s) - CEOS Blue Planet Expert
- CEOS Working Groups
- Secretariat of the GOOS Project Office hosted by IOC (Paris, France)
- OOPC Secretariat (GCOS, Geneva, Switzerland)
- IOCCP Secretariat (IO PAS, Sopot, Poland)
- JCOMMOPS (Toulouse and Brest, France)
- IODE/OBIS Secretariat (Oostende, Belgium)
- In kind support by USA (NASA) and Australia for GOOS
- IOC field offices: Nairobi, Bangkok, Perth, Kingston
- Human resources made available by IEEE.

Financial

- IOC regular annual budget support for GOOS, IODE, JCOMM
- Extra-budgetary voluntary financial contributions from many Member States
- Investment in Capacity Building by POGO, approx \$500K per annum, courtesy of the Nippon Foundation
- Investment in Capacity Building by IODE, courtesy of the Government of Flanders.

Other

- An estimated USD 1-2 billion in direct support to ocean observations, data management and analysis activities, including contributions from space and in situ observations, from a broad variety of countries (national and institutional funding).

- CEOS Virtual Constellations.

GI-08 GEO Geohazard Supersites and Natural Laboratories (GSNL)

1. **Overview**

A global collaboration between local geohazard monitoring agencies, satellite data providers and the wider geohazard scientific community to generate scientific products to better estimate geological hazards. The collaboration is carried out on the Supersites, areas with high hazard and risk problems.

The GSNL initiative is presently evolving towards a more direct use of the scientific products for hazard and risk assessment, thorough a better involvement of local stakeholders.

The follow-on GSNL 2.0 will build on the successes of the initial phase, by adding a better governance and stimulate a collaborative effort of the global scientific community towards the provision of new science tailored on the needs and priorities of the local risk managers.

Satellite imagery is crucial in this regard, since many developing countries still lack the capacity for in situ geohazard monitoring.

We will also demonstrate the benefits of a more open access to EO data for disasters.

2. **Leads and contributors**

Lead : Andrea Taramelli, Italy

Contributors : Italy, China, France, Germany, Japan, Nigeria, Norway, Slovenia, Spain, UK, US, Committee on Earth Observation Satellites (CEOS), EPOS, ESA, EuroGeoSurveys , European Commission, IEEE, GEM, IUGS.

3. **Activities for 2016**

Continuation of existing activities, Plans being developed

4. **Resources**

In kind

5. **Additional activities for 2016**

No one identified.

GI-09 Global Wildfire Information System

1. **Overview**

Wildfires continue to present a major risk in many countries. It is estimated that nearly 400 Million ha of natural areas are burnt every year causing large environmental and economic damages and contributing to the increase of carbon emissions worldwide. Wildfires have seasonal and regional patterns, which are reflected in different fire regimes across the globe and several National and supranational organizations have established systems aiming at providing early warning for large fire events to minimize the effects of catastrophic fires.

Earth observations (Eos) and information, derived both from space and surface networks, have demonstrated not only their maturity, but their critical role in supporting first responders and risk managers by providing effective tools to rapidly map natural hazards and assess impacts.

There is an increasing amount of spatially explicit data and information on Wildfires being collected at the national and global levels. However, the lack of an international initiative to pull resources and information together did not exist.

GEO provides a unique platform for international cooperation. In the area of wildfires, the Global Wildfire Information System initiative aims at bringing together existing information sources at regional and national level in order to have a comprehensive view and evaluation of fire regimes and fire effects at global level.

The task will build on the ongoing activities of the European Forest Fire Information System (EFFIS), the GTOS GOFC-GOLD Fire Implementation Team, the associated Regional Networks, complementing existing, related activities that are on going around the world, with respect to wildfire information gathering.

At the regional level, GWIS builds on the European Commission activities around the European Forest Fire Information System (EFFIS), which currently provides information for the pan-European territory, Middle East and North Africa, and its associated network of 43 countries in that region.

In countries that currently do not have a wildfire information system, GWIS will fill this gap and help countries engage in international collaboration. For countries and regions where wildfire information systems exist, GWIS will provide a complementary and independent source of harmonized information adding to the national/regional information sources.

GWIS includes the following activities:

1. Establish and further develop a prototype Global Wildfire Information System (GWIS) providing harmonized fire information (e.g. fire danger) – building on initial activities of the European Commission in the European Forest Fire Information System and the Global Observation of Forest Cover-Global Observation of Land Dynamics Fire Implementation Team (GOFC-GOLD Fire IT).
2. Promote the networking of major national and regional fire information providers by organizing an annual workshop convening key international organizations and initiatives (e.g. GOFC-GOLD Fire IT) and national and regional providers, e.g. Australia, Canada, China, Central and South America and South Africa.
3. Establish operational links and, if possible, arrangement with other wildfire communities dealing with wildfire aspects at global scale (e.g. burnt area assessment, emission estimation).
4. Further develop the GWIS by integrating and harmonizing as much as possible regional data wildfire information sources.
5. Develop, implement and promote the establishment of mechanisms for interoperability and communication among national, regional and global wildfire information systems following OGC standards and guidelines, and the GEOSS Data Sharing Principles.
6. Coordinate and promote capacity building and training activities in close cooperation with the GOFC-GOLD Fire Implementation Team regional networks and the EFFIS network.

2. Leads and contributors

Lead: Jesus San-Miguel-Ayanz, European Commission JRC

Contributors: GTOS (GOFC-GOLD), Canada (CFS),, USA, China, Japan, South Africa (CSIR), ESA, NASA

3. 2016 activities

M1 Workshop of GWIS partners – Q4 2016

M2 Consolidated prototype of the GWIS – Q4 2016

4. Resources

GWIS is supported by the European Commission Joint Research Centre activities on forest fire monitoring in the context of the extension of the European Forest Fire Information System to the global scale. The contribution of the EC Joint Research Centre includes the development and maintenance of a prototype Global Wildfire Information System

The participants in the GWIS initiative will provide in kind contribution through their participation in the meetings and teleconferences. Contributors to GWIS will provide support for the editing of documents and reports during the life span of the Initiative. The list of participants and their contribution will be regularly updated along the duration of the project.

The European Commission Joint Research Centre, in the context of its activities within the Copernicus program, foresees the provision of financial resources for the organization of an annual workshop. No other specific financial support is provided by any of the Institutions participating in the task.

5. Additional activities for 2016

Establishment of contacts and synergies between the GOFC GOLD Fire Implementation Team regional networks and the GWIS.

GI-10 EO data and renewable energies

Overview

Energy is an essential factor for sustainable development and poverty eradication. Nevertheless, it is estimated that in 2015 still about 2.8 billion people have no access to modern energy services and over 1.1 billion do not have electricity. Furthermore, around 4.3 million people are dying prematurely every year due to indoor pollution resulting from cooking and heating with unsustainable fuels. The challenge lies in finding ways to reconcile the necessity and demand for modern and sustainable energy services with its impact on the environment and the global natural resource base in order to ensure that sustainable development goals are realized.

Given the considerable attention being paid to establishing green, sustainable economies GEO's efforts in the Energy domain should be strategically positioned to make a significant impact globally by enhancing the ongoing activities and increasing linkages with sustainable development efforts.

No specific EO system or program dedicated to Energy exists, but the Energy Domain is using EO systems and programs dedicated to others domain to extract relevant energy information. Nevertheless EO data or information sets dedicated to Energy are existing and a lot of resources are available within GEOSS (from Data Core resources to web services all compliant with the GCI).

Considering the Sustainable Development Goals in the Energy domain and the GEOSS targets, there is a need to:

- Support the development of Earth observation products and services for energy management.
- Consider end-to-end energy production systems (including generation, transmission, distribution, and integrated operations).
- Promote collaboration between users and providers of Earth observation and information.
- Encourage the use of Earth observation and information for informed renewable energy policy planning in developing and developed countries.

2016 Activities

For 2016, a set of activities is already existing. The activities described hereafter are:

- The H2020 ConnectinGEO project (2015-2017) has an activity related to identification of essential variables for renewable energies, gap analysis and industrial challenges on in-situ measurements (<http://www.connectingeo.net>)
- The pre-operational COPERNICUS MACC service for Solar Radiation (<https://www.gmes-atmosphere.eu/catalogue/#list?st=Solar%20radiation>) will be transformed into an operational service within the H2020 Copernicus Atmosphere Monitoring Service (CAMS) project.
- The Participation to AIP-8 (2015) through the ConnectinGEO project for Enhancing GEOSS Webservice-Energy SDI with Sensor Observation Service capacity for the Energy SBA.
- The launch of the H2020 ERA PLANET project, a major contribution from Europe to GEOSS, with specific inputs for Energy within the Strand 2 – Resource efficiency and environmental management
- Activities of the Federation of Earth Science Information Partners (ESIP) Energy & Climate Working Group to enhance communication between data providers at US Federal agencies and renewable energy decision makers.
- Continuation of the compilation of resources related to energy within the catalogue of the community portal <http://www.webservice-energy.org>
- Improvement of the Global Atlas for renewable energies from International-Renewable Energies Agency – IRENA (<http://irena.masdar.ac.ae/>).
- A workshop will be organized in 2016 focused on new applications using NASA and other US agency Earth science resources for energy management decision making.
- A new geospatially enabled web portal to feature upgraded renewable energy data sets derived from NASA and other observations spanning 30+ years at ½ x ½

degree resolution is being produced (<https://eosweb.larc.nasa.gov/sse/>)

2016 Resources: Needed (associated with the 2016 Activities;

Additional Activities for 2016: Recommended if additional resources are being sought – allows GEO Principals to confirm (increase) contributions.

Tentative launch of an industrial professorship dedicated to GEOSS and renewable energies. (2015-2016)

GI-11 Information Services for Cold Regions

1. Overview

Coordinate global, joint efforts to provide Earth observations and information services to decision-makers over the vast Cold Regions areas, including the North Pole, South Pole, Himalaya-Third Pole and Mountain areas.

Objectives and actions

- Build a global network to archive, manage, and provide access to in-situ and remotely-sensed earth status data and social humanity data for monitoring the global cold regions through appropriate national, regional and global systems, centres and programs.
- Provide sustained observations and information exchange mechanism to understand the global change over the cold regions, and address their fragile ecosystem and environmental challenges and societal influences.
- Establish a proactive framework for the development of information and related services, the Global Cold Regions Community Portal, to underpin the Global Earth System of Systems implementation by expand the outreach of, and maximize synergies among, thematically wide GEO activities and thematically deep participant activities, thereby exploiting their complementary roles.
- Advocate open data policy, and free access to the earth observations data over Cold Regions.
- Strengthen the synergies and partnerships with policy-makers, stakeholders, and funders over the cold regions' ecological and engineering fields, and improve the public awareness through the capacity building.

2. Leads and contributors

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Contributors: Canada, China, Denmark, Finland, Germany, Iceland, India, Italy, Japan, Norway, Spain, Sweden, Switzerland, United Kingdom, United States, ICIMOD, CliC (WCRP), WMO, SAON.

3. 2016 Activities

- Building connections and collaboration between the participating organizations, projects and communities (joint on-line conferences and meetings)
- Building cross-cutting connections and collaboration with cold-regions related activities within GEO (a joint committees, including programs' chairs, leaders and points of contact, as support to information services including scientific & technology group, data and information group, GEO secretariat, and users' engagement group) (GEO Plenary and other joint GEO meetings).
- Starting to plan and establish the key or essential variables for cold regions (draft paper)
- Providing observations and products on various scales from cross-continental to regional and in-situ scales (contributions to GEOSS Data-Core etc)
- Bridging the remote-sensing and in-situ communities in the field of cold regions earth observations (joint workshop/seminar in connection or back-to-back with a scientific conference etc. labeled with the GEO/Cold Regions)
- Promotion of awareness the gaps in the scientific knowledge over cold regions (outreach, user engagement, user community, policy makers and stakeholders at various levels)
- Leveraging the use of cold regions related results and products for implementation in strategic assessments by scientific organizations, policy making and other end-users (meetings and knowledge exchange with organizations, consultations etc)
- The Global Cryosphere Watch (**GCW**) will hold its second Asia CryoNet meeting in February 2016 in Salekhard, Russia. The goal is to further develop a regional GCW group focused on surface measurements in the Third Pole region and the Russian Arctic. A similar effort is underway in South America, with a second South America workshop planned for 2016. (\$120,000 for both workshops).
- SAON will continue to work with these contributions: Documenting and understanding the Arctic data management ecosystem; Identifying and promoting common metadata elements; Engaging in data citation and publication movement; Promoting interoperability through action - interoperability experiment; Inventory of arctic observational projects as a contribution to EU PolarNet; Community Based Monitorin (CBM) atlas.
- INTERACT continues building capacity for research and in-situ observations throughout its pan-arctic station network, and bridging of the in-situ and remote sensing communities via joint activities and events. Open access to metadata and data and will be advocated in the station network, as well as efforts to connect open access metadata and data with global data portals such as the GEOSS Data-CORE. Collaboration with arctic and polar scientific organizations and input to strategic and scientific assessments continues. Outreach activities to inform policy makers, other stakeholders and the general public will be continued in various forms. (in-kind, national and international resources for 2016 to be identified later in 2015)
- PEEEX will launch a comprehensive PEEEX metadata collection and build a Modelling Demo ("PEEX View").
- SIOS implementation phase will be supported by Italy, in the perspective of the extension of the CCT-IP concept to other areas of Svalbard (Euro : 100, 000)
- IADC (Italian Arctic Data Centre) will be implemented as the portal of the Italian research activities in the Arctic. In the frame of the Antarctic Research National Programme (PNRA) a distributed cyber-infrastructure (National Antarctic Data

Center- NDAC) will also be developed. Both actions, based on the brokering approach will be integrated in a unique Polar Data Infrastructure (PDI) (Euro: 200.000).

- Establish flagship stations within the Third Pole region for observation and monitoring; (US Dollars : \$200,000), Set up rain gauge along the altitudinal range from 2000 m to 6500 m in a river basin of the Tibetan Plateau, and to obtain the elevation-dependent precipitation data.
- Snow Observations over Tibetan Plateau (SOTP) will continue to explore the remote sensing snow cover products over Tibetan Plateau, with in-kind and somehow \$120,000 support from NSFC.
- ESA – MOST Dragon 4 Hydrology and Cryosphere Theme: It is expected that the current 10 projects under Dragon 3 will be clustered and continue through fewer but larger projects. As in Dragon 3, ESA is expected to provide limited support towards PhD / postdoc work under selected research projects. MOST / NRSCC supports Dragon projects through open Call for Proposals. Total resources committed to selected projects approximately estimated at 2 106 € over the period 2016~2019.
- CNR through Climate Change Integrated Project (CCT-IP) will continue to promote the upgrading of Ny Alesund as observation super-site in the Arctic (Euro : 100.000).
- A Chinese cubesat named TW-1A aiming for polar sea ice observation is scheduled to launch in October, 2015 and will provide satellite observations from December of 2015 in both Polar Regions. This satellite is proposed by Beijing Normal University and developed by Chinese Academy of Sciences.
- The observations by the intended Chinese Water Cycle Mission (WCOM) with a dual frequency dual polarized microwave radiometer would fill a gap in current European observations and would be highly relevant to monitoring of water resources. The mission will provide observations of SWE, precipitation and soil moisture. (\$1.5M)

Identification of additional activities will take place in meeting(s) later in 2015.

4. 2016 Resources

In kind contributions. Possible other resources to be identified later in 2015.

5. Additional activities for 2016

GI-12 Integrated Information Systems for Health (Cholera, Heat waves)

1. Overview

An Integrated Information System for health informs early warning to early action. The systematic collection and analysis of relevant information about and coming from areas of impending risk that:

- Inform the development of strategic responses to anticipate risks and opportunities and their evolution; and
- Communicate options to critical actors for the purposes of decision-making and response

The goal of this task is to foster the development of integrated information systems that

improve the capacity to predict, respond to and reduce environment-related health risks. These systems combine Earth observations, monitoring and prediction; social, demographic and health information; interdisciplinary research, application and assessment; communication, education and training in order to enhance preparedness and resilience. Three initial focus areas are

- weather and climate extremes (*e.g.*, heat);
- water-related illness (*e.g.*, cholera); and
- vector borne disease (*e.g.*, dengue, malaria).

2. Leads and contributors

The U.S. lead is NOAA. Current or potential partners include the WMO, Regional Climate Centers, WHO (Clim-Health Africa, Climate Program, Water Sanitation and Hygiene), GFCS. Key Bilateral Partners include Canada, Mexico, Germany, South Africa, Bangladesh, Ethiopia, and Japan

3. Activities for 2016

The next step is to establish or continue robust working teams in at least these three topic areas. The teams will identify and engage health partners and clarify health needs; address training needs; identify and address; observation and prediction gaps and needs; and establish work plans with the goal of having at least one prototype system in place for each topic area by 2020.

GI-13 Integration of Methods for Air Quality and Health Data, Remote Sensed and In-Situ with Disease Estimate Techniques

1. Overview

Air pollution and resulting public health outcomes continue to dominate growing estimates of mortality and morbidity associated with environmental risks to communities and society. This GEO priority topic will seek to further develop and implement integration of air quality monitoring, related estimation and modeling protocols optimizing both remote sensing and *in-situ* platforms, including small sensors with the goal of providing improved information for use in public health assessment tools. There will be an initial focus on the Institute for Health Metrics and Evaluation (IHME), Global Burden of Disease (GBD) estimates, in particular those related to the United Nations (UN) Sustainable Development Goals, with the goal of providing results of sufficient granularity at a scale useful to citizens, communities and decision makers.

2. Leads and contributors

The U.S. lead is EPA. Other potential partners include the Department of Health and Human Services (HHS), the National Aeronautics and Space Administration (NASA), NOAA, IHME, the Gates Foundation, the World Health Organization (WHO), Clean Air Asia, the United Nations Environment Programme (UNEP), AirNow cities and provinces.

3. Activities for 2016

The priority task in part will examine and integrate current real-time 24-hour average and

annual average modeling, calculations and techniques to optimize efficient use of data sources and platforms.

(A) Pilot(s) developed and deployed in a cloud-computing environment using the Environmental Protection Agency's (EPA) AirNow domestic and international technology will be used to test integration and modeling techniques. The resulting investigation and pilot should be completed within 2 to 3 years with further deployment over 10 years.

GI-14 GECO: the GEO Global Ecosystem Initiative

Overview:

Motivation. Building upon the recently restarted activities of the GEO Ecosystem Task, in 2014 two H2020 projects devoted to the use of Earth Observations (both remote sensing and in situ data) for the assessment of ecosystem services were funded. The two projects are ECOPOTENTIAL, a large 47-partner Consortium devoted to mountain environments, transitional coastal lagoons and drylands and including more than 25 European and non-European protected areas of international relevance, and SWOS, a smaller project focused on remote sensing of wetlands to support international conventions and regulations. ECOPOTENTIAL includes a conceptual part on macrosystems ecology and cross-scale interactions, and it has the goal of building a GEO Ecosystem Community of Practice.

In addition, in the last few years there has been incredible progress by USGS on two fronts related to ecosystem observation by remote sensing. First the ELUs (Ecological Land Units) have been updated to version 2. Second, it was commenced an incredible effort to map global EMUs (Ecological Marine Units), from data, in 3D, in a manner analogous to how was made for the ELUs.

The significant size and funding for the two European projects together and the time span of their activities (4 years), together with the significant and continuing progress on mapping ELUs and EMUs by USGS, indicate the appropriateness of a GEO Initiative devoted to improving ecosystem benefits through Earth Observations, starting from the work done in the two EU projects and the global ELU/EMU mapping, and then extending the approach to other ecosystem types at global level.

Description. Terrestrial and marine ecosystems provide essential goods and services to human societies. In the last decades, however, anthropogenic pressure has caused serious threat to ecosystem integrity, functions and processes, potentially leading to habitat degradation, creation of uncertainty related to "novel ecosystems" and increased risk of collapse, with related loss of ecosystem services. Ecosystem degradation and loss of ecosystem services can seriously affect human wellbeing and climate processes at local and regional scale (<http://www.unep.org/maweb/en/Framework.aspx>) potentially amplifying the negative effects of global change.

Knowledge-based conservation, management and restoration policies are thus urgently needed, in order to improve ecosystem benefits in face of increasing anthropogenic pressures. Fundamental to all these is effective monitoring of the

state and trends in ecosystem conditions and services. New monitoring methodologies are now available that combine approaches in geo- and bioscience, remote sensed data, and *in situ* data. Best use should be made of existing and incoming (new) Earth Observation (EO) and field monitoring data complemented by appropriate interpretation tools and data services and ecosystem models using these data. Knowledge must be built together with the relevant stakeholders to identify the relevant research outputs and support the use of new data and tools. Finally, synergies must be sought with all other international initiatives and projects.

The European H2020 Project ECOPOTENTIAL is designed to reach significant progress beyond the state of the art. It will focus its activities and pilot actions on a targeted set of internationally recognised protected areas (PA) in Europe, European Territories and beyond, including mountain, arid and semi-arid, and coastal and marine ecosystems. PAs such as those considered in ECOPOTENTIAL provide essential ecosystem services but are exposed to a variety of pressures, which can change their very nature. ECOPOTENTIAL sites represent UNESCO World Natural Heritage Sites, Biosphere Reserves, National Parks and important Natura 2000 sites. Additionally, two Large Marine Ecosystems (LME) in the Mediterranean and the Caribbean are included. Many of the sites considered here exhibit a variety of protection categories. Besides the broad cover of the legal status of outstanding PAs, many of the selected sites are directly linked to Long Term Ecological Research (LTER) sites (<http://www.lter-europe.net/>). The European H2020 Project SWOS focuses on the development and use of remote sensing information to improve conservation and management of wetlands.

Finally, activities at USGS have lead to a first version of the global classification of Ecological Land Units (ELUs), already published one year ago. In the last months, the ELUs have been updated to version 2, based on improvements made to the global landforms input layer, and improvements ESA made to the global land cover input layer. It was also commenced a huge effort to map global EMUs (Ecological Marine Units), from data, in 3D, in a manner analogous to how was made for the ELUs as an element of a previous and ongoing GEO Ecosystems and GEO BON Task to map standardized, robust, and practical global ecosystems. A US lead tem will be contributing this Global Marine Ecosystems Map. It will produce, publish, and distribute a high resolution, data-derived, standardized global marine ecosystems map by January 2017. USGS is the U.S. lead. Potential partners include NOAA, Esri, NatureServe, USGS, GGIM, UNEP, UNESCO, the International Union for Conservation of Nature, and the World Bank.

Based on these existing perspectives and results, the GECO Initiative intends to build upon available results and extend them to a global scale, identifying Protected Areas of international relevance where the same methodology used in ECOPOTENTIAL can be applied. Parallel to this, GECO intends to support the efforts of extending and improving the ELU and EMU maps currently ongoing at USGS, fostering other research initiatives of the same kind.

Leads and contributors

Italy CNR, Antonello Provenziale antonello.provenziale@cnr.it

2016 Activities

- Support the global ELU and EMU mapping, contributing with data and results in a close collaboration with the USGS group.
- Discuss how to export the results of ECOPOTENTIAL and SWOS to other ecosystem types and regions of the world, using the know-how and expertise developed during these two projects to set up a global monitoring and modelling approach to ecosystem functions and services.
- Contribute with ecosystem data, results and models to the system of GEOSS portals.
- Create a partnership of key stakeholders and start the construction of the GEO Ecosystem Community of Practice.
- Plan a set of training course on the use of Earth Observation data in the management of ecosystems and preservation of ecosystem services.
- Support the development of conservation and management policies at international level, with the participation of international entities such as UNEP, UNESCO, IUCN, and others.
- Invite representatives of Protected Areas with other ecosystem types and from other regions of the world to the General Assembly of the ECOPOTENTIAL project in mid 2016.

2016 Resources

EUR4M (cash) + EUR500k (in-kind)

GI-15 GEO-GNOME Initiative: GEO Global Network for Observation and Information in Mountain Environments

Overview

Mountains are globally distributed environments, which are home to a significant fraction of the world's human population, flora and fauna. These mountainous environments are rich in endemic and, sometimes, endangered species, particularly within biodiversity hot spots. Simultaneously, mountain ecosystems and environments are directly linked to downstream regions through natural pathways (e.g. rivers and ecologic corridors) as well as human infrastructures. Through these pathways, mountains play an important sustainable development role by providing essential water resources and services to not only the communities living in proximity, but also to the surrounding downstream societies and ultimately the global community.

The role of mountain regions and the associated challenges have also been given special attention in the UN Conference on Sustainable Development Rio+20 outcome document "The Future we Want" (see mountains chapter, paragraphs 210-212) which builds on previous declarations, including the mention of mountains in Chapter 13 Agenda 21 in 1992 and other important policy documents.

All mountain areas and mountain ecosystems are sensitive to the effects of climate, global and environmental change. The threat of losing crucial goods and services and associated benefits for the well being of communities depending on mountain resources is increasing (mountain societies in particular). And although mountain regions in diverse areas around the globe share many common aspects, they are often trans-boundary in nature and have

individual peculiarities, which need to be both specifically and commonly addressed. It is also important that data and information exchange between the various mountain regions be facilitated, and access to this existing body of knowledge be made more readily available to policy makers and decision makers in order to respond to the challenges faced by mountain communities.

For all these reasons, it is essential to establish a Global Network for Observations and Information in Mountain Environments (GNOME), utilizing the partnership framework of the international Group on Earth Observations (GEO). GEO-GNOME will capitalize on previous achieved results and outcomes (such as GLORIA and other global and regional initiatives), with the goal to provide free and open-access to data and products, scientific results and future climate and environmental projections; foster exchange of data and information across different mountain areas and between the scientific community and stakeholders and better connect them; build capacity in mountain research, especially in remote areas; and create a distribution system for the dissemination of this knowledge, in particular to the local communities and decision makers to enable for change.

Particular importance will be given to the definition of national or trans-boundary *Supersites* and regional *Natural Laboratories*, such as the area of Karakoram and specific regions in South America, Africa and elsewhere, including internationally relevant protected areas. These natural laboratories can serve as pilot areas for monitoring and measuring ongoing changes, develop future scenarios with special emphasis on ecosystem services, and implement adaptation strategies through discussion with local populations and governments, taking into account also the needs of downstream populations.

With this as motivation, GEO-GNOME plans to:

- Create a comprehensive partnership of key stakeholders and network of existing measurement and observation systems in the mountain areas, collecting the data and information; and making them available through the GEOSS portals.
- Stimulate new measurements and observational campaigns in mountain areas, with special emphasis on sensitive areas and UNESCO designated Biosphere Reserves, Natural Heritage Sites and internationally relevant protected areas, stimulating the design of new/better management of existing protected areas and the establishment of new parks.
- Provide the Earth observations necessary to support implementation and monitoring of international conventions and agreements, such as the Convention on Biodiversity (CBD), the United Nations Framework the Convention on Climate Change (UNFCCC) as well as regional mountain arrangements and agreements such as the Alpine and Carpathian Conventions.
- Make best use of Earth observations and remote sensing data, which can display critical aspects of mountain areas with complex topography and high elevations.
- Develop capacity-building strategies and concrete activities in mountain monitoring and sustainable development, through the provision of on-site courses and training exercises with a particular focus on developing countries with fragile mountainous ecosystem.
- Identify potential *Supersites* and *Natural Laboratories*, with the related Points of Contact and/or Regional Champions, and start operational activities in the selected areas.
- Create highly visible and valuable outputs (e.g. reports with summaries specifically dedicated to groups interested in mountain environments) to stimulate the interaction between researchers, stakeholders and in particular policy makers to identify the key environmental and associated issues in each mountain area and trigger relevant needed action on the various levels (global, regional etc).

The GEO SBAs supported include Biodiversity, Climate, Disasters, Ecosystems, Water, and Weather.

2016 Activities

1. Telecon to be held in winter, 2016.
2. One general workshop, to be held in spring/summer 2016
3. Census of the existing mountain observatories and initiatives, in collaboration with MRI
4. Collaboration with the Belmont CRA "Mountains as Sentinels of Change", especially in the in-kind activity on mountain observatories
5. Collaboration with the H2020 project ECOPOTENTIAL (for what concerns mountain ecosystems) and the newly-funded ERA-NET on climate services, to support the need for "mountain services"
6. Identification of the priority scientific issues (e.g., elevation dependent warming; mountain hydrological cycle; effect of extreme events on the mountain environment) and related strategies of implementation
7. Organization of two workshops with stakeholders, in key mountain areas of the world, to define the societal demands and challenges

2016 Resources

EUR1M (cash and in-kind)

Participation (updated spring 2015)

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GI-16 GEO-DARMA (Data Access for Risk Management)

1. Overview

GEO-DARMA aims at addressing priorities of the Sendai Framework for Disaster Risk Reduction 2015-2030 using Earth observations (EO). GEO-DARMA will facilitate the sustained provision of accurate EO-based risk information products and services to national and local decision-makers in political and socio-economic sectors, to implement disaster risk reduction and resilience measures, during all disaster risk management phases, whenever those products and services require satellite EO combined with other sources of data (in-situ ground observations, socio-economic, model outputs). The ultimate goal is to establish an inclusive, comprehensive process to address local DRR requirements by using EO technologies efficiently. Long-term outcomes of GEO-DARMA are to foster the use of EO data and EO-based risk information by end users and to increase awareness within donor agencies of the promise of EO solutions. EO-related capacity building is a key

challenge in many developing countries. GEO-DARMA includes a capacity building component both at the outset, from the project initiators towards early pilot countries, and throughout the project, as knowledge gained in the early phases is transferred between pilot countries and the GEO-DARMA effort is extended from early adopters to other countries in region.

Until recently, stakeholders involved in disaster risk management (DRM), including space agencies, have focused their efforts mainly on the response phase, immediately after the crisis. Independent studies from organisations including the World Bank and the European Commission have indicated that for every \$1 invested in disaster prevention, \$4 to \$7 are saved in disaster response.

Progress in every aspect of Disaster Risk Reduction (DRR) requires strong international collaboration given limited capacities and resources. GEO-DARMA aims at supporting the practical implementation of some critical elements of the Sendai Framework for Disaster Risk Reduction 2015-2030.

The broad goal is to define and implement end-to-end solutions that respond to the real needs of the user community. Space EO technology presents new opportunities in this area of work; the challenge is matching such capabilities to those end users most urgently in need. GEO-DARMA will facilitate the sustained provision of accurate EO-based risk information products and services to national and local decision-makers in political and socio-economic sectors, to implement disaster risk reduction and resilience measures, during all disaster risk management phases, whenever those products and services require satellite EO combined with other sources of data (in-situ ground observations, socio-economic, model outputs). The ultimate goal is to establish an inclusive, comprehensive process to address local DRR requirements by using EO technologies efficiently. Long-term outcomes of GEO-DARMA are to foster the use of EO data and EO-based risk information by end-users (e.g. Civil protection agencies, and other agencies and ministries at the national level) and to increase awareness within Donor agencies of the promise of space solutions.

The development and subsequent improvement of prototype solutions for a smaller set of initial target countries will also benefit to the neighbouring countries with marginal additional efforts through capacity building activities. EO-related capacity building is a key challenge in many developing countries. GEO-DARMA includes a capacity building component both at the outset, from the project initiators towards early pilot countries, and throughout the project, as knowledge gained in the early phases is transferred between pilot countries and the GEO-DARMA effort is extended from early adopters to other countries in region.

GEO-DARMA aims to increase the availability and accuracy of risk related information to allow decision makers to simulate the impact of risk reduction measures and make informed decisions about risk reduction investment. In the long term, national and local users will benefit from a more accurate risk-information in complement to their other tools, helping to take appropriate DRR and resilience measures.

Previous development and results

The initiative will leverage on-going projects and initiatives as much as possible through improved coordination. For instance, relevant outcomes and experience from the CEOS Flood, Volcano and Seismic Hazard Pilots and the Recovery Observatory will be included and improved on; GEO-DARMA may become a mechanism to ensure successful elements of early pilots find a path towards sustainability. In each region, the GEO-DARMA team will examine past experience and identify elements that can be built on.

Partners

Point of contact: Ivan. Petiteville, CEOS ivan.petiteville@esa.int

The accomplishment of the task will require the active support of major stakeholders in the field of DRM at global, regional and national level in order to implement a series of pilot projects.

The partnership will be constructed progressively according to the implementation needs and phases.

The Partners sought for GEO-DARMA will be typically from the following groups:

- International and regional stakeholders knowledgeable about regional issues related to disaster risk management such as relevant UN agencies, Global Facility for Disaster Reduction and Recovery (GFDRR), Development banks, etc ...
- National institutions and agencies
- Representatives from the end user communities
- EO and non-EO data providers:
 - o Satellite data providers such as CEOS Agencies (incl. major space agencies in the world) and commercial satellite operators when possible.
 - o Other EO data and information providers
- Providers of risk and other relevant information derived from EO data
 - o Practitioners – Value added information providers including private sector
 - o Scientists

Activities description

The partners will identify and assess the critical needs of the participating disaster management communities and establish priorities. GEO-DARMA will begin by selecting a few user's defined priority themes, building on strong elements from existing initiatives and choosing those elements most likely to be scalable at a regional and global level. Once the usefulness of the implemented prototypes has been demonstrated in a few countries, the extension to neighbouring areas could be envisaged whenever applicable.

Resources

Each stakeholder engaged in the GEO-DARMA initiative will be requested to actively contribute to the various phases on a voluntary basis with contributions in kind.

The number and nature of projects to be started in the prototyping and operational phases will depend on the recommendations made by the Regional Institutions, on their assessment by the GEO-DARMA contributors and on the resources that can be allocated by the potential implementers.

GI-17a Global Urban Observation and Information

Overview:

The Global Urban Observation and Information Task has set the following goals for the period of 2012-2015: (1) Improving the coordination of urban observations, monitoring, forecasting, and assessment initiatives worldwide; (2) Supporting the development of a global urban observation and analysis system; (3) Producing up-to-date information on the status and development of the urban system - from local to global scale; (4) Filling existing gaps in the integration of global urban observation with data that characterize urban ecosystems, environment, air quality and carbon emission, indicators of population density, environmental quality, quality of life, and the patterns of human environmental and infectious diseases; and (5) Developing innovative techniques in support of effective and sustainable urban development.

For the period of 2016-2025, we support the GEO's proposal that a single GEO Initiative on urban issues will be created in the new Work Programme. All activities are continuous

in nature or extensions of the GEO SB-04 activities, which make it easy for the transition in 2016.

Point of contact: Qihao Weng, Indiana State University - USA qweng@indstate.edu

2016 Activities:

- Global Urban Supersites Initiative (Expanded to **Megacities Observation and Monitoring – MOM program**: Currently supported by ESA DUE Innovators III (1/1/2015 - 12/31/2016) and Hong Kong Research Council (1/1/2016 - 12/31/2017), with partners from DLR, Chinese University of Hong Kong, Indiana State University, and National Observatory of Athens, Greece. A new partner starting in 2016 is Chinese Academy of Sciences, supported by National NSF of China (Grant No. 41201357). These projects focus on impervious surface data generation and providing the data sets for municipalities for megacities in the world.
- Continued generation of **Global Human Settlement Layers** at various international and national levels and seek synergies among them. Dr. Weng has recently discussed potential collaboration with the National Administration of Surveying, Mapping and Geo-information of China, which has developed a global land cover dataset at 30 m resolution for 2000 and 2010. A special session will be held at 2016 ISPRS Congress to discuss about it.
- Implementing **Global Urban Remote Sensing Laboratory** through joint projects: This activity has one funded project with €999,870, titled “Thematic Urban Observation Hub (TUrbO-Hub), supported by ESA Thematic Exploitation Platforms (TEP) program, 1/1/2015 - 12/31/2016, with Thomas Esch, DLR, as the PI with several co-Leads of SB-04 from Indiana State, National Observatory of Athens, University of Pavia, Italy, and KTH Royal Institute of Technology, Sweden. A new project has recently been awarded €200,000 through ESA DUE INNOVATOR III on Global Urban Services using Sentinel-1/-2 data (3/1/2015-2/28/2017) to University of Pavia and KTH Royal Institute of Technology.
- Initiate a joint project of Impervious Surface Mapping in Tropical and Subtropical Cities - **ISMiTSC** (Asia, Africa, and South America): This initiative focuses on urban mapping and providing datasets and EO technology services to **developing countries**. A preliminary research has been conducted in selected cities in South America, Africa, South and East Asia with data support from DLR and research collaboration between Chinese University of Hong Kong, Indiana State, DLR and University of Pavia. Preliminary result will be published in late 2015 via a book by CRC Press/Taylor & Francis Group.
- Establish a Global Institute of Sustainable Cities (**GISC**) - Explore EO as a enable technology for development of sustainable cities and for supporting GEO’s objective on urban resilience and coastal resilience by supplying objective data/information on the footprint of global urbanization and assisting in the development of indicators for sustainable cities to support the UN’s sustainable development goals. This initiative has recently been funded at 5 million RMB Yuan by Fujian Normal University, China, 2015-2020.
- The International Program on Global Urban Observation and Public Health (**IPUP**) - linking global urban environment monitoring with public health from space and *in situ* measurements: This initiative was initiated in Changsha, China, in June 2014, and has obtained support from Global Institute of Sustainable Cities (GISC), Fujian Normal University, China (PI, Q. Weng). An international workshop was held in Wuhan, China, June 17-18, 2015, to discuss about this initiative, and will continue the workshop every year.
- Create an annual **International Summer School** to train and educate students and

young researchers worldwide in conjunction with GEO Urban annual symposium/workshop: This initiative will be discussed further during conference of the Mapping Urban Areas from Space – MUAS 2015 at ESA – ESRIN (Frascati - Italy), November 4-5, 2015.

- Organize **Annual GEO SI-13 Symposium** (in conjunction with a conference, e.g., JURSE, EORSA, or a designated workshop from a project) to showcase results, to promote GEO/GI-13 goals, to engage users, and to foster synergies among international contributors. Each symposium has a specific theme. Sponsor an urban public health workshop that will assess the integration of our data and products into public health decision makers. The 2016 Annual Global Urban Observation Symposium will be held in Fuzhou, China, in conjunction with the 4th EORSA international conference.
- **Collaboration with ISPRS and IEEE GRSS:** There will be a special session (SpS18: Earth Observation from Global Land to Urban Systems) at ISPRS Congress, July 12-19, 2016, Prague, Czech, and another special session (focus on Sensors and Sensing Techniques for Urban Areas) at 2016 IEEE International Geoscience and Remote Sensing Symposium, Beijing, July 10-15, 2016.
- Facilitate **publications** and disseminate the results through collaboration with Elsevier and Taylor & Francis: A new Elsevier journal “*Remote Sensing Applications: Society and Environment*” (starting Oct. 2014) has a focused section on urban observation and applications (G. Xian; X.L. Ding, Associate Editors); A theme issue on Earth observation from global land to urban systems is planned to publish at *ISPRS Journal of Photogrammetry and Remote Sensing* in 2016/2017; CRC Press/Taylor & Francis Group will publish a book titled “*Remote Sensing for Sustainability*” in 2016/2017.
- Continue to seek synergies with other GEO tasks/initiatives, such as Global Land-cover and Land-cover Change, Global Ecosystem Classification, Mapping and Inventory, Extension and Improvement of the Climate Record, and Air-borne Diseases, Air Quality and Aeroallergens; Investigation of the relationship between the thermal urban environment and heat-related morbidity and mortality.

2016 Resources:

Projects:

- German Remote Sensing Data Center (DFD) and German Aerospace Center (DLR) in support of global urban footprint production.
- US Geological Survey (USGS) Earth Resource Observation and Science Center (EROS) in support of national land cover datasets generation.
- “Thematic Urban Observation Hub (TUrBO-Hub), supported by ESA Thematic Exploitation Platforms (TEP) program, 1/1/2015 - 12/31/2016, led by DLR.
- “Earth Observation for Urbanization” (EO4U)” supported by the ESA DUE-Innovators III program, 1/1/2015 – 12/31/2016, led by DLR.
- ESA DUE INNOVATOR III on Global Urban Services using Sentinel-1/-2 data (3/1/2015-2/28/2017) awarded to University of Pavia and KTH Royal Institute of Technology.
- “Improving the Estimation of Impervious Surfaces Using Optical and Polarimetric SAR Data in Humid Subtropical Urban Areas” supported by Hong Kong Research Grants Council led by Chinese University of Hong Kong, 1/1/2016-12/31/2017.
- TREASURE: Thermal Risk rEducation Actions and tools for SecURE cities, supported by a European Civil Protection project, led by National Observatory of Athens, Greece.
- “Continuous Monitoring of the Distribution of Urban Temperatures in 5 Greek

Cities' in Excellence Research Programs General Secretariat for Research and Technology (Greece)- SIEMENS awarded to National Observatory of Athens, Greece, 2014-2016.

- DRAGON 3 (KTH, UNIPV, DLR) - "Urbanization project": Use of European and Chinese EO data to monitor urban expansion in selected areas of P.R. China.
- NASA Goddard Space Flight Center/Marshall Space Flight Center Interdisciplinary Science Project, "Combining satellite data and models to assess the impacts of urbanization on the continental United States surface climate".
- ABCC (CEODE, CAS & JRC): NSF of China project of "Comparative Study on Global Environmental Change Using Remote Sensing Technology".
- NOAA's National Geophysical Data Center has a long standing program to generate and provide open access to global nighttime lights from satellite data.
- Global Talents Program of Fujian Normal University, China, in support of creation of Global Institute of Sustainable Cities.
- Funding for projects related to the NASA National Climate Assessment program.
- The European Commission, JRC project: "Global Human Settlement Analysis for Disaster Risk Reduction" (GLOB-HS).
- The European Commission, JRC project "European Urban Development and Territorial Cohesion" (E-URBAN).

In-kind (human resources)

- Global Institute of Sustainable Cities, Fujian Normal University, China;
- Data, models, and related resources associated with US NASA Earth Science research and Earth observing remote sensing platforms such as Terra and Aqua, and the 40-year availability of continuous Landsat data;
- Additional in-kind contributions from the USA (Indiana State University, NASA) and China (Tsinghua University, National Satellite Meteorological Center), Italy (University of Pavia), IEEE Geoscience and Remote Sensing Society.

GI-17b Global Human Settlement indicators for post-2015 international frameworks

Overview:

The GHS initiative builds upon the positive experience of the new Global Human Settlement Working Group (GHS WG) that was launched at the first Global Human Settlement Workshop hosted by the European Commission, Joint Research Centre, on 21-22 October 2014. A *Manifesto for a Global Human Settlement Partnership*¹ was agreed among the partners and made the first nucleus of the group still under evolution. At the date of the last census (June 2015), the group included ~40 registered research teams (accounting >120 individual researchers) working in governmental and international organization, NGO, academic, and private firms. The GHSL applications (so far) include: damage and reconstruction assessment, impact assessment, disaster early warning and alerting, losses estimates, exposure and risk mapping and post-disaster need assessment (PDNA), population spatial modeling, census planning, regional development and planning, transport planning, urban and global climate modeling, spatial epidemics analysis, ecological studies, environmental protection, agricultural fragmentation studies, and historical landscape protection.

The GHS WG was originally initialized in support the GEO task SB-04-C1: "Global Urban Observation and Information" as contribution to the task (1) *Conduct global urban analyses, including time-series for assessing mega-cities development (e.g. urban sprawl)*

¹ <http://www.earthobservations.org/ghs.php>

and a world-wide inventory of human settlements based on satellite data. In the subsequent months, the GHS group evolved far from the original setup of the GEO-SB-04 task, which was made by remote sensing specialists engaged in extracting primary information products from remotely sensed data. The new community is mostly made by policy makers and political communities involved in the post-2015 frameworks, and scientists already providing support to the international negotiation processes in the specific domains: consequently the technical focus has moved from accuracy of the *remote-sensing information extraction* and inventory to fitness-for-purpose of *various-spatial-sources information integration* in support to specific policy goals. In the new perspective remote sensing is only one of the various relevant sources used for designing the indicators², the “urban” category (belonging to urban/rural dichotomy) as goal of the remote sensing data analysis is abandoned in favor of a continuous human settlement conceptualization, and the information extracted from remote sensing and integrated in the indicators goes beyond the classical boundaries of “urban” remote sensing applications.

In the above frame, it is considered the option to create a specific GEO initiative in the draft GEO Transitional Work Programme 2016³, making visible the activities of the GHS group and facilitating the evolution toward operational services that may be set up by some of the partners (tbd). In particular, the EC will support with specific programs the pre-operational phase of the GHS baseline production and yearly update using Sentinel 10m-resolution satellite data input in the perspective of a new operational Copernicus service activated in 2018+.

The scope of the GHS initiative is to develop and assess the fitness-for-purpose of a new generation of measurements and spatial statistics products in support to post-2015 international processes on sustainable and urban development, climate change and disaster risk reduction. Sustainable Development Goals are accompanied by targets and will be further elaborated through indicators focused on measurable outcomes. These indicators are action oriented, global in nature and universally applicable. Moreover, in order to monitor the implementation of the SDGs, it will be important to improve the availability and access to data and statistics to ensure that no one is left behind in the information gaps. The GHS initiative uses a globally -consistent and universally applicable methodology, making the GHS the right platform for testing of alternative options in operationalization of the SDG indicators, particularly those related to Goal 11 on cities. Furthermore, the free and open data policy access of the GHSL information will greatly contribute to fill the information gaps at local national and international levels

In particular, the GHS initiative shall test the production and the use of new global human settlement information products derived by the integration of multi-disciplinary data, namely global remote sensing, environmental, population and socio-economic. The scope is global and multi-disciplinary, with a particular emphasis on the generation of new global fine-scale information products made available through advances in remote sensing technology and open public data access policies. In the frame of the initiative, are considered strategic global and multi-temporal thematic information (land cover) products with a spatial resolution ≤ 50 meters and open and free data access policy. The free and open data access will ensure that GHS derived indicators will be produced also in low-income countries where no census data is available.

² The indicators under development include various land use and land cover information and physical measurements derived from remote sensing data, combined with statistical counts, crowd sourcing (as OSM and GeoWiki), and social sensing

³ http://earthobservations.org/documents/excom/ec34/ExCom34_06_GEO%20Transitional%20Work%20Programme%202016.pdf

In principle, Global Human Settlement information can support all the spatial metrics and indicators related to population and settlements: consequently modelling access (to services, market, industrial infrastructure, food, water, land), exposure (to natural disaster), or impact (ecosystem, water, land degradation). Access, exposure and impact spatial measurements are embedded in several goals and targets under discussion in the post-2015 frameworks. The new GHS initiative is committed in developing a new generation of measurements and information products that provide new scientific evidence and a comprehensive understanding and that can support global policy processes with agreed, actionable and goal-driven metrics. In particular, the GHS initiative is committed to support the following processes: the UN Third Conference on Housing and Sustainable Urban Development (Habitat III, 2016)⁴, the post-2015 framework on sustainable development goals (SDGs)⁵, the UN Framework Convention on Climate Change⁶, and the Hyogo framework for disaster risk reduction⁷.

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2016 Activities:

Oct 2016 - Side event UN Habitat III Quito, including public release of the Landsat GHS baseline (epochs 1975-1990-2000-2014) integrated with other available (open and free) satellite derived products and spatial baseline data in an initial set of SDG indicators proposal database. EC will announce the commitment to sustain the GHS baseline production and updates with Sentinel data. Coordinated with a GHS workshop

Specifically, during 2016 the following products are planned in collaboration with the partners

- Public release of the GHS baseline on population and settlements. Built-up areas are extracted from Landsat satellite data collections in the epochs 1975-1990-2000-2014 integrated with various other open and free available spatial sources. Totals resident population grids at corresponding epochs are estimated from the Gridded Population of the World (GPW)⁸ and other data in collaboration with CIESIN.
- First public release of the population and settlements statistics and derived spatial indicators aggregated at national and sub-national administrative levels.

A prototype of web platform for testing of alternative options in operationalization of the derived indicators and dissemination of information - processing on demand specific spatial indicators and aggregating them on user-defined spatial units.

2016 Resources:

The GHS initiative is based on in-kind support of the participating organizations interested in the development or early testing of the indicators and integration in their modeling and analytical platforms. The participating organizations are already financed by their specific programs. The EC Joint Research Center, is chairing the GHS GEO

⁴ <http://unhabitat.org/habitat-iii/>

⁵ <http://sustainabledevelopment.un.org/post2015>

⁶ <http://newsroom.unfccc.int/> <http://www.un.org/climatechange/>

⁷ <http://www.wcdrr.org/preparatory/post2015>

⁸ <http://sedac.ciesin.columbia.edu/data/collection/gpw-v3>

initiative in the initial phase. A specific budget is foreseen in support of the GHS GEO initiative and the support of the Sentinel GHS baseline production and update in the pre-operational phase 2016-2018. After the initial phase (~ 2 years), the chairing of the GHS initiative will be rotated among the partners with a mechanism tbd.

- GI-18 GEO and SDGs. GEOs role in defining the indicators for the Sustainable Development Goals (SDGs) and providing support to countries in measuring, monitoring and achieving the SDGs.

Overview

GEO's existing strategic engagement with several key Member States and UN Agencies regarding the important role of Earth observations in measuring, monitoring and achieving the emerging Sustainable Development Goals (SDGs) provides a strong foundation to deepen GEO's involvement and contributions in this critical and timely area.

Goals: 1) To engage with Member States, the UN Statistics Division and other partners in the development of the indicators supporting the SDG Goals and Targets to be approved by the UN Statistical Commission in March 2016.

2) Develop pilot projects in one or more GEO Member countries focused on integrating Earth observations with national statistical accounts to better measure, monitor and achieve the SDGs.

Implementation: Goal 1) GEO will expand its partnership with the UN Statistics Division and the UN Initiative on Global Geospatial Information (UN GGIM), other relevant UN agencies (UN Water, UNEP, WHO, etc.), selected Member States and other partners (The World Bank, SDSN, etc.) to help develop the indicators that will support the SDG Goals and Targets.

Goal 2) GEO will expand its partnership with the UN Statistics Division and the UN Initiative on Global Geospatial Information (UN GGIM), other relevant UN agencies (UN Water, UNEP, UNOOSA, etc.), selected Member States (in particular, developing countries) and other partners (CEOS, SDSN, The World Bank, etc.) to help build processes, mechanisms and human capacity to integrate Earth observations with national statistical accounts to improve the measuring, monitoring and achievement of the SDGs. This activity could serve as an early pilot of the GEO focus on identifying Global Earth Observation User Needs. In addition, GEO will deepen its partnership with the World Health Organization (WHO), UN Water, UNEP, UNESCO, the Sustainable Development Solutions Network, CIESIN and other partners in the development and implementation of the GEMI initiative (Integrated monitoring of water and sanitation related SDG targets), with a particular focus on integrating Earth observations into existing, traditional water quality and water management measuring and monitoring mechanisms.

2016 Plans

A one-day side event is planned to take place during the GEO week in November 2015, Mexico City with the objective to form the initial team to activate the initiative in 2016.

- GI-19 AmeriGEOSS

Overview

The proposed AmeriGEOSS initiative is a framework that seeks to promote collaboration and coordination among the GEO members in the American continent, "to realize a future wherein decisions and actions, for the benefit of the region, are informed by coordinated, comprehensive and sustained Earth observations and information". The proposed

initiative will focus its efforts in the four Societal Benefit Areas (SBA's) selected and prioritized by the Americas Caucus country-members, which are:

1. *Agriculture, associated with climate variability, climate change, and food security.*
2. *Disaster risk reduction, particularly for data exchange associated with early warnings and for the generation of regional products of early warnings.*
3. *Water, associated with the management approach of water resources and data management.*
4. *Biodiversity and Ecosystem Monitoring including biodiversity observation in coastal, marine, and continental habitats, in the context of capacity building for better monitoring, management, and maintenance of ecosystems and biodiversity they support; also to predict future changes.*

Some GEO flagships are already addressing the AmeriGEOSS priority areas. The first approach will be to engage with the GEO flagships and their end user communities that are from member countries in the region. From there, the initiative seeks to strengthen the engagement of other Americas countries, and to work with the flagships to tailor their work to address regional needs. Regional needs will be brought to the initiative through the management coordination groups of AmeriGEOSS. In particular, unaddressed needs from developing countries will be prioritized. In each case, the decision-making processes being addressed in the flagships will be tailored to meet the needs of the decision-makers in each of the Americas nations.

AmeriGEOSS has developed a proposed management arrangement based on a review of the approaches being used by UNGGIM-Americas, GEO BON, and AfriGEOSS. This proposed arrangement will be piloted in 2016, and adjusted as needed to achieve the best regional coordination with the least resources. The management arrangements that create organized thematic and coordination-working groups provide the sustained coordination framework to ensure the success of this initiative over the next decade.

Partners in AmeriGEOSS

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In addition to GEO Member countries, there are many participating organizations from the Americas countries. There are non-Americas countries contributing to the development in the Americas that can serve as partners also.

Management arrangements

Also, in many Americas countries, there are embassy representatives that are active in bilateral and regional relationships and activities. AmeriGEOSS members will continue to engage the embassies as a way to increase communications and identify representatives in countries already a member, as well as a way to reach out to additional countries to join GEO. They also may be able to provide additional services, e.g. translation services.

The proposed arrangement includes several working groups, each with a Chair and Vice Chair and at least one participant from each country, and preferably two, to ensure that one member can always be present at working group teleconferences and meetings. Regional participating organizations are welcome to participate as well. The following AmeriGEOSS working groups are proposed:

1. Regional coordination working group responsible for the overall regional coordination between Americas Caucus nations, coordination with resource contributors, political coordination including engagement with other potential member nations, and coordination and reporting to Americas Caucus principles. This single coordination group will bring together the individual thematic working group

contributions to form a comprehensive “view” and work to ensure/facilitate any necessary cross-communication and coordination among the individual working groups.

The regional coordinating group will report to the Americas Caucus in two ways. First, each national member(s) will report through their nation's GEO leadership and reporting structure to keep them apprised of AmeriGEOSS activities. Second, the regional coordinating group's chair, vice-chair, and/or their designated representatives will provide an overall summary of AmeriGEOSS activities to the Americas Caucus. At a minimum, this report will be provided to the Americas Caucus prior to Caucus meetings held in conjunction with GEO Plenaries and Ministerial meetings. Other reports can be made as needed, e.g. in advance of Executive Committee meetings.

2. Agriculture and food security working group responsible for the coordination with, and participation in, GEOGLAM from a regional perspective, engagement and contribution from Americas nations that add new capabilities to the overall GEOGLAM system and objectives, and linking in existing nations' agricultural initiatives that are of benefit to or could benefit from GEO Earth observation assets.
3. Disasters working group responsible for the coordination with, and participation in, other GEO disasters activities, e.g. hazards supersites and flood monitoring systems, from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO disasters activities and objectives, and linking in existing nations' disasters initiatives that are of benefit to or could benefit from GEO Earth observation assets.
4. Water working group – the functions of this group include coordination with, and participation in, other GEO water activities, e.g. global water cycle activities, from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO water activities and objectives, and linking in existing nations' water initiatives that are of benefit to or could benefit from GEO Earth observation assets.
5. Ecosystems and biodiversity working group responsible for the coordination with, and participation in, other GEO ecosystems and biodiversity activities, e.g. GEO BON, from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO ecosystems activities and objectives, and linking in existing nations' ecosystems and biodiversity initiatives that are of benefit to or could benefit from GEO Earth observation assets.
6. Foundational activities working group responsible for the coordination with and participation in other GEO foundational activities, e.g. infrastructure and capacity building activities, from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO foundational activities and objectives, and linking in existing nations' foundational initiatives that are of benefit to or could benefit from GEO Earth observation assets.

With this initiative, the Americas Caucus assumes greater responsibility for short and long term planning for the development of activities through regional cooperation that reflects the local, national, and regional interest. This responsibility will be entrenched in the technical capabilities of its country members and in the resources of other global

initiatives that may be available for the benefit of the region.

2016 Activities

In 2016, the regional coordination framework will be piloted and improved. Each working group will manage their own planning, milestones, and deliverables. Coordination activities include monthly working group telecons, participation in relevant GEO meetings, and at least annual meetings of the AmeriGEOSS community. Deliverables includes telecom notes to be shared with the other working groups and periodic status briefings.

In 2016, deliverables specific to each thematic area will be defined and coordinated with the related global GEO activities.

In 2016, the national and regional needs will be assessed in each of thematic working group areas. The GEO global initiatives needs, e.g. GEO BON's needs for greater regional engagement, will also be assessed. These combined sets of needs will form the basis of the longer-term AmeriGEOSS plans.

2016 Resources

Contributions from the national governments of the Americas Caucus nations have included human resources from Caucus co-chairs Colombia and Mexico, as well as other Americas member countries. These contributions will continue through 2016 to establish the working groups and to assess national, regional, and GEO global initiatives' needs.

In 2016, additional resources will be targeted to support a sustained coordination framework.

Additional Activities for 2016

If additional resources are made available, the AmeriGEOSS working group members will participate more deeply in GEO global initiative meetings and activities. GEO foundational activities will be more fully engaged to address infrastructure and data access gaps, e.g. in nations' spatial data infrastructure.

GI-20 GEO Global Water Sustainability (GEOGLOWS) new-US

1. **Objectives for the Activity:** The GEOGLOWS initiative provides a framework for effectively mobilizing Earth Observation assets to contribute to mitigating water challenges on various scales and across different climates and landscapes around the world. GEOGLOWS seeks to use Earth observations and associated tools and assets to decrease regional tensions and the risk of instability and state failure by ensuring that water is available to all even as the proportion of people living in high water stress is increasing due to climate change, population growth and economic growth; and inequities exist in nations' access to data for decision making. The elements of GEOGLOWS are shown in Figure 1.
2. **Person and Affiliation of the Activity Leads:**
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3. Outputs (Deliverables) Expected and Anticipated Date of Completion:

This activity will deliver continuous developments over the next 10 years including:

- 2016: plan integrating US agency assets to support information aspects of USGEO and GEO through GEOGLOWS.
- 2016: development of a set of principles for agencies to ensure the development of a coherent interoperable data system for the US government and other countries.
- 2016-2020: Increase the contribution of hydrometeorological products by GEO members in the Americas through the GNC-A system.
- 2016-2020: Encourage GEO members to provide contributions to the overall GEOGLOWS framework.
- 2016-2020: Provide better hydrological predictions for the participating GEO member nations.
- 2017-2018: Development of a US federal information source and portal on water for private sector, states and NGOs.
- 2017-2020: Comprehensive integrated data products for the US and other countries that have the interest in sharing this technology
- 2018-2020: GEO GLOWS overall integrated portal leveraging GEO member best practices.

Figure 1.

GEO Global Water Sustainability (GEOGloWS)		
1. Global Water Security Enhancement Water Scarcity and Access Climate Change Cold Regions Sustainable Development Goals	2. Minimizing Basin and Regional Risk Total Water Prediction Floods Droughts Transboundary Issues (IWRM) Water-Energy-Food-Environment-Health Nexus Climate Change Adaptation	3. Essential Water Variable (EWV) Understanding Water Quality Water Use Water Cycle Variables (Precipitation, Soil Moisture, Groundwater, Evapotranspiration, Stream Flow, Surface Water Storage (Includes Snow Pack))
4. Earth Observations, Integrated Data Products and Applications, and Tool Development 5. Data Sharing, Dissemination of Data, Information, Products, and Knowledge 6. User Engagement, Capacity Building and AmeriGEOSS		

4. Description of Activities planned in 2016 (Highlight user Involvement, capacity development and geographical coverage):

Global Water Sustainability will be enhanced by launching a number of activities to address water scarcity, water access, climate change, cold regions and Sustainable Development Goals. Water security and water access will be assessed by analyzing water scarcity over specific regions and periods by measuring water cycle variables across multiple spatial and temporal scales. The impacts of climate change on water resources will be documented and monitored. Data analysis will be needed to document shifts in the timing and magnitude of peak flows and the frequency of extremes nationally and globally. The security of the cold regions, the well-being of their inhabitants and the effective development of its vast resources need to be based on accurate historical and current data from these areas. The UN is approving a set of Sustainable Development Goals and targets which involve water in many cases. Agencies with Earth Observations need to take advantage of a new openness regarding the use of Earth Observations in monitoring indicators related to the implementation of water goals.

Minimizing the effects of **Basin and Regional Risks** arising from water threats is important. Unexpected events are most damaging and are exacerbated by a lack of infrastructure and plans for dealing with the emergency. Within this context data and information are needed to address droughts with their agricultural, hydrological and socio-economic impacts, floods with their need for rapid evacuation, cleanup operations and improved protection infrastructure, improved data sharing across boundaries to minimize risk by improved integrated water resources management at the transboundary basin scale. Land and water management are very closely linked, consequently the interactions between them for industrial development and responses to extreme events must be understood and dealt with, Improved observations and information systems are needed to ensure water is available to sustain Water for Energy, Food, Environment, and Health security nexus. All of these areas require observations and predictions. Climate change adaptation requires response to the changing water cycle through both infrastructure and policy options. The need for measurements and predictions will be documented and demonstration projects showing the value of information will be undertaken.

Within the GEOGLOWS Initiative, the US GEO National Oceanic and Atmospheric Administration's (NOAA) Total Water Prediction (TWP) investigation will establish a framework to deliver next-generation water prediction science and services to a broad range of domestic and international stakeholders. This framework leverages significant advances in water resources science and cyber infrastructure technology to address water challenges that heretofore have been too big or too complex to address on the national scale. TWP is the U.S. contribution to the ***Minimizing Basin and Regional Risk*** element of GEOGLOWS. TWP will integrate centrally collected datasets and system interoperability; Earth System modeling approaches; and high performance computing to deliver comprehensive "street-level" water predictions. This system will provide forecasts to over 100 million citizens who today are not provided with objectively derived hydrologic information, at high-resolution scales that are relevant to day-to-day decision making process of critical sectors and to citizens.

In order to be fully successful this "spatial hydrology at hyper-resolutions" requires massive consumption of Earth observations, both to constrain the intensive modeling through data assimilation and to validate the model to understand uncertainties and build confidence in prediction skill at the models' resolutions. For this to be expanded to global networks, existing observation frameworks need to be 'hardened' and in some cases rescued, while innovative new observation frameworks are needed to fill critical gaps.

This framework leverages significant advances in water resources science and cyber infrastructure technology to address water challenges that heretofore have been too big or too complex to address on the national scale. TWP will integrate, centrally collected datasets and system interoperability; Earth System modeling approaches; and high performance computing to deliver comprehensive “street-level” water predictions for the US.

Specific activities of TWP in 2016 and conducted by the US National Water Center include:

- Operationally implement the initial version of the US National Water Model (WRF-hydro) to produce a suite of water resources budget variables. Limited visualization and data services will facilitate community evaluation of this system.
- Launch the initial version of the Water Resources Data Service (WRDS) that will centrally acquire, archive, and service critical datasets leveraging community adopted, open and machine-readable formats.
- WRF-hydro model will be upgraded to quantify and simulate anthropogenic impacts on the water cycle.
- The *Strategic Research Engagement* will continue with the academic community and in collaboration with CUAHSI, and the National Science Foundation (NSF). The Summer Institute will be hosted at the US NWC in Tuscaloosa, AL, USA.

On a regional scale, new hydro-meteorological products are being developed and shared through various data dissemination systems among among nations in America. El Salvador and Costa Rica contribute with WRF model output and the .5 KM NCEP model outputs for Central America, the Caribbean, and South America. This contribution will continue in 2016. Brazil, will implement 23 new GNC-A receiver stations in each of their regional hydro-meteorological services throughout the country and plans to broadcast radar data through the system. The hydro-met service in Colombia (IDEAM) has offered to contribute with hydro-met and GEOBON products in 2016.

Essential water variables will be collected and analyzed to generate understanding and knowledge for better water management. Coordination of water cycle variables (precipitation, soil moisture, evapotranspiration, streamflow, etc.) are needed to estimate water availability for management purposes and to support water cycle research. Water Quality data will be collected, improved and analyzed to set standards for uses including public health, protection of ecosystems and biodiversity and the assessment of point and non-point pollution. Water Use data is critical to monitoring water security and will be addressed nationally and globally by EO data and surveys that enable use estimates for domestic, industrial and agricultural water use. The USGS maintains ground water and water quality monitoring networks and information systems to support the dissemination of these data. The Water Quality monitoring supports a Framework for Water Quality Monitoring which sets a standard internationally. The National Groundwater Monitoring Network (NGWMN) collates all of the monitoring data from springs and wells to generate data and products to address questions about the availability and quality of the Nation’s ground water. In addition, the USGS undertakes a comprehensive survey program as a major input to the National Water Use inventory prepared for the US on a periodic basis.

Different thrusts in data gathering, analysis and information systems will be undertaken to develop information system that can meet many of these needs. **Earth Observations, Integrated Product and Applications, and Tool Development** use integrating tools such as data assimilation and data fusion systems to bring data sets together for higher

resolution products and more complete coverage. Data handling tools are needed to accommodate the social media and citizen data and will make products more useable within users' decision support frameworks.

The **Dissemination, Data Sharing and Transfer of Data**, information, products, and knowledge is a critical aspect for services. Dissemination and data sharing will be carried out in accordance with GEO principles on data sharing. The use of GEONetCast and the range of water-related products available through this service will be increased. Data providers will work with users to determine when anomalies exceed thresholds and actions are needed. This transition from data to information and finally to knowledge will be repeated in many domains.

GEOGLOWS will place a high premium on **User Engagement and Capacity Development**. User groups will be developed for some variables and users will work with data providers to co-design products that will address specific information needs. Capacity Building through AmeriGEOSS, SERVIR applications and training courses will be used to disseminate the developments in the US to the world community – a critical step in ensuring security through water security and data democracy.

Specific Activities within AmeriGEOSS include:

The National Water Center continues to leverage and adopt technologies that have been demonstrated through CUAHSI member organizations, or initiatives supported by NSF in cyber infrastructure and hydro-informatics. This knowledge, and lessons learned, will be disseminated through capacity building activities (webinars and training workshops) organized by the USGEO working group in the Americas (CIEHLYC), and in collaboration with hydro-met organizations in the region and CUAHSI members. Existing tools and WMO frameworks are leveraged by this effort.

5. Contributors (Names, affiliations, email addresses):

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6. Funding Sources for 2016 and Indicative amounts (includes in-kind contributions):

During 2016, most of the contributions will be in-kind until there is time to budget for this activity within the US federal system. Contributions will be made from NOAA for the coordination of activities and the National Water Center Laboratory. NASA

will also contribute to the coordination and to research calls which will initiate projects that will contribute to the various aspects of this program. NOAA and the GEO Secretariat will contribute with technical support for the CIEHLYC monthly webinars. Data products through the GEONETCast-A system will be in-kind contributions from the contributing countries. Estimated contributions are expected to be \$300K/year but will increase as the program grows.

7. Future Plans (and resource requirements): TBD

GEOGLOWS will establish itself initially as a coordinating mechanism for the Americas and as other nations accept their potential to benefit they will join and expand this framework to a global framework. TWP will continue with the hyper-resolution flexible mesh implementation project to produce high-resolution hydrologic output for hydraulic analysis in a complex environment (e.g., urban); this is a 5-yr project for the US.

5. PROPOSED FOUNDATIONAL TASKS

5.1 General

GEO Foundational Tasks implement the GEO Core Functions through selected, often enabling, tasks necessary to achieve GEO Strategic Objectives and Targets.

They will be performed as a joint effort between the Secretariat and the GEO community.

From the Secretariat side, they are expected to use the totality of the GEO Trust fund resources (cash contributions as well as the time of seconded Experts), except those earmarked for specific Initiatives or Flagships (as it was the case for GFOI). They will also include the necessary contributions from GEO stakeholders in order to achieve the planned outputs.

5.2 Foundational Tasks Grouping and Working arrangements

The Foundational Tasks have been grouped in three groups in such a way to provide a clear picture on how major GEO functions are implemented:

Group GD GEOSS Development and GCI Operations

Group CD Community Development

Group SO Secretariat Operations

Foundational Task Overall Management

Having acknowledged the supporting role of the Secretariat in the definition and approval of the Work Programme (and of the FTs), it is proposed that the Secretariat will ensure overall coordination of the FT execution and will report to the Executive Committee and Plenary on their progress.

The Secretariat will also assume specific responsibilities and perform specific activities for each of the FTs in accordance with the relevant descriptions.

It is also recommended that, also in view of the functions and duties of the Program Board (among which is the ability to establish Task Forces or Advisory Groups on specific topics as needed), no other Bodies are established that report directly to the Executive Committee/Plenary on Work Programme-related topics.

Foundational Task Working Arrangements

Two working arrangements are proposed:

1. The Task Team, with a lead for each Task occurring in most cases; and
2. The Working Group, proposed for three tasks (see below), with the specific purpose to retain expertise and commitment of existing bodies and individuals when transitioning to the new implementation mechanisms.

As mentioned above the role of the Secretariat is different from Task to Task and can be summarized by a combination of the following roles:

Coordination	The Secretariat is the Task Leader.	C
Activities Execution	The Secretariat is actually executing a subset of Task activities. H: Secretariat performs the majority of the activities. M: Secretariat performs a fair share of the activities. L: Secretariat performs a few of the activities.	E-H E-M E-L
Support	The Secretariat provides general support to the Task Team.	S

5.3 Foundational Task List

The list of proposed FTs and relevant descriptions have been developed in consultation with Work Plan Symposium participants and Task contributors. The updated list of proposed FTs is reported below (with some annotation, when necessary, to better characterize the content), and with the indication of the proposed working arrangement and of the role of the Secretariat.

GD	GEOSS Development and GCI Operations	Implementation arrangement	Secretariat role
GD-01	Advancing GEOSS Data Sharing Principles	DSWG	S, E-L
GD-02	GCI Operations (<i>including access to Knowledge</i>)	Team	C, E-M
GD-03	Global Observing and Information Systems (<i>includes systems like WIGOS, GCOS; ... and reference datasets</i>)	Team	C, E-M
GD-04	GEONETCast Development and Operations	Team	S, E-L
GD-05	GEOSS Satellite Earth Observation Resources (<i>includes advocacy for continuity</i>)	Team	S
GD-06	GEOSS non-space based Earth Observation Resources (<i>includes inclusion of citizens' observatories</i>) (<i>includes advocacy for continuity</i>)	Team	S, E-L
GD-07	GCI Development (<i>includes development of Data Management guidelines</i>)	WG	S
GD-08	SBA process: Systematic determination of user	Team	C, E-M

	needs / observational gaps		
GD-09	Knowledge Base development	Team	C, E-L
GD-10	Radio-frequency protection	Team	C
GD-11	Communications Networks	Team	C, E-L
CD	Community Development		
CD-01	Capacity Building Coordination	WG	S, E-L
CD-02	Reinforcing engagement at national and regional level (<i>includes EO uptake for decision making</i>)	Team	C, E-H
CD-03	Assess the benefits from EOs and of their socio-economic value	Team	S, E-L
SO	Secretariat Operations		
SO-01	Management and Support	Secretariat	C, E-H
SO-03	Communication and Engagement	Team	C, E-H
SO-02	Monitoring and Evaluation	Secretariat	C, E-H
SO-04	Resource Mobilization	Team	C, E-H

5.4 Foundational Tasks Description

The description of each FT includes:

- General description
- Implementation approach and responsibilities
 - Contributors
 - Secretariat
- Planned activities and outputs in 2016

ANNEX 1 Provides a summary of the expected outputs of all the Foundational Tasks

GD GEOSS development and GCI operations

In addition to the management arrangements identified for each of the GD tasks below, it is proposed that, during the 2016 transitional period, the Working Group responsible for the implementation of the task GD-07 (GCI development) will also ensure coordination of the task GD-02 (GCI Operations).

GD 1 Advancing GEOSS Data Sharing principles

1. General Description

Continue promoting free, full, open and timely access to Earth Observation datasets, products and services. Maintain dialogues with Governments and support the up-take and implementation of the GEOSS Data Sharing principles by GEO Members and Participating Organizations. Raise awareness of the technical, organizational, and resource implications of implementing the GEOSS Data Sharing Principles.

2. Implementation approach, respectively responsibilities

The activities will be performed by a dedicated Working Group, supported by the GEO Secretariat.

Task leads (*May change according to ToR of the Working Group.*)

Robert Chen (ICSU)
Catherine Doldirina (EC/JRC)
David Halpern (COSPAR)
Michel Schouppe (EC)
Lerato Senoko (RSA)
Paul Uhlir (ICSU)
Greg Withee (US)

Contributors (*To be updated with more contributors, particularly from developing countries*)

See here: <http://www.earthobservations.org/dswg.php>.

Responsibilities

a. Task Members

- i. Update implementation guidelines on Data Sharing Principles that underpin the quality of available data, information and tools and support their integrated use.
- ii. Keep track of international Open Data trends and continue to evolve the next generation of Data Sharing Principles as necessary.
- iii. Analyze and advocate the benefits of Data Sharing. Raise global awareness, including in developing countries, about the free and open datasets, products and services provided through GEOSS including support of measuring and monitoring of the SDGs.
- iv. Promote national coordinating mechanisms for implementing the Data Sharing Principles Post-2015 and monitor data sharing progress by the GEO member governments.
- v. Analyze Data Commons in GEO SBAs that enable data sharing across various SBAs. Address legal interoperability of datasets across various SBAs, through recommended mechanisms to share data as part of GEOSS DataCORE or compatible open licenses.
- vi. Monitor, interpret, and adjust the use metrics to gauge the utilization of shared resources and their value to both data

providers and data users, within and across SBAs.

b. GEO Secretariat

- i. Support the coordination and the administration of this task
- ii. Data sharing point of contact to the external world and helpdesk function, in coordination with the SIF, for Data Providers and Users
- iii. Promotion and extension of GEOSS DataCORE
- iv. Manage and operate a Use Metrics component of the GCI.

3. Planned activities and outputs for 2016

- i. Hold at least one meeting of DSWG.
- ii. Update Implementation Guidelines on Data Sharing Principles for Plenary approval in 2016.
- iii. Produce a report on international Open Data trends.
- iv. Draft a summary of mechanisms for monitoring the status of GEO Members in establishing and implementing Open Data Policies.

GD 2 GCI Operations (including access to Knowledge)

1. General description

Operate and maintain a user-friendly GEOSS Common Infrastructure (GCI) to search and access GEOSS resources (e.g. datasets and services). Ensure routine operations, whilst maintaining the GCI as the architectural framework essential to implementing the GEOSS Data Sharing Principles. Support the integration of new GCI capabilities as developed and tested in GD-08. Continuously engage with data and service providers and user communities to connect new resources.

2. Implementation approach, respective responsibilities

The task activities will be performed by a task Team coordinated by the GEO Secretariat. The role of current operators will be kept for 2016, progressively adding user support functions by the Secretariat.

a. GCI Components operators (ESA, CNR, USGS, IEEE)

- i. Perform GCI Components operations including maintenance, administration, monitoring and integration – covering both software and hardware
- ii. Maintain partnership with Data and Service Providers and make these Providers discoverable and accessible through the GCI in mutually agreed methods
- iii. Collect requirements and feedback from User Communities and Stakeholders for GCI improvement

b. GEO Secretariat

- i. Overarching coordination and GCI configuration management including to maintain the GCI documentations and the list of the GCI Component and related representative persons

- ii. Provide a service desk operation of data and technical assistance and support services to Data and Service Providers, User Communities and Stakeholders.
 - iii. Integrate GCI performance measurement tracking and reporting capabilities across GCI Services
3. Planned activities and outputs for 2016
 - i. Continue GCI operations
 - ii. Establish a user desk
 - iii. Start the configuration control of GCI
 - iv. Connect at least 15 new databases to the GCI
 - v. Test and release new GEOSS resource registration process, including the synchronization of the CSR and the DAB.
 - vi. Produce a report on “GCI Operations options” for GEO-XIII Plenary decision in 2016 and implementation starting from 2017

GD 3 Global Observing and Information Systems (*includes systems like WIGOS, GCOS; And reference datasets*)

1. General description□

The GEOSS as a ‘system of systems’ will proactively link together existing and planned observing and information systems around the world, foster interoperability, and support the development of new systems where gaps currently exist. In this regards, the task will provide various coordination opportunities in order to advocate new systems, to strengthen existing and planned systems and also to encourage integrating and linking different systems.

2. Implementation approach, respective responsibilities□

The task will be coordinated by the Secretariat.

a. Contributors (WMO, GCOS, GEO members)

- i. Improve integration different Observation systems by defining metadata of Observation systems contributing to GEOSS (e.g., WIGOS, GCOS, GOOS, GGOS)
- ii. Sustain and improve existing operational Information systems contributing to GEOSS (e.g., WMO Information System (WIS), OneGeology, IRIS)
- iii. Make efforts to implement the GEOSS Data Sharing Principles.
- iv. Make efforts to ensure interoperability with GEOSS and GCI.
- v. Develop data model for each system, implementing the GEOSS Data Management Principles.
- vi. Maintain and improve the operational network diversities such as satellite based, ground based and internet.

- b. GEO Secretariat
 - i. Overarching coordination in particular to support cross linkages in different communities and to support GEOSS Data Sharing Principles, Data Management Principles and interoperability with GEOSS and GCI.
 - ii. Inventory Global Earth observation systems
 - iii. Identify potential gaps, duplications and synergies;

3. Planned activities and outputs for 2016

- 1. Resume coordination and consultations with Global Observing and Information Systems.
- 2. Produce a document describing GEO plans to support existing Systems and facilitate development of new ones, including their connection with GCI
- 3. Produce a report on “Inventory of Global Earth observation and information systems” with identifying potential gaps, duplications and synergies

GD 4 GEONETCast Development and Operations

1. General description

Further develop GEONETCast – a distribution system for GEOSS information using communication satellites and low cost, off-the-shelf reception stations – and improve the service provided to Users.

2. Implementation approach and respective responsibilities

The task activities are implemented by a task Team, supported by the Secretariat.

a. Contributors (CMA, EUMETSAT, NOAA)

- i. Evolve GEONETCast into a fully operational global system disseminating data and products to the GEO community (including flagships, initiatives and community activities)
- ii. Pursue the integration of the GEONETCast collections catalogue with the GEOSS Common Infrastructure
- iii. Foster relationships with data providers and users to enhance data content in line with the evolving needs of users and decision-makers
- iv. Expand interaction with networks of users in developing countries to improve access to data in areas with limited data accessibility. In particular, facilitate improved access to disaster information in developing countries through collaboration with key disaster management mechanisms, including the International Charter on Space and Major Disasters
- v. Enhance the integration of other existing or emerging satellite data distribution systems
- vi. Expand the GEONETCast broadcast footprint over the Pacific

region.

- vii. Build capacity for using GEONETCast information, particularly in developing countries
- viii. Develop GEONETCast Training Channels to (i) train end-users; and (ii) transmit training materials to local trainers.

b. GEO Secretariat

- i. Overarching coordination and GEONETCast configuration management including to maintain the GEONETCast documentations and the list of the GEONETCast Components and related representative persons
- ii. Provide a service desk operation for User Communities and Stakeholders.
- iii. Integrate GEONETCast performance measurement tracking and reporting capabilities

3. Planned outputs in 2016

Continue GEONETCast operations

Test options for truly global coverage

Develop and test a GEONETCast planning tool and a friendly User Interface (including a service desk)

Develop a GEONETCast User Guide

GD 5 GEOSS satellite Earth Observation Resources (*includes advocacy for continuity*)

1. General description

Satellite Earth observations are critical to understanding all components of the Earth System (atmosphere, ocean, terrestrial, ice, solid earth) across temporal and spatial scales. Satellite Earth observations have unique value, and play a foundational role in enabling all other Earth observations to be understood in context, at global and regional scales, over long time periods.

This cross-cutting task aims to ensure the long-term availability of the sustained, coordinated, comprehensive satellite Earth observation data that is a critical component of the GEOSS and a key enabler of all current and future GEO Community Activities, Initiatives and Flagships.

This task recognizes the long lead-times for satellite development and launch, and the operating lifetimes of satellites. Satellites can typically provide data that supports different applications and domains, making the ability to assess requirements and coordinate missions and data systems across domains key to the long-term success of GEOSS. This activity is complementary to activities focused on formalizing user requirements and providing space data in support of specific activities.

2. Implementation approach, respective responsibilities

The task activities are implemented by a task Team.

- a. Contributors (The Committee On Earth Observation Satellites coordinating delivery through member Space Agencies, associates and partnerships)
 - i. Specify, develop, launch, operate and coordinate space missions to provide new observations, sustain critical time-series, and fill or minimize spatial or temporal gaps in the satellite observations required to support sustained production of fundamental variable sets as defined through the GEO requirements analysis processes.
 - ii. Promote the development and implementation of technologies and the uptake of best practice to enhance space data access in support of the evolution of the GEOSS, particularly focusing on enhanced access to space data via the GCI.
 - iii. Support broader GEO efforts to promote Earth observation by providing evidence of the unique, and complementary, value of satellite data to successful delivery of major regional and global initiatives.
 - iv. Coordinate increased interoperability among space data infrastructures and develop integrated global and regional space datasets that support validated and prioritized requirements identified through GEO processes.
- b. GEO Secretariat
 - i. The Secretariat provides general support to the Task Team

3. Planned activities and outputs for 2016

1. Review the strategy and plans for the implementation of Virtual Constellations to ensure they continue to develop to support GEO objectives.
2. Develop options on how CEOS can foster space agency planning and coordination processes that will be responsive to user needs/observation requirements identified through the SBA-based rolling requirements processes.

GD 6 GEOSS non-space based Earth Observation Resources (includes inclusion of citizens' observatories) (includes advocacy for continuity)

1. General description

Analyze the current trends and develop new scenarios for non space-based measurements, coordination, and access to data, which would allow inclusion of new types of data (such as drones, citizens' observatories) and their provenance. The regional scale would be considered as the reference to start.

Promote and coordinate non space-based observing systems (including both in situ and remote sensing airborne, land and ocean-

based systems) to provide long-term continuous observations of all components of the Earth System (atmosphere, ocean, terrestrial, ice, solid earth). Identify critical gaps in existing observational networks with a particular focus on: the needs of developing countries, the need for continuity of observations, and the potential benefits of enhanced observing systems. Individual Earth observing systems operated by national, regional and international entities are integral to GEOSS.

Identify data resources needed by GEO (including flagships, initiatives and community activities) to achieve the objectives of the GEO Strategic Plan. Coordinate increased interoperability of non space-based data including new data flows from the private sector and the public, and develop global and regional datasets supporting the GEO community.

Compile global perspectives on existing plans for new non space-based observing networks and develop common strategies and actions to ensure sustained observations. Advocate adequate resources to maintain systems that provide continuity of observations.

Promote coordination of non space-based and space-based observation networks to provide calibration and validation sources, to fill measurement gaps, and to promote technology sharing and infusion between the two communities. Promote communication between the non space-based and space measurement communities by sponsoring workshops, side events, and educational material as needed.

2. Implementation approach

The task activities are implemented by a task Team, supported by the Secretariat

a. Contributors

- i. Cooperate with non space-based operators to promote and coordinate development activities related to non space-based observation infrastructures and networks; build upon ongoing coordination efforts & activities
- ii. Explore and determine how non space-based coordination frameworks put in place for national, regional (e.g. Copernicus, ConnectinGEO, ENEON, AfriGEOSS) and global (e.g. Eye on Earth) levels benefit most effectively the GEOSS objectives
- iii. Improve coordination and facilitate access to non space-based data resources
- iv. Improve global coordination of non space-based atmospheric observations (e.g., instrumented aircrafts, drones, balloons)
- v. Improve global coordination of non space-based ocean

- observations and promote the development of new and enhanced measurements (e.g., global high-frequency-radar network to measure coastal surface currents)
- vi. Improve global coordination of non space-based land surface observations and promote the development of new and enhanced measurements
 - vii. Explore how citizen science observation initiatives can contribute to filling non space-based observational gaps
 - viii. Develop a global database of non space-based activities (i.e., regional and global projects), organized by domain (land, ocean, atmosphere) that includes information on the activities, its measurements and data access. Such a database will be essential for non space-based gap assessments and coordination with the space-based observation community. Coordinate the database development with the development of the GEO Knowledge Base.
 - ix. Coordinate increased interoperability among non space-based datasets, between space and non space-based datasets, and new non space-based data flows from private sector and the public, and develop global and regional datasets supporting the GEO community. Coordinate this activity with the global observing systems, including the Global Geodetic Observing System (GGOS).
- b. GEO Secretariat
 - i. Overarching coordination with administrative support
 - ii. Promote coordination between space and non space-based observation communities and conduct gap assessments, as needed.
3. Planned activities and outputs in 2016
- a. Develop a plan of activities for the task with defined leadership roles
 - b. Publish a report on the status of global non space-based coordination and frameworks. Include content addressing sustainability of existing measurements, investigating new non space-based measurements, facilitating the transition from research to sustained long-term operations, and coordinating the integration of space-based and non space-based observations.

1. General description

Define and maintain the GCI evolution strategy and architecture based on documented and emerging user requirements, and analysis of evolving landscape in technology and production/consumption of EO data products and services. Undertake R&D activities, in collaboration with public, private, and voluntary sectors, to develop and test new functionalities, solutions, and components needed to support the achievement of GEO Strategic Plan objectives and user needs. Develop documentation and training material needed to support transition from development to operations of identified new components and solutions.

2. Implementation approach and respective responsibilities

This task will be implemented by a GEOSS Development Working Group (GDWG), which will include major contributors. The GEO Secretariat will support the GDWG and ensure that its activities are fully supportive of the current needs of the Portal and common components.

a. Contributors (JRC, USGS, CNR, ESA, OGC, IEEE)

- i. Define and maintain of the GCI evolution Strategy and Architecture based on documented and emerging user requirements, and analysis of evolving landscape in technology and production/consumption of EO data products and service
- ii. Develop and test new functionalities, solutions, and components
- iii. Develop Data Management Guidelines and best practices
- iv. Implement subsequent Architecture Implementation Pilot Projects on yearly basis (AIP-9 in 2016), to test solutions and to promote the use of GEOSS data to develop products and services
- v. Support the advance of the GEOSS interoperability through the Standards and Interoperability Forum (SIF)
- vi. Engage the GEO community through guidelines and tutorials that explains the utilization of the GEOSS and the GCI.
- vii. Continue to develop the Community Portal Recommendations paper that provides best practices, examples and lessons-learned to promote and facilitate communities' use of the GCI and assist them in contributing their capabilities to GEOSS.

b. GEO Secretariat

- i. Overarching coordination
- ii. GCI Requirements consolidation and update

3. Planned activities and outputs

1. Consolidate/update a document "Evolution of GCI functionalities and architecture" for GEO-XII Plenary approval
2. Develop and integrate the new functionalities to ensure access to the Knowledge base being developed.

3. Continue to improve GCI performance in response to user feedback and GEO activities needs
4. Report results on AIP - 9
5. Develop Data Management Guidelines and Best Practices
6. Finalize and publish the documentation that reflects current GCI configuration
7. Organize a GEOSS Interoperability Workshop
8. Publish new guidelines and tutorials in the Best Practices Wiki

GD 8 SBAs process: Systematic determination of user needs / observational gaps

1. General description

Undertake regular, systematic analysis of global observational requirements to identify, document, prioritize and close gaps in the information value chain. Publicize gap analysis and the need to close them.

Societal Benefit Areas will provide the framework to perform this analysis by providing an important function in engaging stakeholders from different domains, different regions, and different roles – including from end users to data providers.

Once in place and running this process is also expected to provide other key outputs such as contributing to user engagement and to knowledge development.

2. Implementation approach and respective responsibilities

The GEO Secretariat will activate this SBA-related process, building on the activities of the communities that are already active within each SBA and progressively cover the totality of the SBAs themselves.

The Secretariat will coordinate the participation of key stakeholders to the agreed activities, will foster their engagement and the exchange among them and create the relevant linkages to GEO activities (Community, Initiatives and Flagships).

The GEO Secretariat will coordinate and support this SBA process by appointing one expert for each of them and by assigning dedicated resources in the trust fund, to support their activities.

3. Planned activities and outputs in 2016

The 2016 will be used to activate this process, starting from the SBAs already active and ensuring participation by all the actors involved in the Information value chain from the observations to the end user service, (here included the private sector) as well as by the developers of the GCI. Expected outputs:

1. Issue a document describing the process and how it will be run
2. Define initial plans for each SBA
3. Activate of the process for at least **three** SBAs by June 2016

GD 09 GEO Knowledge Base development

1. General description

The key objective of this task is to “develop a comprehensive interdisciplinary knowledge base defining and documenting observations needed for all disciplines. This will allow sharing not just data but also how these data can be used to address key policy or scientific question, and link also to the community of users addressing similar problems.

The Knowledge base will document the relationships between the data and the processes (models, workflows, algorithms) needed to develop the selected information/indicators.

The functionality of the knowledge base will support the GEOSS infrastructure in facilitating availability and accessibility of the observations to user communities. The knowledge base will include the rules for defining the observational needs and how to link them to user requirements, addressing a wide range of environmental and socio-economic information needs. *Of particular interest are those information needs that are linked to indicators supporting the advocacy and monitoring of the Sustainable Development Goals (SDGs).* The knowledge base will include rules to define the observation needs for these indicators.

The GEO Knowledge Base will be developed by leveraging existing knowledge repositories and databases and documenting what is being developed in association with GEO activities.

It will include user feedback with respect to the fitness for purpose of both data and processes.

2. Implementation approach and respective responsibilities

The activities will be coordinated by the Secretariat, which will ensure dialogue between the Community-developing Knowledge- and the GCI development Team, developing solutions to make it available through the Portal. Key inputs are expected to come from task GD-6.

a. Contributors (IEEE, CNR, others TBD)

- i. Identify relevant existing and developing knowledge bodies in various domains.
- ii. Develop the concept for a comprehensive interdisciplinary knowledge base defining and documenting observations needed for all disciplines, including the rules for deriving the observational needs from user’s requirements.
- iii. Design and develop the functionalities in order to support the

GEOSS infrastructure, including the DAB, in facilitating discoverability and usability of observations to user communities;

- iv. Implement a prototype of the knowledge base and import the contents of the GEOSS User Requirements Registry to the prototype –i.e. one of the knowledge bodies.

b. GEO Secretariat

- i. Overarching coordination
- ii. Coordinate and support the development and population of the Knowledge Base and engage user communities, including S&T communities, in these activities.
- iii. Document the relevant existing and developing knowledge bodies in various domains and establish organizational links where needed.
- iv. Coordinate the utilization of the knowledge base (e.g. in the GCI) and contribution to the knowledge base from all GEO activities (community, initiatives, flagships) and ensure coordination with capacity building activities.

3. Planned activities and outputs for 2016

1. Form and convene the Team
2. Issue a report on GEOSS knowledge base concept and development approach
3. Start the compilation of available knowledge resources
4. Design and prototype a database to host GEO-developed knowledge

GD 10 Radio-frequency protection

1. General description

Perform all the actions necessary to ensure the protection of the frequency spectra used by EO instruments

2. Implementation approach and responsibilities

The task will be coordinated by the Secretariat.

a. Contributors (WMO, ESA, GEO members)

For radio frequency, develop their own position towards use of frequencies and coordinate them within the GEO framework.

b. GEO Secretariat

- i. Overarching coordination
- ii. Drafting documents and communications
- iii. Representing GEO and voice EO needs and requirements at

the appropriate events

3. Activities in 2016

Specific plans are TBD. The reference for the plans will be the events where decisions on frequency allocation are expected to be taken.

GD 11 Communications Networks

1. General description

GEOSS information exchange has been principally based on the Internet and contributing information distribution systems such as GEONETCAST, the Global Telecommunications Network (GTS) component of the WMO Information System (WIS). GEO, through collaboration with existing and new contributors will explore possibilities of making other communication resources available and advocate for adequate resources to develop the communication infrastructure that will ensure wider and sustainable access to and use of EO data and information. A key counterpart will be the ITU.

2. Implementation approach and responsibilities

The task will be coordinated by the Secretariat.

a. Contributors (GEANT, ...)

- i. Document existing communication infrastructure within GEOSS and develop a concept architecture for a worldwide communication network of networks available to GEOSS. This concept should incorporate how to complement existing use of the Internet and operational data transmission services such as the WMO Information Systems (WIS) and GEONETCast.
- ii. Draft a plan delineating how such a network of networks would be implemented and outlining requirements for operation, maintenance and administration.
- iii. Engage with AfriGEOSS and potentially other flagships to assess network requirements and possible improvements of data dissemination.
- iv. Investigate state of art information technologies, such as cloud services, available through existing and potential contributing networks and how these may be applied to GEOSS.

b. GEO Secretariat

- i. Overarching coordination
- ii. Drafting documents and communications
- iii. Representing GEO and voice EO needs and requirements at the appropriate events

3. Activities in 2016

1. It is envisaged to hold a meeting with all contributors to discuss on a possible architecture and present the output to the GEANT

Programme Board.

2. Facilitate meeting with AfriGEOSS and the African NREN organizations to discuss existing communication infrastructure, requirements and developing activities in the region.
3. Participate in the 2016 activities of WMO's Expert Team on Telecommunications Infrastructure (ET-CTS) with an aim to refining the conceptual architecture.
4. Report on the initial progress and findings of this task to the 16th session of the Commission for Basic Systems (CBS) to be held in the second half of 2016, seeking further commitment to this GEOSS activity.
5. Activate a specific advocacy action with ITU for improvement of communication infrastructure in developing countries.

CD Community Development

CD 01 Capacity Building coordination

1. General description

Coordination of the capacity building activities associated with the acquisition, processing and use of EO data and information for policy and decision-making. They include definition and use of clear mechanisms for identification of the "global CB offer", its gaps in and promotion of coordinated actions to address them.

2. Implementation approach and responsibilities

This task will be implemented by a Capacity Building Working Group (CB-WG), which will include major contributors. The GEO Secretariat will support the CB-WG and facilitate linkages with other GEO activities. Annual meetings will play a key role; in particular three annual events are planned:

- A CB Symposium, which will assemble all major institutions active in CB programs, providing the opportunity to know their priorities, plans, and how they work; it will also be used to maintain the database on needs and resources;
- A CB forum, which will assemble all CB component coordinators of the GEO Flagships and Initiatives; the CB-WG will engage with the Forum at least twice a year - prior to Work Program Symposium and prior to Plenary;

3. Activities and outputs in 2016

a. CB Working Group

- i. Periodic review and update of the resource facility (relevance, maintenance and marketing)
- ii. Periodic review of capacity building needs
- iii. Develop and maintain a database with resource providers, ongoing programmes and activities
- iv. Undertake brokering activities - match needs with capabilities

- v. Strengthen links with the Permanent Framework Network (PNF) for improved stakeholder interaction
- b. GEO Secretariat
 - i. Overarching coordination
 - ii. Develop and maintain a database with resource providers, ongoing programmes and activities
 - iii. Impact assessment - M&E – guidelines

Outputs

1. **Two** meetings of the CB Working Group
2. Holding the GEO Capacity Building Symposium
3. **Develop and maintain** a database with resource providers, ongoing programmes and activities
4. Undertake brokering activities - match needs with capabilities starting from January 2016
5. Holding a Capacity Building Forum (with participation of GEO Initiatives and Flagships Representatives)
6. Annual report on capacity building needs

CD 02 Reinforcing engagement at national and regional level (*includes EO uptake for decision making*)

1. General description

Provide support to GEO Members in establishing and strengthening national coordination mechanisms. Undertake active recruitment of new Member and Participating Organizations. Provide information and support to Members and POs on how to better participate in GEO activities and engage in GEO processes.

It is proposed that, as a measure to reinforce engagement and internal coordination, Members and POs publish a yearly report addressing their achievements in implementing the GEO objectives in different areas such as contribution to GEO activities, data policy, observation systems development and operations, use of Eos in decision making at various levels, development of the EO-related commercial sector. These reports will provide valuable information for several purposes.

2. Implementation approach and responsibilities

The task will be led by the Secretariat. Members and POs will have an active role in implementing the agreed guidelines and practices, in accordance with their respective responsibilities.

3. Activities and outputs in 2016

- a. Contributors (Members and POs)
 - i. Provide national Earth observations reports
 - ii. Establish and run national GEOs
- b. Secretariat
 - i. Overarching coordination
 - ii. Develop table of contents for national reports
 - iii. develop guidelines for national coordination mechanism.
 - iv. Support Members in preparation and publishing their national Earth observation reports.
 - v. Assist international development and donor organizations with local knowledge and expertise from our country-principals and GEO coordinating organizations. This will ensure that the investment will strengthen the institutional capacity of the organizations with the legal responsibility to operate and manage monitoring and infrastructure related to GEO principles.
 - vi. Outreach to potential and new Members

Outputs

1. Issue Template for EO reports
2. Outreach to potential and new Members
3. Members/POs Earth observations reports
4. Issue guidelines for national coordination mechanism.
5. Support Members in preparation and publishing their national Earth observation reports.

CD 03 Assess the benefits from EOs and of their socio-economic value

1. General description

The goal of this task is to assess the socioeconomic benefits and impacts of information on decisions and society. The impacts of data, information and applications on decisions need to be better understood, not only intuitively, but also through quantitative assessments. The primary focus of the task will be on developing methodologies, creating use cases/assessments, developing examples that can be broadly understood and conducting training. The work will build upon prior developments carried out by JRC in support of INSPIRE, the efforts supporting NASA Earth Science applications, the USGS economic analyses and case studies that are currently under examination. We anticipate that this multi-year effort will support a

range of GEO activities including GEO Flagships and other GEO Initiatives.

2. Implementation approach and responsibilities

The task will be performed by a Task Team supported by the Secretariat Task Leader and Contributors

Jay Pearlman, IEEE – Task Lead
Richard Bernknopf, IEEE (also University of New Mexico)
Andrew Coote, Consultingwhere
Max Craglia, JRC European Commission
Claire Jolly, OECD
Jamie Kruse, University of East Carolina
Francoise Pearlman, IEEE
Hans-Peter Plag, IEEE
Alan Smart, ACIL Allen

2. Planned activities and outputs in 2016

The work in 2016 will consist of defining methodologies that can be applied to Flagships and Initiatives. This will include an international workshop at OECD in March 2016 and selected case studies. The latter will provide for assessment of applicability to GEO activities. Existing case studies will be consolidated to facilitate ready access. An essential element of this Task is outreach to the community, both to professionals and to the public that has an interest in Earth observation. The core information will be made available through a task website and through contributions of material to GEO website. Professionals will participate in a Linked-in community to exchange ideas and approaches for impact assessments. For the public, Earthzine will provide a base for the outreach through the inclusion of articles and themes supporting GEO and this task. Additionally, results of this Task will be presented at selected international meetings.

a. Contributors

- I. Identification and consolidation of representative case studies for baseline analyses.
- II. International Workshop at OECD in March 2016 to bring together natural, social and economic scientists to look at use cases and applications.
- III. Sessions or presentations at major conferences (AGU in US and one in Europe)
- IV. Expansion of a related LinkedIn community
- V. Publication of themes and discussions in Earthzine and other journals.
- VI. Maintenance of a web site.

b. GEO Secretariat

Coordinate and develop the LinkedIn virtual community.
Support organization and documentation of, and attend, the

workshop in March 2016.

Provide relevant material about GEO to an SEB web site and and material for articles in Earthzine.

Provide input material into the GEO website and keep it current based on inputs from the team.

Support the coordination of key areas of impact assessment through information from GEO tasks and consolidation of use cases.

SO Secretariat Operations

SO 01 Management and Support

1. General description

This task consolidates the definition of the activities (and of the associated resources) currently performed by the Secretariat, with some additional support from Members and POs, to ensure the functioning of the Organization.

Two kinds of activities are included:

Supporting the GEO Governance and convening the GEO Stakeholders:

- i. Preparation and execution of Summits, Plenaries, Executive Committee meetings, documents preparation and reporting.
- ii. Support Program Board activities
- iii. Development of Work Programmes,
- iv. Development and operation IT tools (website, ftp, ..)
- v. Organization of meetings to make the GEO cooperation framework working, such as the WP Symposium, AP Symposium, ...
- vi. Support travel of seconded experts dedicated to initiatives/flagship (AfriGEOSS, GEOGLAM)
- vii. Performing all the internal activities to ensure a functioning Secretariat, such as Human and financial resources Management

2. Planned activities and outputs in 2016

a. Contributors

- i. Support organization of and participation to GEO meetings and events

b. GEO Secretariat

- i. Development and maintenance of a GEO Calendar
- ii. Overarching coordination and execution of the activities

SO 02 Communications and Engagement

1. General description

This task utilizes the outputs and results of the other GEO activities as the foundation for Engagement and Communications with Stakeholder Communities. The task also develops tools and activities to increase the

visibility and awareness of GEO and its achievements.

The main tools to implement the Communications and Engagement activities will include:

- Development or updating, and implementation of, an engagement and communications strategy, including identification of critical partners and targeted stakeholders;
- development of annual Communications and Engagement Plans;
- continued development of the GEO website;
- utilization of web-based magazines focused on GEO and Earth observations;
- development of dedicated Communications material in conjunction with GEO community experts;
- identifying and arranging GEO's participation in selected events within and outside of the GEO community;
- organization of dedicated events targeting users and decision makers,
- utilization of social media;
- developing and implementing guidelines on the use of the GEO "brand," including consistent representation of GEO by its volunteer partners (e.g., use of logo, GEO colors, GEO name); and
- ,
- identifying and implementing systematic actions to promote and facilitate the uptake of EO in decision-making, in collaboration with GEO community experts.

2. Implementation approach and responsibilities

The task will be led by the Secretariat, which is expected to perform the majority of the activities. It will be supported by a "Communications and Engagement Team" whose main function would be to identify opportunities for GEO to engage with stakeholders within and beyond the GEO community, and provide access to GEO Member and PO resources to implement relevant actions.

3. Activities in 2016

Based on the Engagement Strategy approved at the 34th Session of the GEO Executive Committee, during 2016, the Communications and Engagement activities will focus on the following:

- Overarching communication activities, which will lay the foundation for GEO's outreach to a global audience, and will include development of foundational materials and communication channels;
- Developing engagement messages geared toward identified "priority" stakeholders, to be delivered at targeted events, based on GEO's strengths and competencies compared to existing or emerging national, regional and global challenges;
- Assisting in convening a limited number (2-3) of segments of the GEO community with interested stakeholders in face-to-face workshops, forums and one-on-one dialogues to identify stakeholder needs and potential GEOSS-based solutions; and
- Developing partnerships between interested stakeholders and GEO

experts to deliver the added-value of GEO and GEOSS directly to these “strategic partners”.

Working in close collaboration with the SBA communities, the Secretariat will provide support in the following initial areas of focus:

1. Assisting the Disasters SBA in developing pilot projects in one or more developing countries focused on building human and technological capacity to implement the Sendai Framework for Disaster Risk Reduction;
2. Assisting the GEOSS/GCI community in developing a strategic data infrastructure partnership with Future Earth to address domain-specific needs collaboratively identified by the Future Earth and GEO communities;
3. Developing new or deepening existing partnerships with the UN organizations responsible for specific Multilateral Environmental Agreements (MEAs) (e.g., Sendai Framework for Disaster Risk Reduction (UNISDR), Ramsar Convention on Wetlands of International Importance (Ramsar), Convention on Biodiversity (CBD)); working with Member States and other stakeholders to integrate Earth observations into national processes to measure, monitor and achieve agreed MEA goals;
4. Integrating Earth observations into decision-making in International Development Banks and Non-Governmental Organizations (NGOs); through partnerships with international development banks, demonstrating the value of Earth observations in decision-making in developing countries, understand country-specific needs and help to develop capacity to use Earth observation information in decision-making through the delivery of products and services tailored to those countries’ needs. Similarly, GEO will encourage systematic use of Earth observations in the various project management phases of the development banks – assessment, monitoring and evaluation, as appropriate;
5. Developing partnerships with international development banks and NGOs (e.g., The Nature Conservancy, Conservation International, The Natural Capital Coalition), to assist governments in developing national ecosystem accounts and integrating Earth observations into Environmental Ecosystem Accounting, thus establishing a critical link between Earth observations and the core efforts of the UN Statistical Commission System of Environmental-Economic Accounting (UNSEEA);
6. Deepening existing or developing new, strategic partnerships with national, international and global foundations to help develop in-country capacity to utilize Earth observations in the implementation of funded and future projects, with an initial focus in the agriculture, health and water domains;
7. Developing partnerships with selected companies, and their Associations, to facilitate contributions to and increase up-take of GEOSS resources for the development of applications, information

and products to be used by decision makers;

8. Identifying and convening potential partners (valued-add providers, mobile application developers, data integrators, etc.) to collaboratively identify user needs and GEO capabilities to develop value-products for specific user needs. GEO will also seek to engage companies to help deliver user driven applications, tools and resources in GEO initiatives and activities; and
9. Building on its existing partnership with the Belmont Forum, assist in the implementation of the recommendations of the E-infrastructures and Data Management Collaborative Research Action (pending approval of the recommendations in October 2015).

SO 03 Monitoring and Evaluation

1. General description

Perform all the Monitoring and Evaluation activities identified by the M&E Framework attached to the Strategic Plan. In general terms they include:

2. Implementation approach and responsibilities

(from the Strategic Plan Reference Document)

The purpose of monitoring is to track the progress of the completion of the GEO Work Programme. The GEO Secretariat will conduct monitoring on an on-going and systematic basis, making use where possible of indicators and coinciding timelines with the development of the forthcoming GEO Work Programme and meetings of the Programme Board.

The purpose of the evaluation is to inform improvement of GEO's activities by conducting assessments of the progress towards achieving targets, including intended outputs and outcomes. The evaluation will take note of other contributing activities that are not included in the GEO Work Programme, but are attributable, at least in part, to GEO's actions. Results of the evaluation will help determine what difference GEO has made (effectiveness).

The evaluation previously performed by the Monitoring and Evaluation Working Group is implemented through a Foundational Task included in the Work Programme. Reports are used by the Programme Board.

An independent Evaluation Team, supported by the Secretariat, should be set up for each evaluation to execute the evaluation processes. Two comprehensive evaluations should be conducted with one mid-way through the Strategic Plan period and the other near the end.

3. Activities in 2016

a. GEO Secretariat

- i. Identify performance indicators for the Targets identified in the Strategic Plan, for ExCom endorsement
- ii. Track progress of Work Programme activities, including

- feedback on implementation mechanisms
- iii. Measure baseline values for performance indicators.
- iv. Propose 2019 and 2024 values for the performance indicators, for Plenary approval

SO 04 Resources Mobilization

1. General description

Ensure that the level of resources contributed by GEO stakeholders is compatible with the planned GEO activities and facilitate their use.

2. Implementation approach and responsibilities

The task will be led by the Secretariat, with the support of a small team (To be identified). Members and POs will have an active role in implementing the agreed guidelines and practices, in accordance with their respective responsibilities.

a. Contributors

- i. (Members and POs) Establish internal processes to identify resources for contribution to GEO activities and to coordinate their use
- ii. (support team) support the Secretariat in define guidelines and engaging with funding agencies

b. GEO Secretariat

- i. Overarching coordination
- ii. Define guidelines and practices for resources mobilization within GEO
 - i. Support the definition of the resources for the implementation of GEO planned activities
 - ii. Engage with international funding agencies to secure resources (different mechanisms may be applied)

3. Planned activities and outputs for 2016

- 1. Define guidelines and practices for resource mobilization for GEO activities
- 2. Engage with (2-3) international funding organizations to define mechanisms to secure resources for specific GEO activities

5.5 Foundational Tasks Resources Summary

A preliminary resource estimation has been performed by the Secretariat and its results are presented in ANNEX 2 at the level of individual task, grouped in the three blocks identified above, and as an Overall summary, for a total of four tables

GEO Secretariat human resources are identified in terms of hours x year and estimated using two average reference values, one for professional personnel and one for support personnel. Seconded experts involvement will be identified in terms of hours x year; 1750 hours is the reference total hours x year.

The total estimated resources (both in cash and in kind, i.e. seconded experts) form the basis for the definition of the 2016 Budget and of the associated Secretariat staffing plan.

External contributions are identified in terms of total hours contributed and of actual costs to be incurred for the performance of the activities identified.

Annex 1 – Table: Foundational Tasks – Summary of 2016 Deliverables

GD	GEOSS Development and GCI Operations	Key Deliverables
GD-01	Advancing GEOSS Data Sharing principles	1. Hold at least one meeting of DSWG 2. Draft Implementation Guidelines on Data Sharing Principles for Plenary approval in 2016 3. Produce a report on international Open Data trends 4. Draft a summary on monitoring the progress of GEO Members in establishing and implementing Open Data Policies
GD-02	GCI Operations (<i>including access to Knowledge</i>)	1. Continue GCI operations 2. Establish a user desk by June 2016 3. Connect at least 15 new databases to the GCI 4. Test and release new GEOSS resource registration process, including the synchronization of the CSR and the DAB. 5. Produce a report on “GCI Operations options” for 2016 Plenary decision and implementation starting from 2017 6. Start the configuration control of GCI
GD-03	Global Observing and Information Systems (<i>includes systems like WIGOS. GCOS; ... And reference datasets</i>)	1. Resume coordination and consultations with Global Observing and Information Systems 2. Produce a document describing GEO plans to support existing Systems and facilitate development of new ones, including their connection with GCI 3. Produce a report on “Inventory of Global Earth observation and information systems” with identifying potential gaps, duplications and synergies
GD-04	GEONETCast Development and Operations	1. Continue GEONETCast operations 2. Test options for truly global coverage 3. Develop and test a GEONETCast planning tool and a friendly User Interface (including a service desk) 4. Develop a GEONETCast User Guide
GD-05	GEOSS satellite Earth Observation Resources (<i>includes advocacy for continuity</i>)	1. Review the strategy and plans for the implementation of Virtual Constellations 2. Develop options on how better support the SBA’s rolling processes on User Needs/Observation Requirements

GD	GEOSS Development and GCI Operations	Key Deliverables
GD-06	GEOSS non-space based Earth Observation Resources (<i>includes inclusion of citizens' observatories</i>) (<i>includes advocacy for continuity</i>)	1. Develop a plan of activities for the task, with defined leadership roles 2. Design and prototype a global database of non-space-based activities (i.e., regional and global projects), organized by domain (land, ocean, atmosphere) 3. Publish a report on the status of global non space-based coordination and frameworks, addressing also sustainability of existing measurements
GD-07	GCI Development (<i>includes development of Data Management guidelines</i>)	1. Consolidate/update a document "Evolution of GCI functionalities and architecture" for GEO-XII Plenary approval 2. Develop and integrate the new functionalities to ensure access to the Knowledge base being developed 3. Continue to improve GCI performance in response to user feedback and GEO activities needs 4. Report results on AIP - 9 5. Develop Data Management Guidelines and Best Practices 6. Finalize and publish the documentation that reflects current GCI configuration 7. Organize a GEOSS Interoperability Workshop 8. Publish new guidelines and tutorials in the Best Practices Wiki
GD-08	SBA's process: Systematic determination of user needs / observational gaps	1. Issue a report on GEOSS knowledge base concept and development approach 2. Start the compilation of available knowledge resources 3. Design and prototype a database to host GEO-developed knowledge
GD-09	Knowledge Base development	1. Convene the team 2. Issue a document describing the process and how it will be run 3. Define initial plans for each SBA 4. Activate of the process for at least three SBAs by June 2016

GD	GEOSS Development and GCI Operations	Key Deliverables
GD-10	Radio-frequency protection	Actions will be activated to prepare GEO positions for the events requiring strong support to EO instruments working frequencies protection.
GD-11	Communications Networks	1. Hold a meeting with all contributors to discuss on a possible architecture and present the output to the GEANT Programme Board. 2. Facilitate meeting with AfriGEOSS and the African NREN organizations to discuss existing communication infrastructure, requirements and developing activities in the region. 3. Participate in the 2016 activities of WMO's Expert Team on Telecommunications Infrastructure (ET-CTS) with an aim to refining the conceptual architecture. 4. Report on the initial progress and findings of this task to the 16th session of the Commission for Basic Systems (CBS) to be held in the second half of 2016, seeking further commitment to this GEOSS activity. 5. Activate a specific advocacy action with ITU for improvement of communication infrastructure in developing countries.

CD	Community Development	Key Deliverables
CD-01	Capacity Building coordination	1. Two meetings of the CB Working Group 2. Holding the GEO Capacity Building Symposium 3. Develop and maintain a database with resource providers, ongoing programmes and activities 4. Undertake brokering activities - match needs with capabilities starting from January 2016 5. Holding a Capacity Building Forum (with participation of GEO Initiatives and Flagships Representatives) 6. Annual report on capacity building needs
CD-02	Reinforcing engagement at national and regional level (includes EO uptake for decision making)	1. Issue Template for EO reports 2. Outreach to potential and new Members 3. Members/POs Earth observations reports 4. Issue guidelines for national coordination mechanism. 5. Support Members in preparation and publishing their national Earth observation reports.
CD-03	Assess the benefits from EOs and of their socio-economic value	1. Define case studies for baseline analyses. 2. Holding an International Workshop at OECD in March 2016 3. Ensure presence at major international events (such as AGU in US and EGU Europe) 4. Publication of themes and discussions in Earthzine and other journals 5. Maintenance of a web site 6. Develop and coordinate the LinkedIn virtual community 7. Update GEO website and keep it current based on inputs from the team

SO	Secretariat Operations	Key Deliverables
SO-01	Management and Support	1. Convene GEO Governance meetings (preparation and execution of GEO-XIII Plenary, Executive Committee meetings, documents preparation and reporting. 2. Support Program Board activities 3. Development of Work Programme 2017-19, 4. Development and operation IT tools (website, ftp, ..) 5. Organization of meetings to make the GEO cooperation framework working, such as the WP Symposium, AP Symposium 6. Perform all the internal activities to ensure a functioning Secretariat, such as Human and financial resources Management
SO-03	Communication and Engagement	1. Perform communications campaign 2. Develop foundational materials/ communication channels 3. Develop and deliver targeted engagement messages 4. Assist in convening a limited number (2-3) of segments of the GEO community with interested stakeholders in face-to-face workshops, forums and one-on-one dialogues to identify stakeholder needs and potential GEOSS-based solutions, including developing partnerships between interested stakeholders and GEO experts to deliver the added-value of GEO and GEOSS directly to these “strategic partners” 5. Assist specific communities in engagement activities (Disasters - Sendai framework, GEO-Future Earth) 6. Strengthen/Develop partnerships to foster use of EO's, with: Un Conventions, MEAs (including Environmental Ecosystem Accounting), Development Banks, NGOs, Foundations, Companies / Associations. 7. Assist in implementing Belmont Forum recommendations on e-infrastructure and data management
SO-02	Monitoring and Evaluation	1. Identify performance indicators for the Targets defined in the Strategic Plan, for ExCom endorsement 2. Track progress of Work Programme activities, including feedback on suitability of GEO implementation mechanisms development 3. Measure baseline values for performance indicators. 4. Propose 2020 and 2025 values for the performance indicators, for GEO-XIII approval
SO-04	Resource Mobilization	1. Define guidelines and practices for resource mobilization for GEO activities 2. Engage with (2-3) international funding organizations to define mechanisms to secure resources for specific GEO activities

Annex 2 - Foundational tasks Resource Summary (1)

GEOSS Development and GCI Operations	GEO Secretariat resources										External Contributions	
TASK	GEO Trust Fund									Secondment		
	Personnel					External services KCHF	Travel KCHF	Meetings support KCHF	TOT KCHF	Personnel (hours)	Personnel (hours)	Direct expenditure K\$
	Professional		Support		Total							
	Time	KCHF	Time	KCHF	KCHF							
GD-01 Data Sharing	849	121	170	14	135	2	11	8	157	0	1900	56
GD-02 GCI Operations	892	127	170	14	141	0	44	2	187	1486	9975	340
GD-03 Global Observing and Information Systems	255	36	42	3	40	0	8	0	48	0	2500	10
GD-04 GEONETCast Development and Operations	255	36	0	0	36	0	8	0	44	0	2625	130
GD-05 GEOSS satellite Earth Observation Resources	170	24	0	0	24	0	10	0	34	0	10000	0
GD-06 GEOSS in situ EO Resources	340	49	0	0	49	0	10	0	59	0	3500	20
GD-07 GCI Development	340	49	170	14	62	0	76	0	139	679	12950	670
GD-08 SBA process: Systematic determination of user needs / observational gaps	849	121	170	14	135	0	13	34	182	5349	4000	100
GD-09 Knowledge Base development	255	36	170	14	50	0	34	0	84	5349	2250	112
GD-10 Radio Frequency Protection	85	12	0	0	12	0	0	0	12	0	500	0
GD11 Communications Networks	127	18	0	0	18	0	0	0	18	0	350	0
TOTALS	4288	613	892	71	684	2	215	44	945	12863	50200	1438
					WMO Administration Costs			7.00%	66			
							GRAND TOTAL		1011			

Foundational tasks Resource Summary (2)

TASK	GEO Secretariat resources										External Contributions	
	GEO Trust Fund									Secondments		
	Personnel					External services CHF	Travel CHF	Meetings support CHF	TOTAL (CHF)	Personnel (hours)	Personnel (hours)	Direct expenditure K\$
	Professional		Support		Total							
	Time	CHF	Time	CHF	CHF							
CD-01 Capacity Building coordination	0	0	340	27	27	0	68	0	95	866	2318	70
CD-02 Reinforcing engagement at national and regional level	467	67	170	14	80	0	30	0	110	0		
CD-03 Assess the benefits from EOs and of their socio-economic value	446	64	0	0	64	0	4	0	68	722	1125	66
TOTALS	913	130	509	41	171	0	101	0	273	1588	3443	137
WMO Administration Costs									7.00%	19		
									GRAND TOTAL	292		

Foundational tasks Resource Summary (3)

Secretariat Operations Summary	GEO Secretariat resources										External Contributions	
TASK	GEO Trust Fund									Secondments		
	Personnel					External services CHF	Trave l CHF	Meetings support CHF	TOTAL (CHF)	Personnel (hours)	Personnel (hours)	Direct expenditur e K\$
	Professional		Support		Total							
	Time	CHF	Time	CHF	CHF							
SO-01 Management and support	6903	986	3863	309	1295	335	235	305	2171	3838	4100	390
SO-02 Monitoring and Evaluation	1248	178	170	14	192	0	8	0	200	0	0	0
SO-03 Communication and Engagement	2675	382	442	35	417	76	59	0	553	0	300	0
SO-04 Resources Mobilization	1274	182	85	7	189	0	8	0	197	0	400	10
TOTALS	#####	1728	4559	365	2093	412	311	305	3121	3838	4800	400
					WMO Administration Costs			7.00%	218			
							GRAND TOTAL		3339			

Foundational tasks Resource Summary (4)

TOTAL FOUNDATIONAL TASKS	GEO Secretariat resources										External Contribution	
	GEO Trust Fund									Secondment		
	Personnel					External services CHF	Travel CHF	Meetings support CHF	TOTAL (KCHF)	Personnel (hours)	Personnel (hours)	Direct expenditure K\$
	Professional		Support		Total							
GROUP	Time	CHF	Time	CHF	CHF							
GEOSS Development and GCI Operations	4288	613	892	71	684	2	215	44	945	12863	50200	1438
Community Development	913	130	509	41	171	0	101	0	273	1588	3443	137
Secretariat Operations	12099	1728	4559	365	2093	412	311	305	3121	3838	4800	400
TOTALS	17300	2471	5960	477	2948	413	627	349	4338	18289	58443	1975
						WMO Administration C		7.00%	304			
							GRAND TOTAL		4642			

Projected trust fund for 2017: 5.4 MCHF

Average Secretariat staff during 2016:

Professional staff	10
Support staff	3.5
Seconded experts	10

Planned Secretariat staff at the end of 2016:

Professional staff	11
Support staff	4
Seconded experts	12

APPENDIX 2

Work Programme Reference Document v3.0

GEO 2016 WORK PROGRAMME REFERENCE DOCUMENT

Version v3

29 September 2015

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CA-32	Research Data Science Summer Schools (new-CODATA/RDA)	- Detailed description
GI-01	GEOGLAM-Global Agricultural Monitoring and Early Warning	- Implementation Plan
GI-02	GEOBON-Global Biodiversity Observation (GEO BON)	- Implementation Plan - WorkPlan 2014-2016
GI-03	GFOI Global Forest Observation Initiative	- Detailed description
GI-04	Global Observing System for Mercury and Persistent Pollutants	- Draft Implementation Plan
GI-05	Global Carbon Observation and Analysis System	- Draft Implementation Plan
GI-06	Reinforcing engagement at regional level: AfriGEOSS for Africa	- Implementation Plan
GI-07	Ocean and society - Blue Planet	- Draft Implementation Plan
GI-09	Global Wildfire Information System	- Detailed description
GI-16	GEO-DARMA = Data Access for Risk Management (new-CEOS)	- Draft Implementation Plan
GI-17a	Global Urban Observation and Information	- Detailed description
GI-17b	Global Human Settlement indicators for post-2015 international frameworks	- Detailed description
GI-19	AmeriGEOSS (new)	- Draft Implementation Plan

1. INTRODUCTION

The draft “GEO Strategic Plan 2016-2025: Implementing GEOSS” makes reference to a Work Programme Reference Document (WPRD) and states that this WPRD is maintained by the GEO Secretariat, complementing the Work Programme itself, by providing important background information, here included a compilation of the relevant Implementation Plans of GEO Flagships, GEO Initiatives and other relevant documents.

2. WPRD STRUCTURE AND PROVISIONAL CONTENT

Consultation with the IPWG has determined that the WPRD, because of the amount of information it will contain, will be a web-based, “electronic document” only, to allow easy consultation and also identified a provisional content for the WPRD, as follows:

- An Introduction
- How GEO works, how different activities are interrelated
- How the SBAs process on User needs and gap analysis works
- Information on the Foundational Tasks actual content and reference
- Information on GEO Flagships and Initiatives (for each of them there would be: an Implementation Plan; additional documents (e.g., technical documents, progress reports, etc.); their link to GEO Targets; their link to the SBAs.
- Information on the Community Activities
- Monitoring and Evaluation

3. CONTENT OF THIS FIRST DRAFT

3.1 General

This first draft consists of a collection of more detailed information on the following Community Activities and GEO Initiatives, for which the proposing Teams have made additional documentation available.

Contrary to its final draft, this first draft has been compiled as a document.

3.2 List of attached documents

CA-25	Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity-building phase	- Detailed description
CA-32	Research Data Science Summer Schools (new-CODATA/RDA)	- Detailed description
GI-01	GEOGLAM-Global Agricultural Monitoring and Early Warning	- Implementation Plan

GI-02	GEOBON-Global Biodiversity Observation (GEO BON)	- Implementation Plan - WorkPlan 2014-2016
GI-03	GFOI Global Forest Observation Initiative	- Detailed description
GI-04	Global Observing System for Mercury and Persistent Pollutants	- Draft Implementation Plan
GI-05	Global Carbon Observation and Analysis System	- Draft Implementation Plan
GI-06	Reinforcing engagement at regional level: AfriGEOSS for Africa	- Implementation Plan
GI-07	Ocean and society - Blue Planet	- Draft Implementation Plan
GI-09	Global Wildfire Information System	- Detailed description
GI-16	GEO-DARMA = Data Access for Risk Management (new-CEOS)	- Draft Implementation Plan
GI-17a	Global Urban Observation and Information	- Detailed description
GI-17b	Global Human Settlement indicators for post-2015 international frameworks	- Detailed description
GI-19	AmeriGEOSS (new)	- Draft Implementation Plan

CA-25	Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity-building phase	- Detailed description

Introduction

Understanding the abundance and spatial distribution of chemical elements in the Earth's near-surface environment is critical for many human endeavours ranging from locating our future mineral resources to monitoring changes in the chemistry of the Earth caused by natural processes or human activities. There is worldwide concern about the potentially damaging effects of chemicals in the environment on the health of humans, animals, agriculture and ecosystems. Economic and population growth are increasing rapidly, exacerbating such problems as land degradation and pollution from uncontrolled urbanisation, industrialisation, intensive agricultural practices and over-exploitation of aquifers. These and other problems are having an impact on the geochemistry of the Earth's surface and the sustainability of its life-support systems from the local to the global scale. On the other hand, there is also worldwide concern about securing mineral and energy resources to meet the demand of our growing population. Understanding the geochemistry of the Earth's surface is vital in locating these resources and in exploiting them in an environmentally responsible manner.

Systematic geochemical mapping is the best method available to assess and provide a basis for monitoring changes in the levels of chemical elements at the Earth's surface. Geochemical maps have traditionally been valuable in addressing a whole range of environmental problems, as well as for identifying potential mineral resources at the local to national scale. The present proposal is to develop for Africa a land base multi-element geochemical baseline database for mineral resource and environmental management according to the specifications of IGCP 259 "International Geochemical Mapping" (Darnley et al., 1995).

This project proposal for Africa is within the vision of GEO "To realise a future wherein decisions and actions, for the benefit of humankind, are informed by coordinated, comprehensive and sustained Earth observations and information". It also will be an important contribution to AfriGEOSS (2014), and the IUGS initiative "Resourcing Future Generations" (IUGS, 2014).

Objectives and motivations: *To develop a land base multi-element geochemical baseline database for mineral resource and environmental management.*

Africa is the world's second-largest and second-most-populous continent. Its area, including adjacent islands, is 30,221,532 km². According to Wikipedia, Africa consists of 54 sovereign states and 10 non-sovereign territories

(https://en.wikipedia.org/wiki/List_of_sovereign_states_and_dependent_territories_in_Africa#Sovereign_states). In order for Africa to develop its vast mineral resources, and also to safeguard its environment, it urgently needs a harmonised geochemical baseline database for planning and decision-making. To develop such a database it is necessary to start a capacity-building programme for training professional applied geochemists from all African countries.

Names of activity co-leaders: David B. Smith, Xueqiu Wang, Alecos Demetriades, Anna Ladenberger, Abera Mogessie, Beneah Odhiambo and Gabi Schneider

Key partner organisations: EuroGeoSurveys, IUGS/IAGC Task Group on Global Geochemical Baselines, UNESCO International Research Centre on Global-scale

Geochemistry, Geological Society of Africa and Organisation of African Geological Surveys.

Activities and outputs planned for 2016

- ☐ Capacity-building: Organisation of capacity-building workshops in global geochemical baseline mapping at central locations in Northern, Eastern, Southern, Western and Central Africa. The workshops will comprise indoor lectures in applied geochemistry, including data processing and map plotting, and training in the field (selection of sampling sites, and sampling).
- ☐ User involvement: Participation of applied geochemists from all African countries.
- ☐ Geographical coverage: The whole African continent.

Funding sources and indicative amounts for 2016: 300,000 Euro

Future plans

To develop a geochemical baseline database for the entire African continent through systematic sampling and chemical analysis according to the specifications of IGCP 259 "*International Geochemical Mapping*" (Darnley et al., 1995) We propose using only one sample medium, depending on terrain type, namely overbank or floodplain or catchment basin sediment, which is generally alluvial (or agricultural soil).

The framework for the sampling is the Global Geochemical Reference Network (GRN) established by IGCP 259 (Darnley et al., 1995). The GRN consists of about 5000 grid cells, each approximately 160 x 160 km in size (area 25,600 km²). The 54 countries in Africa are covered by approximately 1500 GRN grid cells (see Figure 1). Five sites are identified within each cell for a total of 7500 sample sites for the continent (approximately 1 site per 4000 km²). Sample media:

- ☐ Overbank sediment (alluvial soil) in mountainous and hilly terrains, and
- ☐ Floodplain or catchment basin sediment (alluvial soil) in desert, savanna and plain terrains.

At each site, two samples will be collected, a top and a bottom. The top (surface) sample will be collected from 0-25 cm, and the bottom (deeper) 25-cm thick sample below a depth of 75 cm. Thus, the total number of samples will be in the order of 15,000.

Duplicate field samples will be collected from at least 3 per cent of the sampling sites, giving a total of 225 duplicated field sites, with a total of about 450 samples.

The samples, after preparation at a central facility in Africa, will be analysed for 76 elements at the laboratories of the China Geological Survey (UNESCO International Research Centre on Global-scale Geochemistry). Splits of each sample will be archived and stored for future investigations at either a central facility within Africa or at a facility designated by each participating African country. 3

To monitor the quality of geochemical data, five large standard samples with different element concentrations (low to high) will be prepared.

The cost of sampling and sample preparation for the whole African continent, and preparation of the five standard samples, is approximately in the order of 5 million Euro.

The cost of laboratory chemical analysis for 76 elements is approximately 3 million Euro, which may be funded by China.

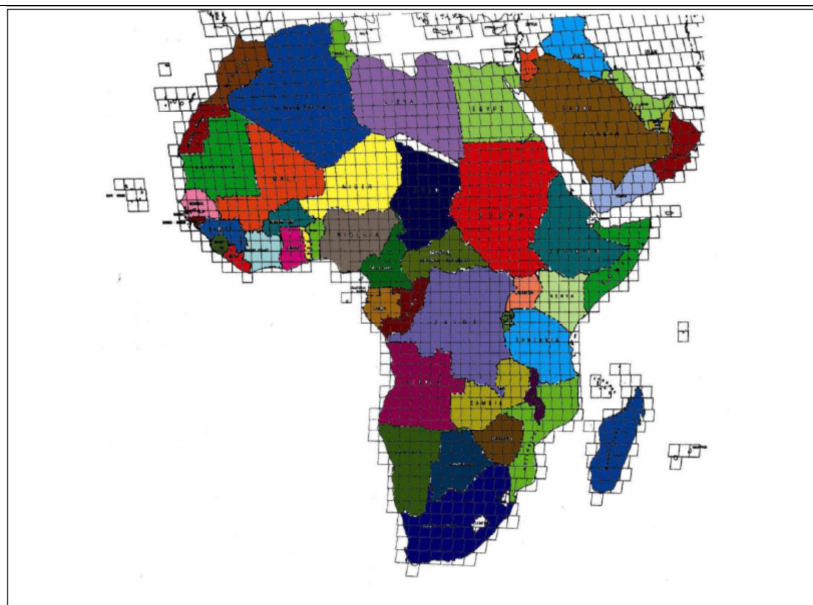


Figure 1. Map of Africa showing the GRN grid cells of 160 x 160 km.

AfriGEOSS, 2014. GEO-X — 15-16 January 2014: AfriGEOSS - Approach, Progress and Way forward. Group on Earth Observations, Document 11, 5 pp., https://www.earthobservations.org/documents/afrigeoss/geo_x_AfriGEOSS_Approach_Progress_Way_Forward.pdf.

Darnley, A.G., Björklund, A., Bølviken, B., Gustavsson, N., Koval, P.V., Plant, J.A., Steenfelt, A., Tauchid, M., Xie, X., Garrett, R.G. & Hall, G.E.M., 1995. A global geochemical database for environmental and resource management. Final report of IGCP Project 259. Earth Sciences, 19, UNESCO Publishing, Paris, 122 pp., http://www.globalgeochemicalbaselines.eu/wp-content/uploads/2012/07/Blue_Book_GGD_IGCP259.pdf.

IUGS, 2014. Resourcing Future Generations - White Paper: Mineral Resources and Future Supply. International Union of Geological Sciences, 38 pp., <https://www.geolsoc.org.uk/~media/shared/documents/RFG/Wh>

CA-32	Research Data Science Summer Schools (new-CODATA/RDA)	- Detailed description

1.1 Objectives and Need

The ever-accelerating volume and variety of data being generated is having a huge impact of a wide variety of research disciplines, from the sciences to the humanities: the international, collective ability to create, share and analyse vast quantities of data is having a profound, transformative effect. What can justly be called the ‘Data Revolution’ offers many opportunities coupled with significant challenges. Prominent among these is the need to develop the necessary professions and skills. There is a recognised need for individuals with the combination of skills necessary to optimise use of the new data sets. Such individuals may have a variety of different titles: Data Scientist, Data Engineer, Data Analyst, Data Visualiser, Data Curator. All of them are essential in making the most of the data generated.

Contemporary research – particularly when addressing the most significant, transdisciplinary research challenges – cannot effectively be done without a range of skills relating to data. This includes the principles and practice of Open Science and research data management and curation, the use of a range of data platforms and infrastructures, large scale analysis, statistics, visualisation and modelling techniques, software development and annotation, etc, etc. The ensemble of these skills, we define as ‘Research Data Science’.

Modern Research Data skills are common to all disciplines and training in ‘Research Data Science’ needs to take this into account. For example, all disciplines need to ensure that research is reproducible and that provenance is documented reliably and this requires a transformation in practice and the promotion of ‘Research Data Science’ skills.

It is strategic priority for both CODATA and the Research Data Alliance to build capacity and to develop skills, training young researchers in the principles of Research Data Science. Particular attention is paid to the needs of young researchers in low and middle income countries (LMICs). It is important that Open Data and Open Science benefit research in LMICs and the unequal ability to exploit these developments does not become another lamentable aspect of the ‘digital divide’. On the contrary, it has been argued that the ‘Data Revolution’ provides a notable opportunity for reducing that divide in a number of respects.

1.2 GEO Strategic Objectives

This activity relates most specifically to the GEO Strategic Objective of ‘Engage’ and the ‘Capacity Building’ activity therein. The promotion and development of data science skills, as described here, is an important component of capacity building and essential to the greater use and reuse of earth observation data to meet Societal Benefit Areas.

1.3 Mission of the CODATA-RDA Research Data Science Summer Schools

The CODATA-RDA Research Data Science Summer Schools will:

- address a recognised need for Research Data Science skills across disciplines;
- follow an accredited curriculum;

- provide a pathway from a broad introductory course for all researchers (Vanilla) through more advanced and specialised courses (Flavours and Toppings);
- be reproducible: all materials will be online with Open licences;
- be scalable: emphasis will be placed on Training New Teachers (TNT) and building sustainable partnerships.

1.4 A Scalable Programme of Short Courses in Research Data Science

The CODATA-RDA Data Science Summer Schools are designed to be scalable and to provide a pathway in Research Data Science for individuals who are at an early stage of their research career. The schools are primarily targeted at students who have completed a bachelors degree and are embarking on a research degree. However, other students, including post-docs and early career researchers are not excluded where need lies. The approach is modular and intended to allow the possibility of students accumulating credits towards a recognised and accredited qualification. For all the schools, the CODATA-RDA Working Group is collaborating with a wide number of partners and to the greatest degree possible re-using available materials.

1.1.1 *Vanilla Schools*

The first school, named ‘Vanilla’ by analogy to the most basic flavour of ice cream, will provide a bedrock of introductory material, common to all research disciplines, and upon which more advanced schools can build. This school is designed to run for up to two weeks and participants will achieve the following learning outcomes:

- 1) To understand the importance of data sharing and open science.
- 2) To understand the importance of annotation and metadata.
- 3) To have an introductory understanding of developing software for research.
- 4) To understand how to query and modify an SQL database and the principles behind relational databases.
- 5) To understand basic principles of statistics, how to deploy machine learning techniques and understand their limitations.
- 6) To be able to generate simple visualisations of data in an informative fashion.
- 7) To understand the basic taxonomy of cloud computing.
- 8) To be able to launch and deploy a Virtual Machine on a Cloud Computing platform.
- 9) To be able to use a batch submission process.

This programme will be run in partnership with the Software and Data Carpentry communities and the UK’s Digital Curation Centre. Other partnerships are being explored.

The first full Vanilla School will take place on 1-12 August 2016 at the International Centre for Theoretical Physics, Trieste.

1.1.2 Flavoured Schools

Schools following Vanilla will be more advanced and specialised, refined as required to the ‘Research Data Science’ needs of particular disciplines. For example, a school on ‘Extreme Data’, which will deal with the analysis of very large data sets and another on large biological data sets are planned. Such ‘flavoured’ schools, which will run for 1 or 2 weeks, will allow a student to have a more specialised knowledge in Data Science, as it is applied in a more specific, disciplinary research context. A flavoured school will not necessarily run directly after a Vanilla school and may be held in a completely different location.

Discussions are ongoing on a school on ‘Extreme Data’ in collaboration with [CERN](#) and the [SKA](#); Bioinformatics with [Elixir](#), [H3Africa](#) and [Goblet](#); Geospatial Data with NASA, ESA and [GEO](#); Library Science with the [RDA Libraries for Research Data Interest Group](#) (including representatives of [LIBER](#), [COAR](#), [Purdue University Library](#) and the [University of Goettingen Library](#)); and Agricultural Science with the [RDA Interest Group on Agricultural Data](#) (including representatives of the [UN Food and Agriculture Organisation \(FAO\)](#), the [Indian Statistical Institute](#) and [INRA](#), as well as [CODATA Kenya](#) and the [Jomo Kenyatta University of Agriculture and Technology \(JKUAT\)](#)).

The first more advanced Flavoured School is likely to take place over one week in the Spring of 2016 at the University of Cape Town.

1.5 Accreditation and a Worldwide Programme

The vision for the schools a series of data science short courses that use a quality assured set of reusable material, are supported by online delivery and are quality controlled and accredited by an appropriate body or bodies so that they can count towards students post-graduate qualifications. The CODATA-RDA Working Group is seeking to put the mechanisms for these important features in place.

The Working Group is liaising with a number of partners to host schools in future years. The initiative builds on events held by CODATA in [Beijing](#), [Nairobi](#) and [Bangalore](#). As well as the various organisations mentioned, the WG is exploring whether the regional offices of the [International Council of Science](#) and [The World Academy of Science](#) can host schools from 2017.

Strong emphasis will be placed on Training New Teachers. Specific components and accreditation for participants wishing to instruct on and lead future schools will be established.

1.6 Progress and Resourcing for the First Vanilla School

The first full introductory or Vanilla course will take place from 1-12 August 2016 at the Abdus Salam International Centre for Theoretical Physics in Trieste, Italy. The venue is a delightful self-contained site, overlooking the sea, the Adriatico Guest House, where there is accommodation, lecture halls, a terminal room and a canteen.

As host, and following their general practice, the ICTP will provide accommodation and subsistence for up to 120 students.

The ICTP has committed 15K euros, TWAS 10K euros and CODATA at least 5K euros to support student travel. The current funding from ICTP, TWAS and CODATA will be prioritized for participants from LMICs.

The Working Group is now looking for additional support from partner organizations, funders and sponsors. Thanks to the hosting support, funds will be used entirely for student and instructor travel.

1.7 Materials and Further Information

Working Group Webpages: <https://rd-alliance.org/groups/rdacodata-summer-schools-data-science-and-cloud-computing-developing-world.html> and <http://www.codata.org/working-groups/research-data-science-summer-schools>

Presentations given about the initiative in July 2015, at ICTP, Trieste in discussions to plan the first Vanilla Research Data Science Summer School at ICTP in August 2016: <http://dx.doi.org/10.5281/zenodo.22670>

GI-01	GEOGLAM-Global Agricultural Monitoring and Early Warning	- Implementation Plan

GEOGLAM Implementation Plan

Version dec 2014

Note : a revised version should be available before end 2015.

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- **FOREWORD**

This document describes the GEOGLAM implementation, outlining the highly complex operating environment in terms of the range of the institutions, programmes and projects currently involved, the R&D heritage from the GEO Agriculture Community of Practice, the most relevant achievements to date, the organization into three main components and three cross-cutting components, the phased approach for full implementation associated with a logic stepwise model, the governance model along with its draft terms of reference as well as specific activities for the near term (activities for the period 2015-2016) with a timeline for guiding the implementation process, while allowing monitoring by its coordination group and relevant stakeholders.

Given the unreliability of funding this Implementation Plan must be viewed as a living document. It will serve as the basis for the full GEOGLAM Implementation Plan to be completed once GEOGLAM governance is in place, with a dedicated Program Coordination Office.

- **INTRODUCTION**

GEOGLAM, the GEO Global Agricultural Monitoring initiative, was initially launched by the Group of Twenty (G20) Agriculture Ministers in June 2011, in Paris. The initiative forms part of the [G20 Action Plan on Food Price Volatility](#), which also includes the Agricultural Market Information System (AMIS, <http://www.amis-outlook.org>), another inter-institutional initiative hosted by the UN Food and Agriculture Organization (FAO). The G20 Ministerial Declaration states that GEOGLAM “will strengthen global agricultural monitoring by improving the use of remote sensing tools for crop production projections and weather forecasting”. By providing coordinated Earth observations from satellites and integrating them with ground-based and other in-situ measurements, the initiative will contribute to generating reliable, accurate, timely and sustained crop monitoring information and yield forecasts.

The following paragraph is part of the G20 Head of States Declaration in Cannes, November, 2011.

44. We commit to improve market information and transparency in order to make international markets for agricultural commodities more effective. To that end, we launched:

- The “Agricultural Market Information System” (AMIS) in Rome on September 15, 2011, to improve information on markets. It will enhance the quality, reliability, accuracy, timeliness and comparability of food market outlook information. As a first step, AMIS will focus its work on four major crops: wheat, maize, rice and soybeans. AMIS involves G20 countries and, at this stage, Egypt, Vietnam, Thailand, the Philippines, Nigeria, Ukraine and Kazakhstan. It will be managed by a secretariat located in FAO;

- The “Global Agricultural Geo-monitoring Initiative” in Geneva on September 22-23, 2011. This initiative will coordinate satellite monitoring observation systems in different regions of the world in order to enhance crop production projections and weather forecasting data.

The Geo-Global Agricultural Monitoring Initiative (GEOGLAM) builds on GEO’s Agricultural Community of Practice (AG COP) agenda and implementation actions in GEO’s Agriculture’s Societal Benefit Area. Established in 2007, this global network now has over 300 members, including such key organizations and programs as the FAO’s Global Information and Early Warning System, the US Department of Agriculture’s Foreign Agricultural Service, the USAID Famine Early Warning Systems Network, the Crop Watch programme of the Institute for Remote Sensing and Digital Earth of the China Academy of Sciences, the European Commission’s JRC/MARS program, and Agriculture & Agri-Food Canada, India’s FASAL programme from ISRO and India Ministry of Agriculture, to name just a few. The first coordinated effort of the AG CoP was JECAM, the Joint experiment of

Crop Assessment and Monitoring (www.jecam.org). The overarching goal of JECAM is to reach a convergence of approaches, develop monitoring and reporting protocols and best practices for a variety of global agricultural systems. JECAM is enabling the global agricultural monitoring community to compare results based on disparate sources of data, using various methods, over a variety of global cropping systems. The JECAM experiments will facilitate international standards for data products and reporting, eventually supporting the development of a global system of systems for agricultural crop assessment and monitoring. As such, JECAM is now fully integrated into GEOGLAM as its R&D component.

The main objective of GEOGLAM is to reinforce the international community's capacity to produce and disseminate relevant, timely and accurate projections of agricultural production at national, regional and global scales by using Earth Observation data. This will be achieved by:

- enhancing national agricultural reporting systems, including through a geo-spatial education curriculum to enable training of participants worldwide;
- establishing a sustained international network of agricultural monitoring and research organisations and practitioners; and
- harmonizing the operational global agricultural monitoring systems based on both satellite and in situ observations, including through improved coordination of satellite observations.

- **THE CASE FOR GEOGLAM: WHY SHOULD GEO MEMBERS ENDORSE AND SUPPORT THE GEOGLAM INITIATIVE**

Because GEO must – GEO was created around thematic areas that match the Millennium Development Goals. Advanced agriculture information through the use of timely Earth Observation inputs, is a key GEO target and there is no defence for food shortages, famine and malnutrition to be newspaper headlines, when one knows months in advance what would happen;

Because GEO can – it is the vision of GEO to increase EO to inform decision making and with the combined use of in-situ data, remote sensing data and crop models and it is now possible to use remote sensing parameters linked to plant phenology to monitor crop condition and ascertain crop production outcomes months ahead of harvest;

Because it makes sense – better knowledge will inform better action and will result in better outcomes;

Because the benefits are clear and the costs are minor – practical knowledge on how to better manage a global food system worth trillions of dollars that impacts billions of people will cost millions of dollars;

Because the cost of inaction is too high – political instability, conflict, depravation, malnutrition, lost productivity through the impacts of poor nutrition, the persistence of the poverty traps – the list is well known, but solutions are available.

- **GEOGLAM OPERATING ENVIRONMENT**

GEOGLAM has a policy mandate coming from the G20 Action Plan to reduce Food Price Volatility launched in 2011. GEO, as an intergovernmental organization created to enhance the use of Earth Observations to inform decisions and policies, was given the task by the G20 governments. Despite the fact that the G20 is focussed on the four main commodities, GEO has also the strategic mandate to enhance the capacities of countries that are food insecure to assess their crop conditions.

In order to take the task on board, GEO based its capacity on the existing Agricultural Community of Practice, established in 2007 as a result of two meetings hosted at FAO, which was in charge of developing the GEO Task in Agriculture with the aim to achieve the established strategic targets for Agriculture by 2015. GEOGLAM is where policy and science meet to enhance current operational systems for agricultural monitoring; one can also say that GEOGLAM is where top-down and bottom-up actions meet.

The GEO Community of Practice, the partners in GEOGLAM, has now more than 300 members and keeps growing. Among its members are UN agencies, recognized programmes (international, national or regional), academic departments, research centres, institutions that have R&D and operational mandates in agriculture, space agencies, regional organizations and members of the private sector. The list include, to name a few: USDA (FAS, NASS), FAO (GIEWS, Global Strategy), WMO (Agricultural Meteorology Programme), WFP, EC/JRC (MARS unit), USAID (FEWSNET), EC/Copernicus, CSIRO and ABARES (Australia), VITO (Belgium), IIASA (Austria), ISRO (India), NASA (USA), ESA (EU), INPE (Brazil), JAXA (Japan), SANSA (South-Africa), CONAB (Brazil), CGIAR, INTA (Argentina), CIRAD (France), AAFC (Canada), University of Maryland (USA), Université Catholique de Louvain (Belgium), SADC, RADI (China CropWatch), CILSS, AMESD, Asia-RiCE team, and AFSIS (ASEAN+3 Food Security Information project).

Given its stakeholder interests, mandates and capacities, GEOGLAM was designed around three main pillars and three cross-cutting elements, making up to six components or building blocks. The components are the basis for identification of deliverables and activities, implementation plan and management through their teams and leads; they are described in the next section. The three pillars are: 1) Enhancement of Global and Regional systems; 2) National capacity development and 3) Countries-at-Risk. The three cross-cutting components are: 4) EO data coordination; 5) R&D coordination and, 6) Information systems (for disseminating data, products and information).

▪ **Component 1 builds on:**

- a) The USDA's Foreign Agriculture Service Global Agricultural Monitoring in partnership with University of Maryland Department of Geography & NASA (<http://www.pecad.fas.usda.gov/glam.htm>);
- b) The Institute of Remote Sensing and Digital Earth (RADI), China CropWatch System (CCWS) developed by the former Institute of Remote Sensing Application (IRSA), merged in 1998 into the Institute of Remote Sensing and Digital Earth (RADI) of the Chinese Academy of Sciences (CAS), covering China and 46 major grain-growing countries of the world (<http://www.cropwatch.com.cn/en/>);
- c) The Asia Rice Crop Estimation and Monitoring (<http://asia-rice.org/>), an Asian partnership for GEOGLAM that includes a broad range of stakeholders such as national governments and their agencies responsible for their various rice crop monitoring and food security systems and capabilities; Regional intergovernmental coordination bodies with ambitions in this domain, including AFSIS, ASEAN and APEC; Remote sensing organizations and their coordination groups that can support supply of the necessary space data – these including the space agencies of Japan, China, India, Indonesia, South Korea, Thailand, Vietnam and others; as well as the regional space agency forum APRSAF and the international Committee on Earth Observation Satellites (CEOS) and its Space Data Coordination Group (SDCG); FAO and their regional activity groups; and key donor organizations, global (World Bank), regional (ADB), and national (e.g. JICA and AusAid);

d) The European Union Joint Research Centre Monitoring Agriculture Resources (MARS) unit, that releases timely crop Monitoring Information for Europe, including forecasts, early assessments and the scientific underpinning for efficient monitoring and control systems. MARS serves the Agriculture and Food policies of the European Union, their impact on rural economies and on the environment, encompassing the global issues of food security and climate change.

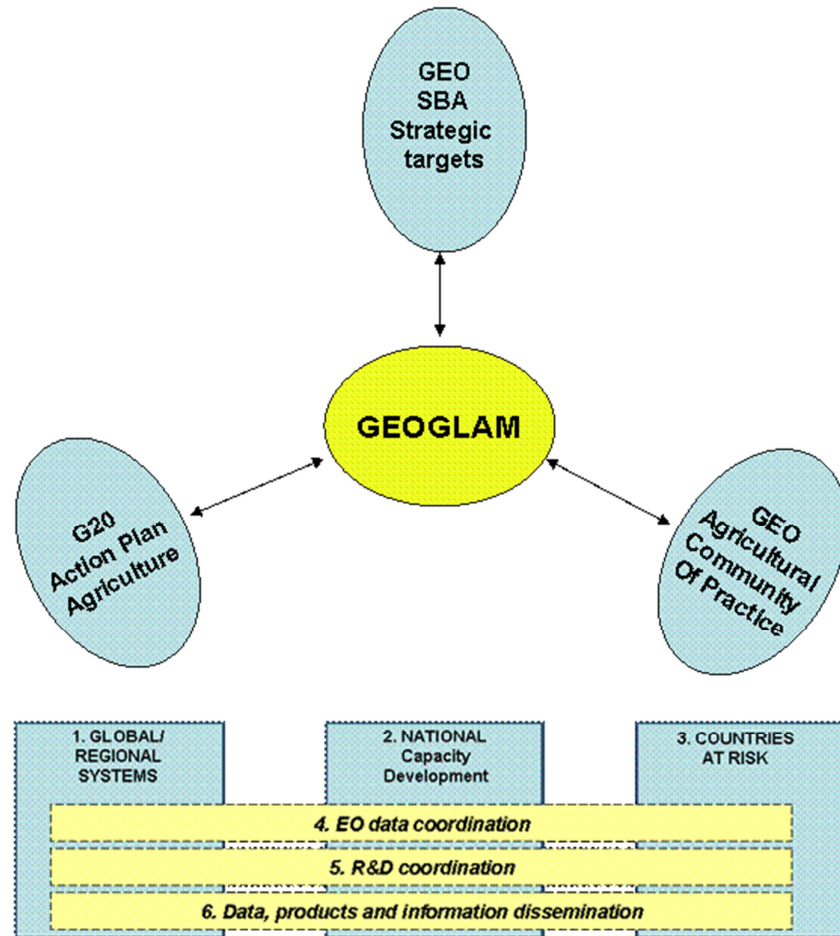


Figure 1 - The operating environment and components of GEOGLAM

▪ **Component 2** (National Capacity Building) builds on:

a) The Food and Agriculture Organization of the United Nations (FAO) on-going efforts in supporting capacity development among the concerned agencies of member countries, with emphasis on the use of Earth Observation to increase accuracy and reduce costs for their crop statistics system, through, for example through the Global Strategy to Improve Agricultural and Rural Statistics program (<http://www.fao.org/economic/globalstrategy/en/>). The Natural Resources Division leads the effort inside the agency with a large network of partners engaged in those efforts. Both food insecure and producers/exporters are targets for FAO capacity development.

b) National on-going efforts by many nations to leverage on the increasing offer of ‘public good’ space-based Remote Sensing data to add timeliness and transparency to their systems and reducing costs from traditional systems. In all countries, capacity can be further enhanced for operational uptake of EO to support their own national strategies and contribute to the G20 goals of bringing stability in global food prices.

c) On-going and developing cooperation between GEOGLAM members, Agriculture and Development Agencies to enhance agricultural monitoring capabilities through the enhanced use of EO. For example, the cooperation between JAXA and other Japanese partners with many organizations in South-East Asia for enhancing capacity on rice monitoring and yield forecasting (Asia-RiCE programme) and cooperation between USDA, FAO and Pakistan national and regional authorities to build capacity at Crop Reporting Services in Pakistan. The Gates Foundation is supporting a number of GEOGLAM members in the use of EO for agriculture in a number of countries in Africa

d) Promotion of remote sensing products on agricultural weather and climate services. WMO and EUMETSAT organized three Training Sessions on the use of Satellite Data and Products for Agricultural Meteorology for African countries. They were supported by the JRC, FAO, University of Reading, Meteo-Belgique, University of Lisbon and the State Agency for Meteorology in Spain (AEMET).

▪ **Component 3** (Countries at Risk) builds on a number of on going programs:

a) The EU JRC MARS unit with its long tradition of investing (and supporting the development of) in crop monitoring in many North-African and African countries, as well in the Black Sea Region;

b) The Food and Agriculture Organization Global Information and Early Warning Systems (GIEWS) <http://www.fao.org/giews/english/index.htm>. The GIEWS has developed tools for visualizing remote sensing imagery and methods for crop and food security missions, emphasizing early warning in African countries, as well as Latin America and South east Asia;

c) The Famine Early Warning Systems Network (FEWS NET), which is a USAID-funded activity that collaborates with international, regional and national partners to provide timely and rigorous early warning and vulnerability information on emerging and evolving food security issues. NASA, NOAA, USGS, WMO WIGOS and USDA/FAS are members of the FEWS NET network of partners.

This component requires a specific strategy that differs from the G20 and Global Systems as it addresses different crops and agricultural systems found throughout Africa and South Asia.

▪ **Component 4** (EO data coordination) is the coordination effort to increase the use of Earth observations to improve operational agricultural monitoring. For this GEO relies on its space-based arm which is the Committee on Earth Observation Satellites (CEOS), a group of the world's civil remote-sensing space agencies. A joint co-community effort is in place to develop requirements, the data and implementation plan for coordinated, sustained satellite acquisition and processing for agricultural regions of the World. Increasing attention is being given to the emergence of private sector satellite operators, providing fine resolution data from constellations of privately owned systems. Partnering with the WMO Agricultural Meteorology Programme, GEOGLAM will also use meteorological syntheses based on in-situ and short-term and mid-term forecasts and increase the availability of gridded datasets into the WMO Information System (discoverable in GEO CGI), which is key for the initiative as whole, and specially for the At Risk Countries early warning information chain.

▪ **Component 5** (R&D Coordination) is largely concerned with the implementation of the Joint Experiments (JECAM) (see <http://www.jecam.org/>) as the primary R&D component of GEOGLAM where data and methods are shared and compared and best practices are developed. As such JECAM has provided the test bed for the CEOS data acquisition effort in supporting crop monitoring from satellites. In addition there are a number of operational research and development activities within the framework of GEOGLAM, which are adapting new research and technology developments for operational agricultural monitoring. Examples include geospatial technologies, crowd sourcing and the development of new EO products.

▪ **Component 6** (Outreach and Dissemination) accounts for the information system where datasets can be discovered and the GEOGLAM information to its stakeholders will be available. The system will be designed during Phase 1/2. GEOGLAM will utilize the GEO Infrastructure Tasks and teams for

developing and enhancing its information systems. As a first step a GEOGLAM website is under development and will be online by December 2013.

GEOGLAM is a very complex initiative, with institutions involved all over the World dealing with widely different agriculture structures from producers/exporters to food insecure countries and activities. The component's structure is designed to facilitate implementation, management and coordination. But one must keep in mind that GEOGLAM is not made up of pieces that are disconnected. The cross-cutting components really encompass the main pillars of GEOGLAM and the enhancement of national capacity takes into consideration the multiple needs of different stakeholders, countries and regions. This very complex nature and funding is reflected in the work plan of GEOGLAM and impacts its implementation.

• **GEOGLAM GOVERNANCE**

GEOGLAM comes from the strong network of institutions gathered in the GEO Agricultural of Practice, setup in 2007 to advance the GEO Agriculture strategic target by implementing a specific task as part of the GEO work plan. As such there is a significant range of both institutional culture and capacity level. To be able to implement its goals GEOGLAM requires a governance arrangement that is simple enough but goes beyond the overall GEO approach to manage its Work Plan and target progress assessment.

The structure for the governance model is shown below in **Error! Reference source not found..**

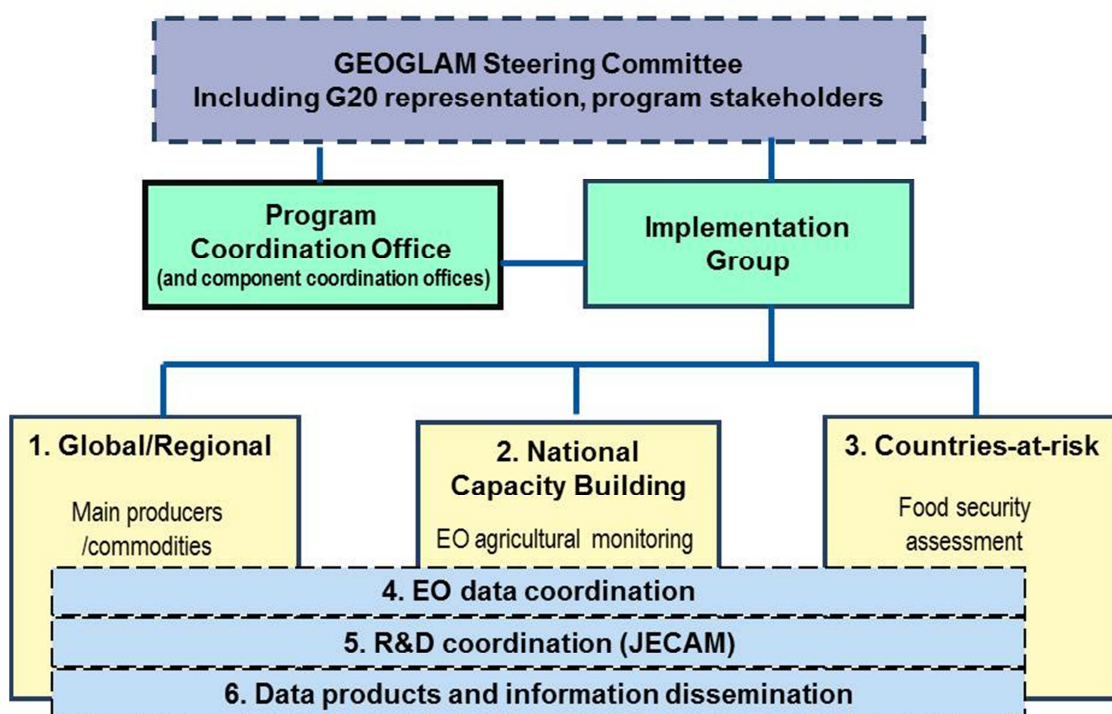


Figure 2 - The GEOGLAM governance model

The governance of GEOGLAM takes into consideration the voluntary nature of GEO, with a dedicated Program Coordination Office initially hosted by the GEO Secretariat, consisting of a Program Coordinator (high-level P5 equivalent), a junior expert (mid-level P3 or P4 equivalent) and a secretary staff. Each GEOGLAM component has an implementation team formed by leads from the projects contributing to its deliverables. Components are encouraged to establish their own coordination offices to help manage the component implementation, working closely with the Program Coordination Office. The structure requires an Implementation Group with membership from its 6 components. The initiative also requires a Steering Committee with membership including G20 representation and other stakeholders (such as AMIS and representatives of donor organizations).

The general organization and roles of the governance entities are as follows:

Steering Committee:

Stakeholder Program Steering and Donor Coordination.

Program Coordination office:

- Program coordination;
- Fund raising and management;
- Program reporting and outreach;
- Ex Officio member of the Steering Committee.

Component Coordination Offices:

- Coordination of Component Implementation Groups;
- Component reporting and outreach;
- Liaison with the Program Coordination Office.

Implementation Group:

- Coordination across Implementation Teams;
- Reporting to and discussion with the Steering Committee on progress and future developments;
- Coordination with other partner programs;

Implementation Teams (for each component):

- Representation from the individual project/activities.

Projects (with Project Leads):

- Projects/activities contributing to meeting the GEOGLAM goals.

The Implementation Group will either elect a chair for a two-year term from the team or appoint the Program coordinator to the position.

1.8 Terms of Reference for the Program Coordinator

The (draft) Terms of Reference for the Program Coordinator are to respond to duties in two categories:

1) External Relations with donor, intergovernmental and potential host organizations and, 2) Coordinate GEOGLAM programmatic implementation.

External relations duties are:

- Promote the GEOGLAM strategy and outputs on the international scene, and propose relevant adaptations to GEOGLAM Work Plan in response to the evolution in societal demand;
- Establish interfaces and cooperation with other international Agriculture-related initiatives, programs and institutions (e.g. FAO, AMIS, CGIAR, the World Bank, G20 agriculture and existing global and regional agriculture monitoring programmes);
- Negotiate with potential donor organizations to ensure sufficient funding for a sustainable implementation of GEOGLAM work program with an adequate balance between its components (e.g. projects for R&D, product development, capacity development, animation and coordination);
- Help interface with the Committee on Earth Observing Systems (CEOS) to assure ongoing data supply supporting the requirements of participating countries;
- Negotiate with potential donor organizations, image providers and CEOS to facilitate bulk purchases of (non-core mission) satellite data required to support the Work Plan;
- Support the definition of a long term implementation of GEOGLAM activities in terms of technical, legal and organizational aspects, and commence exploring institutional candidates and criteria for long term hosting of GEOGLAM;
- Coordinate voluntary national leads for the GEOGLAM components;
- Encourage national support for GEOGLAM;
- Liaise with G20 POCs for GEOGLAM and AMIS;

Programmatic implementation duties are:

- Coordinate the implementation of GEOGLAM Work Plan and activities in its 6 components and provide the necessary coordination with the GEO Agricultural Monitoring Task (Ag 01) and the associated Agricultural Monitoring Community of Practice, as well as other relevant tasks of GEO/GEOSS;
- Establish and manage the necessary reporting process for GEOGLAM;
- Ensure the information to partners and stakeholders on activities and progress which may impact their interest with the GEOGLAM implementation, including regular reporting to the GEOGLAM Coordination Committee, preparation of draft reports to the GEO Executive Committee and Plenary;
- Interface with the Agricultural Community of Practice and the science community to ensure that GEOGLAM Best Practices documents are developed, published and updated, incorporating results from coordinated R&D activities;
- Develop criteria and procedures for participation of countries in GEOGLAM, as contributors and/or as beneficiaries, and assure representation of participating countries in the GEOGLAM Implementation, with particular emphasis on developing/risk country participation;
- Help coordinate specific GEOGLAM capacity development activities with related international programmes;
- Manage GEOGLAM Office staff in accordance with WMO HR and participating organizations practices; develop the GEOGLAM Office's budget and human resources;
- Organize outreach, newsletter, workshops and accounting.

1.9 Terms of Reference for the Implementation Group

The (draft) Terms of Reference for the Implementation Group are:

- Coordinating activities across the Components
- Plan and timely review the activities carried out by the Components within GEOGLAM, according to its Work Plan;
- Keep stakeholders informed of progress and activities which may impact their interest with GEOGLAM implementation;
- Develop pathways for participation of countries in GEOGLAM, both producer/exporters and countries at risk;
- Interface with the Committee on Earth Observation Satellites (CEOS) for the ongoing data supply supporting the requirements of participating countries and reporting to CEOS on the use of EO data provided;
- Interfacing with the science community to ensure that coordinated R&D activities are conducted and relevant results incorporated into a GEOGLAM best practices documents, to be updated as necessary;
- Provide liaison to partner programs and develop specific GEOGLAM capacity-development activities while ensure coordination with related international capacity-building programmes.

1.10 TORs for the Steering Committee (in progress)

- To represent stakeholder interests;
- To review periodically the progress of the GEOGLAM Program;
- To provide guidance to the GEOGLAM Program to help ensure its success;
- To work with the Program Coordination Office to help identify new stakeholders that would benefit from the program and funding sources to support the activities.

- **GEOGLAM CURRENT STATUS AND ACCOMPLISHMENTS**

There is to-date many achievements to GEOGLAM's credit such as:

- 1) A substantial effort of coordination with CEOS agencies to develop the GEO agricultural monitoring requirements and the satellite data acquisition plans, through many meetings and teleconferences;
- 2) Development of the GEOGLAM Crop Monitor. Generation and contribution to monthly Global Crop Outlooks for the main commodities of interest to the G20 Action Plan on Agriculture, communicated to AMIS on a monthly basis, with the establishment of the necessary networks for the global crops outlooks, combining satellite and in-situ inputs and expertise;
- 3) Establishment of a network of pilot sites across the globe for developing sharing best practices (www.jecam.org);
- 4) Development of a new regional system, the Asia Rice Asia-Rice Crop Estimation & Monitoring (Asia-RiCE, <http://asia-rice.org>);
- 5) A Community of Practice with more than 300 members engaged in achieving the GEO strategic targets for agriculture;
- 6) Developed and shared the best available cropland map based on satellite imagery;
- 7) Set up of the framework for new regional organizations and agencies interested in enhancing their agricultural monitoring services to join (example SADC);
- 8) Several funded projects in support of GEOGLAM and its components, such as a EC SIGMA Project, ESA Sentinel2-for-Agriculture, JAXA's Asia-RiCE, NASA's GEOGLAM Support Project;
- 9) Attracted the attention of donors such as the Gates Foundation to fund GEOGLAM Members as GEOGLAM goals help them meet their priorities (STARS project);
- 10) National engagement in developing capacity for incorporating EO into their crop projections system (Argentina, Australia, Brazil, Ukraine, Mexico, Pakistan, Tanzania, Algeria, Morocco, Tunisia...);
- 11) Several activities for countries-at-risk and involving the GEO Agricultural CoP being better coordinated. France Ministry of Agriculture secondment of GEOGLAM program coordinator; USDA setting up a GEOGLAM Global Component Office by USDA.

• THE PHASED APPROACH FOR GEOGLAM IMPLEMENTATION

1.11 The Phased approach of main pillar components

GEOGLAM aims at responding to the lack of reliable and up-to-date information on crop supply, using remotely sensed, satellite-derived information. The use of satellite-based data will bring transparency and timely information for decision making on food security. The expected outcome of GEOGLAM will be an improved and more harmonized system of systems taking advantage of new satellite assets, in-situ data information and methods, as well as a higher level of international coordination amongst and between many diverse agricultural monitoring programs and activities.

The phased implementation across all components will have 4 phases through approximately 2017.

Phase 1 (P1): The 2012-2014 time frame has focused on foundation activities, building on existing activities and pilot projects for a few countries, and scoping out the programme for the following years;

Phase 2 (P2): The 2015-2016 time frame will review and expand previous activities with new starts;

Phase 3 (P3): The 2016-2017 (approximately) time frame will be the last building pre-operational one with the completion of previous projects and geographical expansion, leading to 2018 when the Operational Phase starts.

Phase 4 (P4): The operational phase will begin circa 2018.

• *Global / Regional components phasing*

For the Global/Regional systems (Component 1), P1/P2 activities include the Crop Condition Global Outlook for building international consensus and the development of new and improved global baseline data sets needed in support of the monitoring. P2 and P3 activities will include the harmonization within different systems for GEOGLAM ultimate goal to deliver timely information on crop production using repeatable scientific methods to augment current operational procedures.

• *National capacity development phasing*

Concerning the national capacity development (Component 2), for both main commodities (wheat, maize, rice and soybeans) producer/exporter countries and Countries at Risk. Table 1 below shows the main activities spanning over P1 and P2. Four steps were identified as necessary to establish a road map for national capacity development building on linkages & feedback between global/regional monitoring systems and activities ; 1) Develop a series of regional workshops for status assessment, needs and priorities; 2) National engagement and commitments by interested parties; 3) National Implementation and 4) Regional training / information exchange and continued regional networking.

Table 1 - Phased approach for national capacity development

Argentina	
2012-2014	Assessment of current status and priorities for enhancements – crop monitoring
2012-2014	Crop condition monitoring/cropland mapping/ crop area prototype
2015-2016	Prototype yield, evaluate crop area approach and expand
Mexico	
2012-2014	Regional Needs Assessment Workshop
2012-2014	Cropland mask and crop type mapping
Russia – Ukraine/Belarus/Kazakhstan	
2012-2014	Regional Needs Assessment Workshop

2015-2016	National Engagement
Australia	
2012-2014	Assessment of current status and priorities for enhancements – crop monitoring
2012-2014	JECAM/crop condition/cropland mapping/ crop area prototype
2015-2016	Prototype yield, evaluate crop area approach and expand
Brazil	
2012-2014	Scope out activities for in-country institutional arrangements for including/increasing use of EO in the crop statistics/monitoring system
2015-2016	Prototype/pilot studies
Asia-RiCE team: Thailand/Indonesia/Philippines/Vietnam/Japan/Chinese Taipei and other agreed	
2012-2014	Rice crop monitoring pilot activities in technical demonstration sites (provincial level) in Asia RICE countries and provision of agro-met based outlook for selected countries (Thailand, Indonesia, Vietnam, Philippines and Japan) in cooperation with AFSIS and target countries agriculture experts
	Implementation and workshop / capacity building
2015-2016	Wall-to-wall rice crop monitoring in selected Asia-RiCE member countries Rice crop outlook service GEOGLAM augmentation needed in terms of operational data access – ALOS2/RISAT /Radarsat-2 /Sentinel 1/CSK and TerraSAR-X with selected optical sensors and archived SAR such as ALOS.
Pakistan	
2012-2014	Capacity Building for Crop Reporting Services
2015-2016	Capacity Building for Crop Reporting Services
Uganda	
2012-2014	Pilot Early Warning and National Monitoring (NUDC/FEWSNET)
2015-2016	Pilot Early Warning and National Monitoring (NUDC/FEWSNET)
Ethiopia	
2012-2014	National Monitoring System (FAO and others)
2015-2016	National Monitoring System (FAO and others)
Algeria	
2012-2014	Crop outlook and yield forecast (EU/INRA Min Ag)
North Africa (regional)	
2012-2014	Regional Workshop on Status and Needs (EU/JRC)
Southern Africa (regional SADC)	
2012-2014	AMESD / MESA / GEOGLAM Workshop on National Monitoring (EU)
2015-2016	Pilot activities (crop condition, area, yield)
2015-2018	Implementation of a regional/national operational system / Moderate Resolution Data Delivery

- **At-risk countries component phasing**

Regarding at-risk countries (component 3) East Africa was selected as the initial target region, given that there have been identified potential partners and in-kind sources such as JRC, FAO GIEWS, FEWSNET CMRD, the SERVIR regional hub, ICPAC and the Gates Foundation. The component identified activities in Phases 1 and 2, build on existing systems and established collaborative networks (with potential for growth). The phased approach can be summarized in Table 2. The issues identified are of a capacity development nature in terms data sets, data gaps and training, for food “insecure” countries with specific cropping systems.

Table 2 - Countries-at-risk phased approach summary.

Data Sets	
2012-2014	FEWS NET Global gridded rainfall FEWS NET MODIS ET FAO Agricultural Stress Index
2015-2016	Work with WMO to strengthen national climate station and crop reporting networks
2015-2016	Leverage advanced computing capabilities to apply high- to medium-resolution (5m - 30m) imagery to seasonal monitoring for early warning (Rapid Eye, Landsat, Sentinel 2, etc.)
Data gaps	
2012-2015	FEWS NET/WMO/GEO Workshop with East Africa National Met Services
R&D	
2012-2014	National and sub-national crop production shortfall risk profiling – loss exceedence probability functions
2012-2014	Long time-series agricultural drought indicator
Training	
2012-2014	Exploration and application of FEWS NET gridded rainfall and MODIS ETa data sets
2012-2014	Exploration and application of FAO agricultural stress index data set

With regard to rice monitoring, there are countries in Asia subject to food security issues associated with weather associated disasters such as floods. For management simplicity, this particular area will be dealt with by the GEOGLAM Asia Rice team.

1.12 Cross Cutting Components

Component 4 (Satellite and in situ data coordination) is key to the success of GEOGLAM and is being developed with the support of CEOS for satellite data and WMO for the weather data. A CEOS Ad-hoc Advisory Team was created to take responsibility for working with GEOGLAM to further develop the space-based observations component suggested by the draft Work Plan. The Ad-hoc Advisory Team is composed of representatives from the following agencies: CONAE, CSA, ESA, INPE, ISRO, JAXA, NASA, and USGS. It includes participation from CEOS Agency staff with expertise in satellite mission planning, coordination, and management, and the use of space-based EO data to generate actionable information for agricultural decision-makers. The composition, skill set and expertise of the CEOS Ad hoc Advisory Team on GEOGLAM allowed the group to develop a coordination framework to address the CEOS SIT actions and initial needs of GEOGLAM.

Also, the GEOGLAM partners will liaise with other potential partners and projects that seek to improve in-situ soil moisture observations. These projects include the WMO/George Mason University project that will integrate coarse resolution satellite information with in-situ soil moisture measurements in South Africa. There is a proposal to install soil moisture sensors in Ethiopia and possibly a country in West Africa. Also to be brought into the early warning systems is the global in-situ soil moisture database being established by the International Soil Moisture Network (<http://ismn.geo.tuwien.ac.at/>).

Another important aspect of determining agricultural production is using weather forecasts to aid in assessing the final agricultural production number. Based on the recommendation from a WMO/GEO/WCRP International Conference held in November 2014 in the Republic of Korea, WMO is developing a pilot project using weather forecasts from the Sub-Seasonal to Seasonal (S2S)

Prediction Project for developing potential applications for agricultural and drought monitoring. The objectives of the S2S project are to improve forecast skill and understanding on the subseasonal to seasonal timescale and to capitalize on the expertise of the weather and climate research communities to address issues of importance to the Global Framework for Climate Services. These daily forecasts will be provided by several weather forecasting centres around the world starting in the first half of 2015 and will be extended up to 60 days. WMO will work with several Republic of Korea institutions to provide pilot products through the World AgroMeteorological Information Service (www.wamis.org). For further information on the S2S project go to <http://s2sprediction.net/>.

- **Earth Observation coordination phasing**

The proposed approach suggests an implementation strategy in three phases over five years preceded by an 18 month phase 0 (completed). The phasing is dictated in part by the planned availability of new space-borne assets needed by GEOGLAM. The proposed phasing would permit an evolution of growing capacity in several parameters: a) Increased number of countries; b) Integration of additional sensors as agencies and new sensors come on board, and datasets are made available; c) Assimilation, processing, product creation, distribution and integration of information products into decision making processes, and, d) Capacity building, particularly in at-risk countries for ingestion and processing of EO data. The following phasing for this component is as:

Phase 1/2: Support for demonstration and feasibility (2013-2015). The work will test sample sites and information products, to validate their usefulness, robustness and affordability. The focus will be on major commodities (wheat, maize, rice and soybean). Some observations will be wall to wall, others will be sampled. The Rice Monitoring pilot activity will be expanded with available SAR data in Asia and other region.

Phase 2/3: Assessment and expansion phase (2014-2016). This phase will pilot a global sampling strategy for the main producers. There will be new regions for wall-to-wall coverage (about 5.) . New missions will be added (i.e. Sentinels & Brazil's Amazonia). SAR missions will be also added. The Rice Monitoring study plan will be expanded with available SAR data in Asia and other regions. New information products will be added. A sampling strategy will be started for at-risk countries.

Phase3: Pre-operational details (2016 – 2017). This phase will solidify the sampling strategy for at-risk countries. Global information will be produced. At the end of Phase 3, all large producer countries will be covered (global producer sampling), 3-5 at risk countries will be covered, and new missions will be integrated.

- **R&D phasing**

The R&D Component (5) builds on two kinds of actions:

- on different international and national R&D projects, such as the EC FP7 SIGMA (Stimulating Innovation for Global Monitoring of Agriculture and its Impact on the Environment in support of GEOGLAM, November 2013-March 2017) or STARS (Spurring a Transformation for Agriculture through Remote Sensing, June 2014-February 2016). By nature, these projects are limited in time.
- on JECAM, the Joint experiment for Crop Assessment and Monitoring, a permanent GEOGLAM action aiming at reaching a convergence of approaches, develop monitoring and reporting protocols and best practices for a variety of global agricultural systems.

The phased approach for JECAM in promoting R&D towards monitoring enhancements include in Phase 1 (2013-2014): a) Annual JECAM Meetings; b) Directed Workshops to address GEOGLAM research needs, including National Capacity building; c) SAR for Soil moisture Monitoring, SAR for monitoring crops in tropical-subtropical regions, d) Sampling Frameworks for agric monitoring, and, e) Best practices for crop monitoring. Phases 2 and 3 will focus on directed research funding for collaborative research in support of GEOGLAM priorities.

- ***Information system development phasing***

In 2014, Component 6 phasing has focused on organizing the GEOGLAM website and the interface for the Global Crop Outlooks. In 2015, working with the GEOSS Common Infrastructure (GCI) team, a dedicated GEOGLAM team will develop the requirements and road map for the GEOGLAM information system. Help will be also sought from other relevant GEO IT Activities and partnership will be explored with other programs focussed on collection and dissemination of agricultural information e.g. GEOSHARE.

- **FIRST STEPS TOWARDS IMPLEMENTATION – 2013-2014 PHASE 1/2 TIMEFRAME**

1.13 Global / Regional Agricultural Monitoring Systems

- **Summary**

In recent years, there has been increasing demand for more accurate and timely forecasts of global agricultural production. The primary focus of the Global Monitoring component of GEOGLAM to-date has been the use of EO (ground and satellite-based observations) for enhanced provision of timely, accurate, objective, actionable information on crop condition, and crop production forecasts of the major producer and export countries which produce over 80 percent of global crops and strongly influence international commodity markets. The activities within this task build on the existing key monitoring systems at global and regional scales that are focused on the main production countries. These monitoring systems include the USDA Foreign Agricultural Service CropExplorer, EC JRC MARS unit, China RADI/CAS CropWatch, and UN FAO GIEWS. This component is designed to augment and strengthen the current operational monitoring capabilities within these global systems. A major activity has been the development of harmonized consensus crop assessments, focused on four major crops, corn, wheat, rice, and soy, with the eventual extension to other main commodities (such as sorghum and sugar crops). The system developed to provide this information to the G-20 Agricultural Market Information System (AMIS) is the GEOGLAM Crop Monitor. As inputs to AMIS, we are developing enhanced baseline global datasets critical for agricultural monitoring and robust global EO-based indicators. We are also fostering relationships with crop assessment groups around the World and exchanging methods, data, and tools between the global/regional monitoring systems and national systems, and strengthening linkages with the policy and decision makers who are primary users of within-season information on crop condition and prospects. There is an emphasis on ‘consensus of evidence approaches,’ which integrate data from multiple sources including Earth observations, crop models, weather data, surveys, and ground observations to reach evidence-based assessments using repeatable, scientifically-sound methods. In Phase 1/2 we initiated the design of a global rangelands activity. In addition, in this component we are undertaking research and development to quantify agricultural land use change around the world and examine the impacts of extreme climate events on food production, examining their impacts on food security and the environment. The component is also fostering partnerships with other related global programs as appropriate.

- **Current Status**

During 2013-2014, the GEOGLAM Community of Practice has made significant progress within this global component in terms of securing agency and partner commitments, building community, developing a working relationship with AMIS, generating new products, expanding visibility, and engaging high level support. Specifically these accomplishments include:

- Development of the Crop Monitor and provision of monthly crop assessments for AMIS including contributions from multiple national and international partners, coordinated by UMD;
- Release of monthly Bulletin by CropExplorer by USDA;
- Release of monthly MARS Bulletin by JRC;
- Release of quarterly CropWatch Bulletin by RADI/CAS;
- Release of monthly ASIS crop stress indicator by FAO;
- Release of a beta best available Global Croplands map produced by IIASA;
- Release of beta crop specific calendars in the framework of the Crop Monitor;
- Release of spatially explicit cropland phenology (agricultural growing season calendars);

- Transfer of capabilities from global/regional systems to strengthen national systems including JRC tools and data availability within FAO GIEWS, USDA/NASA/UMD GLAM prototype system within Argentina, Australia, Brazil, Pakistan and Mexico; CropWatch drought system for Mongolia;
- Development of the Asia-RiCE team led by JAXA with ISRO and other countries in cooperation with AFSIS;
- Dissemination by Asia-RiCE team of results of international projects such as, "ADB technical assistance program for estimate rice crop production using SAR in Thailand, Vietnam, Philippine and Lao PDR" to GEOGLAM partners

Significant funding commitments include:

- FP7 SIGMA Project (with key contributions to the global GEOGLAM component) 9 million Euros;
- NASA support for GEOGLAM Crop Monitor and Outlooks development and related activities ~ 500K;
- CAS and China State Grain Administration support for enhancing CropWatch (12Million CNY), and China GEO indicates support for Coordination and Dissemination;
- JAXA - GEOGLAM Asia-RiCE (in-kind and projects under APRSAF (Asia Pacific Regional Space Agency Forum) and other international projects such as AFSIS, ADB Technical Assistance project, etc.);
- CSIRO - rangelands planning workshop;
- JRC (in-kind and projects);
- FAO (in-kind and projects).
- USDA in-kind support for GEOGLAM Global R&D Component Coordination Office

- ***Objectives, activities and expected outcomes***

The global component of GEOGLAM aims to strengthen capacity for timely agricultural monitoring of the main producer countries. This is being accomplished through five primary activities:

- Development of harmonized global crop outlooks,
- Coordination and enhancement of new or improved global baseline datasets and EO-derived monitoring products
- Strengthening monitoring systems through EO
- Global Rangelands Monitoring
- Agricultural Land Use Change and Climate Change (Phase 2/3)

- **Development of harmonized global crop outlooks**

The goal of this activity is to provide timely information based on EO, weather data, agro-met models, and expert knowledge through the development of a transparent, timely, qualitative crop condition assessment in primary agricultural production areas, highlighting potential hotspots of stress or conversely bumper crops. Through the Crop Monitor, elaborated global information on crop condition and prospects are provided to the AMIS Market Monitor with a common global qualitative outlook (overall growing status, areas under specific agro-climatic conditions likely to impact global production and impact factors, monthly);

- **Coordination and enhancement of new or improved global baseline datasets and EO-derived monitoring products**

This activity is focused on compiling and enhancing baseline geo-spatial datasets that are fundamental for improving our capability to effectively monitor global agriculture, such as cropland distribution and crop calendars. There is a lack of harmonized, up-to-date, accurate global information at the needed spatial resolution and as such there are several on-going and planned efforts for enhancing these datasets. This component builds on existing initiatives and new GEOGLAM projects focused on

deriving enhanced products, as well as improved global geo-datasets for required for operational agricultural monitoring. This includes:

Baseline Data Sets

- Arable land, cropland maps;
- Agro-ecological zone map;
- Crop type distribution;
- Growing season calendars;
- Crop specific calendars;
- Cropping systems and crop management;
- Agro-meteorological data such as soil moisture, drought index, PAR, LST, precipitation;
- Historical statistics (> 15 years) on area and yield, breakdown at an appropriate sub-national level;
- Field size distribution;
- Rangelands extent/distribution;
- Livestock numbers and distribution;
- Environmental and biophysical crop variables

EO-Derived Products

- Global Vegetation Indices;
- Global Soil Moisture;
- Global Precipitation
- Global Weather Data
- Six-month Climate Forecasts

• **Strengthening monitoring systems through EO**

Near real time (NRT) data processing and dissemination of global RS data for crop condition monitoring

R&D and evaluation of new Earth observation-based indicators of crop conditions

Transition of global / regional crop condition monitoring systems for national use;

Initiating a global / regional NRT reporting system on crop condition, pests and diseases;

Prototyping and developing interoperable EO data sets from similar sensors, ensuring continuity of critical data streams including NASA MODIS, VIIRS and Sentinel 3, LDCM and Sentinel 2, FY-3;

Inter-comparison and harmonization of existing global monitoring systems concerning their results and methods for understanding discrepancies, system feedback and improvement;

Development of benchmarking datasets for models/methods and validation through the GEO Joint Experiment for Crop Assessment and Monitoring (JECAM);

R&D on crop area and yield indicators of main crops within the main producer and export countries including using multi-resolution and multi-sensors Earth observation data to obtain an area-change indicator (early area estimate predictor); soil moisture for water stress; and cropping pattern, crop biomass and harvest index. This includes R&D on both process and empirical EO based yield models.

• **Global Rangelands Monitoring**

Adding monitoring of livestock production and productivity from global rangelands and pasture lands; and

Develop improved methods to model herd dynamics in rangelands and pasture lands.

Establish several National Pilot sites with in-country collaborating institutions in order to evaluate satellite derived products and validation of biomass estimates.

- Agricultural Land Use Change and Climate Change (Phase 2/3)**
 The mapping and regular monitoring of significant agricultural land use and cropping system changes at global to regional scales;
 Developing the satellite component of spatially explicit projections of the global effect and impacts of extreme weather events and climate change on agricultural production (with partner programs and groups e.g. AGMIP, IIASA).
- Phased approach**

Table 3 -Global/regional systems Activities and Schedule (2014-2016)

Activity and Short Description	Status	Institutions/ coordinating teams	Budget category
1. Crop Outlooks for AMIS			
1.1 Operational monthly harmonized outlooks (com, wheat, soy, rice) and delivery to AMIS	Ongoing	UMD and Crop Monitor POC's	Routine outlooks (main commodities)
1.2 Operational provision of rice outlooks in the GEOGLAM Crop Monitor - involving national POC's	Ongoing	Asia-RICE Consortium	Routine outlooks
1.3 Refinement of the Crop Monitor Interface	Ongoing	UMD	Information system
1.4 Sub national statistics	Ongoing	Crop Monitor POC's	
1.5 Development of EO-based Production Indicators	Ongoing	GEOGLAM CoP	R&D
1.6 Workshops and AMIS meetings: 2 workshops & 2 AMIS meetings/ year	Ongoing	Various Crop Outlook POC's	Workshops
2. Global Baseline Datasets and Coordination		UCL/ UMD/ FAO/ IIASA/ EC FP7 SIGMA	
2.1 Crop calendars Compilation of best available gridded crop calendars Development of a new enhanced spatially detailed crop type calendar product	ongoing	FAO/UMD	Information system
2.2 Cropland distribution Compilation of best available products New initiatives for enhanced products	ongoing	UCL/ IIASA/ FAO/ NASA	Information system
2.3 Crop type distribution Compilation of best available New enhanced products	ongoing	UCL/ IIASA/ IFPRI/ NASA	Information system
2. 4 Cropping systems	planned	EC FP7 Sigma, RADI	Information system
2.5 Crop Variables	planned	EC/FP7 Sigma	Information system
2.6 Rangelands typology and distribution	planned	CSIRO	Information system

2.7 Livestock numbers and distribution	planned	CSIRO	Information system
2.8 Rangelands distribution	planned	CSIRO	Information system
2.9 National sub-national stats on production, area and yield	ongoing	UMD/ FAO/ JRC/ RADI/ USDA	R&D Forecast
2.10 Evaluation & Validation	planned	EC FP7 Sigma	R&D Forecast
3. Enhancing Existing Monitoring systems		JRC/ FAO/ UMD/ USDA	
Transition capabilities, methods and tools from global systems to regional systems Strengthen collaborations with regional systems	ongoing	JRC/ RADI/ UMD/ USDA/ NASA/ FAO	R&D Forecast
Data integration across platforms Includes interoperability of data across missions (ie. NASA VIIRS/MODIS)	ongoing	NASA/ CNES/ USDA/ USGS	Routine outlooks
Harmonization between global/regional systems	Planned	USDA/RADI/ JRC	Routine outlooks
Global R&D on global crop indices, metrics	Ongoing	FAO/UMD/JRC/ RADI	R&D forecast
4. Global Rangelands Monitoring			
Continued develop community of practice. 3 rd workshop planned	Ongoing	CSIRO	Workshops
Current status assessment, development of implementation activities and pilot studies	Ongoing	CSIRO	Workshops
Current status assessment, development of implementation activities and pilot studies	Done	CSIRO/INRA	Workshop at INRA France
National Pilot Coordination Meeting	Proposed	CSIRO	Brazil

Table 4. Indicative Cost for Global/regional systems for phases 1/2

		Phase 1 2012	Phase 1 2013	Phases 1/2 2014
Global/regional systems (main producers & commodities)	Prototype outlooks	0.5	0.5	0.5
	Routine crop outlooks		0.5	1.0
	Asia-Rice Pilot studies	0.4	1.0	1.0
	Asia-Rice Forecasts/production	0.2	0.3	0.3
	Information system	0.1	0.1	0.1
	R&D Forecast	0.1	0.1	0.2
	Workshops		0.2	0.2
Sub tot Mio US \$		0.3	2.7	3.3

1.14 National Capacity Development for Agricultural Monitoring

This component focuses on supporting national and regional institutions willing to develop agricultural monitoring capacities through the use of Earth observations and modelling. Most countries have some form of agricultural monitoring system, but the level of uptake and use of Earth observations is extremely variable. In a number of cases traditional statistical field-based methods are used and do not benefit from the synoptic information that is afforded by current Earth observation data. In many instances, there is a lack of coordination between institutions that develop and utilize remote sensing for agricultural monitoring and the agricultural ministries or statistical services responsible for operational agricultural production monitoring. There is also much to be gained by sharing experiences and approaches for the use of remote sensing between countries with similar crops (and cropping systems) and between countries with significant livestock numbers on pasture or rangelands. This component will provide technical and institutional training, training of trainers, methodological guidelines and tools, identification and documentation of best practices, facilitated access to Earth observation including meteorological data (component 4), and access to expert advice and support. GEOGLAM will stimulate networking and the sharing of technical experience between all G20 and other countries focusing on the main producers/exporters identified in co-operation with AMIS and FAO, as well as countries identified as at-risk (Food insecure) where Earth observations and crop models could improve present information.

- **Background**

GEOGLAM aims at improving operational global and national crop area and production estimates and weather forecasting using EO and their timely dissemination. It will respond to the lack of reliable and up-to-date information on crop supply, bringing transparent and timely information for decision making on food security. GEOGLAM will re-enforce countries' capacity to conduct agricultural monitoring by supplying reliable observations, helping to build capacity, developing methods and guidance and encouraging coordinated research and development. Key to success lies in the availability of coordinated satellite and in situ observations, and in providing guidance to help ensure that these data are processed appropriately. Networking and sharing of technical experience between all G20 and other countries focusing on the main producers/exporters and countries identified as at-risk (food insecure) will also be an important outcome of the programme. The National Capacity Development component focuses on supporting national and regional institutions that are willing to develop agricultural monitoring capacities, in the integration of in-situ and earth observation data and methods.

- **Current Status**

Most countries have some form of agricultural monitoring system, but the level of uptake and use of Earth observations is extremely variable. In a number of cases traditional statistical field-based methods are used and do not benefit from the synoptic information that is afforded by current Earth observation data. In many instances, there is a lack of coordination between institutions that develop and utilize remote sensing for agricultural monitoring and the agricultural ministries or statistical services responsible for operational agricultural production monitoring. There is also much to be gained by sharing experiences and approaches for the use of remote sensing between countries with similar crops and cropping systems and between countries with significant livestock numbers on pasture or rangelands.

- **Objectives and expected outcomes**

The GEOGLAM National Capacity Development component aims to develop/strengthen capacity of national agencies concerned with the collection, consolidation, and use of geospatial data to provide timely and precise agricultural statistics based on the integration of available datasets for improved

estimates. The methodology employed will be to increase the knowledge, skills, and competencies of their staff as well as facilitated access to EO data. Emphasis will also be placed on strengthening and sustaining the capacity of regional and national training centres to develop and deliver good-quality training in agricultural statistics and statistics-related subjects, with a focus on the efficient use of EO data.

The National Capacity Development component will provide technical and institutional training, training of trainers, methodological guidelines and tools, facilitated access to Earth observation including meteorological data and expert advice and support and assist with the identification and sharing of existing best practices.

Building on linkages & feedback with global/regional monitoring systems and activities, several steps were identified as necessary to establish a road map for national capacity development:

1. Define pilot countries/regions according to food surplus/exporter/importer. Phase 1 focus on 5 countries (3 G20 countries +2 food stressed countries) and 1 Region (Asia);
2. Conduct a series of regional workshops for status assessment, needs and priorities through regional incubator / institutions;
3. Encourage national engagement and commitments by interested parties;
4. Assess national capacity in agriculture monitoring and EO data use, and enhancement needs;
5. Define data coverage requirements based on national needs assessment;
6. Define processes and activities that can assist national implementation;
7. Support Regional training / information exchange and
8. Establish global / regional / national networks.

Expected outcomes are:

1. Improved crop area estimates and yield forecasts;
2. Strengthened capacity to include EO in national agricultural monitoring;
3. Facilitated access to EO data;
4. Shared information, experiences and data among countries with similar cropping systems;
5. Compiled inventory of active agricultural monitoring organizations and techniques they use.
6. Increased transparency of national monitoring systems and estimates
7. Functional networks (global, regional, national)

- **Activities, Schedule and Budget 2014-2016**

- **Phase 1: Tasks and activities**

The period 2012-2014 has focused on foundation activities, mainly existing initiatives for few countries, and scoping out the programme for the following phases.

This demonstration & early feasibility phase regards 5 countries and 1 Region (4 large producers according to AMIS and 2 'at risk' and focuses on the main commodities of concern to the G20: wheat, maize, rice and soybeans. Six main tasks have been identified to implement the national capacity development component of GEOGLAM:

- Set-up / preparatory phase;
- National needs assessment;
- National baseline datasets;
- Research & Development; best practices;
- Data, Products and Information Dissemination;
- Technical assistance and capacity building;

Following is a general description of each task.

- ***Set-up / preparatory phase***

Objective of this task is establishing the basis for GEOGLAM national implementation and phased approach by gathering information about the current status of agricultural monitoring and the use of remote sensing techniques. The activities for this task are:

Selection of countries / region:

Determination/grouping of countries/regions among food surplus/exporter/importer (AMIS) and “at risk” (FEWSNET). Three countries and one region as large producer (Australia, Argentina, Ukraine and Asia), two countries at risk (Uganda, Ethiopia) were selected.

Identification of point of contacts, candidate/existing regional incubators, national institutions:

With this activity the program aims to produce an inventory of active regional and national agricultural monitoring organizations (trainer/trainee communities) in order to identify regional centres of excellence that can provide remote sensing capabilities, develop statistical methods, and guide the implementation of information technologies in providing support to national institutions, and country based institutions which are responsible/mandated in the country for agriculture statistics creation and its supply. The establishment of regional centres could be a focal point for support from donors and international organizations. MOU’s will be developed as needed.

Regional assessment/networking workshop:

These workshops, which should be conducted in selected institutions/ incubators (statistics commissions, ECA, Regional entities, RCMRD, AGRHYMET, IGADD, CILSS, ECOWAS, SADC, AU, CGIAR Centres), aim to perform regional assessments, national engagements (country willingness, acceptability & uptake), demonstrations of capabilities, confidence building in RS results, enhancement of current systems, and regional and international coordination of agricultural, agro-meteorological and meteorological data. Agricultural services, national meteorological services, FAO, WMO, JRC, GEO and FEWSNET will discuss integration of in situ national data with regional/global weather products to improve outputs.

- ***National assessment***

Objective of this task is the assessment of national capacities for: 1. Agricultural monitoring (technical skills, institutional framework, infrastructure, access to data...); 2. The use of Earth Observation for agricultural monitoring; 3. Requirements in terms of capacity development and 4. The design of a national strategy for the continual improvement of the agricultural monitoring systems.

Develop country assessment methodology and questionnaire:

This activity regards the development and implementation of a methodology to assess current national agricultural monitoring capacity, analyze available resources, gaps and requirements and design roadmaps for capacity development for the use of remote sensing to support agricultural monitoring. A questionnaire will be prepared with learning from similar initiatives currently on going in countries such as Argentina. Particular attention will be given to building questions related to the agricultural monitoring system and statistical field-based methods and contribution of EO data. The questionnaire must also be able to assess training needs in order to design a country based training programme, and identify hardware, software and human resources existing or required for establishing or improving national monitoring programmes.

Assess national capabilities, gaps and priorities:

The implementation of the national capacity development component builds on a detailed country assessment that defines specific actions at country, regional, and international levels to identify priority areas, resources available/required, and timeframes. An in depth assessment will be conducted through the compilation of a standard questionnaire and report during country visits (3 weeks per country) and national workshops. The assessment will collect information on:

- o data, models, training and infrastructure available, gaps, needs and priorities.
- o EO and agrometeorological data requirements (for CEOS and WMO)
- o utilization of weather data by national meteorological services for national crop production estimates;
- o current sampling frame approaches and capacities to implement new approaches based on EO data.

Status of EO based national agricultural monitoring:

The following activity describes a specific country based analysis regarding the current status of agricultural monitoring and the use of remote sensing techniques

Based on existing international and national initiatives, this activity aims to analyze and report on current national agricultural monitoring systems and the level of inclusion of EO. Examples of national programmes that currently utilize EO are: GeoSafras Project of Brazil, Crop Condition Assessment Programme of Statistics Canada, China Agriculture Remote Sensing Monitoring System, FASAL programme of India, Cropland Data Layer (CDL) of the USDA NASS and other national systems.

The proposed analysis will provide the basis for defining EO data requirements and related attributes (type of data, frequency and timing of acquisitions, geographical areas, etc.) and to facilitate un-interrupted supply of EO data through CEOS.

- **National baseline datasets**

Objective of this task is to identify and assemble a set of “Agricultural Monitoring Essential Variables (AMEV’s) – a common set of core datasets comparable across space and time. These can be in part from national available archives, in part produced on an ad-hoc basis, but sustainability / regular updating of these AMEV’s will need to be ensured.

Available national core data sets, including EO and weather data:

A variety of products is needed for effective agricultural monitoring. This task aims to collect:

- o crop area planted and harvested, yield, and production, field size, irrigated cropland and dynamics, cropping systems, crop type, date of planting, crop calendars;
- o precipitation, temperature, evapo-transpiration, soil moisture, snow water content and vegetation condition (via. satellite-based vegetative indices) provided by in-situ and satellite observations;
- o grass, forb and browse types, livestock type, numbers and dynamics and pasture condition and seasonality of production (because rangelands and pasture lands are included in GEOGLAM).

Coarse resolution cropland map and crop (specific) mask (distribution):

Coarse-resolution (>250m) satellite-based crop land maps and crop specific distribution

National/regional harmonized, standard based and regularly updated land cover:

With technical advices, methodologies and tools, FAO is implementing and/or assisting several mapping activities for the production of standardized and harmonized general land cover baselines, including croplands. The updated database can be a valid support for many environmental applications, including national agricultural analysis, strengthening national capacity of handling and processing data and conduct agricultural monitoring, and strengthening monitoring countries and regional risk management. This activity encourages the development of national land cover products based on LCCS/LCML – ISO 1914 standard.

Of course, these land cover baselines, including croplands, need to be regularly updated in accordance with the speed of changes occurring in the field.

- **Research & Development; best practices**

Objective of this task is to stimulate and coordinate research, development and experimentation to improve methods for the use of Earth observation to support agriculture monitoring at the national level. Through collaborative studies, these activities will include developing methods for an extended variety of crops and rangelands, new satellite sensors and products, and various crop production systems. This task will be closely coordinated with and linked to Component 5, JECAM.

Initiate national JECAM/other sites and associated research agenda:

This activity regards the establishment of one or two sites at the national level for developing improved methods, testing and validation to include systematic collection of ground based observations; focus on new and experimental EO data acquisition. These sites with better geographic representation can be used to demonstrate new capabilities of EO, develop demonstration projects to show the utility of Numerical Weather Prediction (NWP) products for crop production monitoring and estimates.

Thematic workshops could be arranged bringing together the JECAM research community, and additional thematic expertise as required. Themes could be:

- o in situ data collection and minimum datasets;
- o optical EO data;
- o SAR data;
- o Standards.

Sites:

- o Ukraine [SRI]: Annual crop types mapping using synergy of new optical and SAR data (SIGMA);
- o Argentina [INTA];
- o Australia [CSIRO].

R&D on crop (specific) area estimate (selected regions) methodologies:

Remote sensing information has been widely applied in the field of crop area estimates. Objective is testing methods to produce crop area estimates based on frame and ground sampling techniques in combination with Remote Sensing. As part of this activity, the design, implementation and testing of the area frame methodology for crop area estimates could be conducted using high res LC data mapped according to the FAO approach.

R&D on crop (specific) yield forecasting:

Activity regarding test and implementation of Earth Observation (EO) data and processing techniques in combination with process based crop models (FAO) for yield forecasting.

Development/sharing of tools, guidelines and documents on standards and best practices:

Collect lessons learned and good practices in country to be used in trainings and e-learning initiatives. As part of this activity, also compilation of guidelines for area frame implementation using standard LC supported by EO information and guidelines on using IT devices to improve efficiency of field survey.

- **Data, Products and Information Dissemination**

A wide variety of data and information from multiple sources are required to effectively monitor the diverse range of agricultural systems at sub-national, national, regional and global scales. GEOGLAM will work with the satellite data providers (primarily through CEOS), the national, regional and international agricultural monitoring agencies, meteorological agencies, and researchers to implement a phased, coordinated data and information dissemination approach. This task regards the development of a national crop condition monitoring portal aiming to provide users with real time information on vegetation condition in various crop stages. The envisaged system will build where possible on existing systems developed in other GEO tasks and activities.

Crop Condition interface prototyping:

National tool for monitoring the state of vegetation based on coarse resolution satellite data (e.g. MODIS, VIIRS, Sentinel 3, SGLI).

- ***Technical assistance and capacity building on the use of EO data***

This activity will define processes and activities that can assist and support national implementation, improvement and maintenance of agricultural monitoring systems and will include.

Need-based training programmes, tools and toolkits:

Curriculum development for national training programmes, tools and toolkits:

- o Development of standard guidelines for technical assistance and training;
- o Development of training material and curriculum for acreage and yield estimation; crop forecasting; and agriculture environmental indicators;
- o Development of distance /e-learning products (modules);

Technical assistance/training on methodologies, tools and the best use of EO data:

The activities here include regional and national training courses/seminars and multi-lingual distance learning courses on crop monitoring methodologies, data discovery, analysis and management tools and services. Target institutions will be the ones responsible/mandated in-country for agriculture statistics creation and its supply. Support participation to Master level courses / short courses / scholarships. Assist national system design and implementation (cropland mapping, area planted, ground sampling, crop condition, yield forecasting assessment, reporting) with emphasis on building sustainable systems.

Improvement of infrastructure and human capacity for carrying out national monitoring programme:

Technical assistance / support (infrastructure revision and technology transfer). Train national staff (Statistical Offices and Ministries of Agriculture) or train the trainers (regional incubators) in accessing and applying improved EO-based methodologies (sampling, survey design, data compilation, and data analysis), and addressing specific technical and methodological gaps.

Establish regional/sub regional networks for technical support and capacity sharing

The establishment of technical support and capacity sharing networks will be facilitated through initiatives such as AfriGEOSS where the objectives will be the sharing of knowledge, techniques and methodologies and mutual skills and expertise support at sub-regional and regional level, so impacting on the continual improvement of national agricultural monitoring systems.

Promotion of remote sensing products on agricultural weather and climate services developers EO remote sensing data and products are widely available but there is a need for continuous training for staff involved into the production of agricultural weather and climate advisories and services. Rainfall and soil moisture evaluation, vegetation status, cloudiness radiation modulate crop monitoring and final yield estimations. This is especially relevant in Africa where ground information networks are weaker. WMO and EUMETSAT are conducting training sessions on the use of satellite data and products in agricultural meteorology to improve provision of agricultural climate and weather services in many African countries. Those efforts are supported by FAO, JRC and other relevant institutions. A link with AfriGEOSS could be easily established.

- **Phase 1: Activities status, Schedule and Responsibilities**

Following the overall phased approach, the component National Capacity will focus on foundation activities, building on existing activities and on pilot projects for a few countries, and scoping out the programme for the following phases. The key activities are outlined in Table 5 below.

Table 5. National Capacity Building activities for Phase 1/2 (2012 - 2014).

TASK / activities <i>Description notes</i>	<i>Calendar</i>	<i>Status</i>	<i>Institutions/ Teams</i>	<i>Budget</i>
4.5.1 Set-up / preparatory phase				
Establish basis for GEOGLAM implementation and phased approach. Gathering information about the current status of agricultural monitoring and the use of remote sensing techniques.				
Selection of countries (producers/at risk) / regions <i>Australia, Argentina, Ukraine, Pakistan, Mexico, Uganda, Ethiopia, Algeria, Asia RiCE countries - P1 Brazil - P2</i>	2013	completed	<i>GEO Ag CoP</i>	<i>Regional assessment</i>
Identification of point of contacts, regional incubators, national institutions (trainer/trainee community)	2013	ongoing	<i>GEO Ag CoP</i>	<i>Regional assessment</i>
Regional assessment/networking workshops (link with other components' activities?) <i>Russia planned (with CIS) 2014 Thailand, North and southern Africa) being considered</i>	2013-2014	planned	<i>GEO Ag CoP</i>	<i>Regional assessment /Workshops</i>
4.5.2 National Assessments				
Assessment of national capacities for agricultural monitoring (technical skills, institutional framework...), for the use of Earth observation for agricultural monitoring, for requirements in terms of capacity development and design of an empowerment strategy to improve agricultural monitoring.				
Development of country assessment methodology and questionnaire	2013	ongoing	<i>FAO Ag CoP</i>	<i>Workshops</i>
Assessment of national needs, gaps and priorities <i>Country visit to perform assessment and compile report (before/after/during workshop). Activity envisioned in budget.</i>	2013-2014	Planned	<i>FAO</i>	<i>Workshops</i>
Status of EO based agricultural monitoring Needs assessment and available capacities study	2013-2014	ongoing	<i>CEOS Ag CoP</i>	
4.5.3 Baseline, EO and agro-met data				
Define data coverage requirements based on national needs assessment. This task aims to compile a common set of core data sets comparable across space and time.				
Available national core data sets <i>Inventory of existing national data (e.g. crop calendars, cropland and crop type distribution). Initial Focus on available Optical and SWIR and on Regional SAR (Asia Rice)</i>	2013-2014	ongoing	<i>CEOS Ag COP</i>	<i>EO Satellite Data</i>
Moderate resolution cropland map and crop (specific) mask (distribution)	2013 -	ongoing	<i>IIASA Ag COP</i>	<i>EO datasets Cropland mapping</i>
National/regional harmonized and standard based land cover	2014	planned	<i>FAO, Ag COP, Land cover Task</i>	<i>EO datasets</i>
4.5.4 Research & Developments; best practices				
Initiate JECAM/other sites and research agenda.	2014	Planned	<i>JECAM, FAO</i>	<i>R&D Best Practices</i>

R&D on crop (specific) area estimate (selected regions) methodologies <i>Testing Area Frame methodology with high res LC data, RS support, and mobile technology for field survey. (Countries TBD)</i>	2014	Planned	JECAM, FAO	R&D Best practices
R&D on crop (specific) yield forecasting <i>Testing models with inputs from RS and weather data. (Countries TBD)</i>	2014	Planned	JECAM, FAO	R&D Best practices
Development/sharing of tools, guidelines and documents on standards and best practices <i>Synergy with development of curriculum and e-learning/distance learning</i>	2014	Planned	JECAM, FAO	R&D Best practices
4.5.5 Data, Products and Information Dissemination				
Crop Condition interface prototyping	2013-2014	Planned	UMD	Information systems
4.5.6 Technical assistance and capacity building Define processes and activities that can assist national implementation.				
Need-based training programmes, tools and toolkits <i>Inventory of existing trainings, tools and toolkits Development of curriculum for trainings Development of distance learning modules</i>	2013-2014	planned	FAO Ag COP	Workshops
TA/trainings on methodologies, tools, best use of EO data <i>Regional/national capacity building workshops</i>	2013-2014	planned	FAO Ag COP	Workshops
Training course on the use of satellite data and products for agricultural meteorology <i>Regional capacity building workshops</i>	2012-2014	completed	WMO/ EUMETSAT/ FAO/JRC	Workshop
Improvement infrastructure and human capacity for carrying out national monitoring programmes <i>hardware/ software/Mobile technology/ Master/short courses</i>	2014	planned	FAO AgCoP	Workshops/ CB
4.5.7 Research and EO data coordination				
<i>Regional workshops in selected institutions/ incubators for networking for promotion, sharing, refining requirements, improving data sharing.</i>	2013-2014	ongoing	AG COP	Workshops
4.5.8 Asia-RiCE				
4.5.8.1 Phase 1a				
Identification of POCs and responsible agencies	2012-2013	Completed	Asia-RiCE	Coordination
Technical Demonstration Site specification	2012-2013	Completed	Asia-RiCE	Coordination
Crop calendar determination	2012-2013	Completed	Asia-RiCE	Coordination
Space data requirements compilation	2013	Completed	Asia-RiCE	Coordination
Communication of requirements to data providers	2013	Ongoing	Asia-RiCE	Coordination
4.5.8.1.1 Indonesia				
Develop rice crop growth estimation research	Jun 2013 – May 2014	Planned	LAPAN, IPB, ICALRD-MoA	R&D

Use space data with in-situ and statistical information to make rice crop area estimations	Sept 2013 - April 2014	Planned	LAPAN, IPB, ICALRD-MoA, BPS	EO datasets
Communicate results to the BPS and Ministry of Agriculture (MoA)	Dec 2013 – June 2014	Planned	LAPAN, IPB, ICALRD-MoA, BPS	Information system
4.5.8.1.2 Thailand				
Use data to produce and verify rice crop area maps in technical demonstration sites	2013-2014	Planned	GISTDA, OAE, RD	EO datasets
Develop KKU rice crop growth model	2013-2014	Planned	GISTDA, OAE, RD	R&D
Confirm rice crop yield estimation results with in-situ results and statistics	2013-2014	Planned	GISTDA, OAE, RD	R&D
Communicate results to OAE and RD	2013-2014	Planned	GISTDA, OAE, RD	Information system
4.5.8.1.3 Vietnam				
Use data to produce rice crop area maps and quantify accuracy improvements	2013-2014	Planned	VAST, CIS, MARD, STI, GIC, HCMIRG	EO datasets
Develop rice crop growth estimation techniques	2013-2014	Planned	VAST, CIS, MARD, STI, GIC, HCMIRG	R&D
Make rice production estimates to supplement in-situ and statistical results	2013-2014	Planned	VAST, CIS, MARD, STI, GIC, HCMIRG	R&D
Develop relationships with agricultural managers and planners at the local to national level.	2013-2014	Planned	VAST, CIS, MARD, STI, GIC, HCMIRG	R&D
Communicate results to agricultural managers/planners and DARD/MARD to enhance their rice monitoring capability and yield estimation accuracy.	2013-2014	Planned	VAST, CIS, MARD, STI, GIC, HCMIRG	Information system
4.5.8.2 Phase 1b				
Investigate full country estimation in Thailand.	2013-2014	Planned	GISTDA, OAE, RD	R&D
Identify demonstration sites in other ASEAN countries to, along with India, China and Japan, implement rice crop yield estimation methods and compare the results with in-situ and statistical information.	2013-2014	Planned	Asia-RiCE	R&D
Work with technical demonstration site representatives in Chinese Taipei (Taiwan) to perform data processing and information validation activities.	2013-2014	Planned	Asia-RiCE	R&D
Develop partnership with AMIS through outlook forecasting in cooperation with existing frameworks using agro-meteorological information derived from space observation data.	2013-2014	Planned	Asia-RiCE	Coordination

- **Phases 1/2: Funding / Budget for National Capacity Building**

Table 6-Indicative budget for National Capacity Building, Phases 1/2

		Phase 1 2012	Phase 1 2013	Phases 1/2 2014
National development (EO data into crop monitoring systems)	Regional assessments	0.1	0.5	0.6
	Crop area mapping	0.2	0.5	0.3
	Workshops	0.2	0.2	0.2
	EO satellite data	0.5	0.6	0.9
	Infrastructure			0.7
	Agromet data			0.2
	Information System		0.1	0.1
	R&D Best Practices	0.2	0.2	0.2
Sub tot Mio US \$		1.2	2.1	3.2

Countries at Risk: Agricultural Monitoring in Support of Food Security Assessment

- **Background**

The Countries-at-risk component has a specific focus on countries at risk. It tackles different crops, agricultural systems and calendars and different information needs. Agricultural monitoring in countries at risk supports timely food security assessment and early warning of potential significant food shortages. By at-risk we mean countries that:

- are chronically food insecure, in part due to adverse climate - this is the case of drought prone regions, such as the Horn of Africa or the Sahel region -;
- and/ or are strongly dependent upon the global market for their food security, due to extreme variability of national production (typically North African countries), and as such are not major producers on a global scale ;
- Are often characterized by subsistence and low-input agriculture, with mostly fragmented agricultural landscapes, where agricultural production is heavily influenced by climate variability.

Many national and regional agricultural monitoring institutions in at-risk countries have a limited ability to generate agricultural production data, and they are often unable to integrate them into a broader assessment of current or near-future food security. At the same time, the avenues available to them for improving their technical capabilities for producing data and information products are limited. A number of GEOGLAM members including, FAO's Global Information and Early Warning System on food and agriculture (GIEWS), USAID's Famine Early Warning Systems Network (FEWS NET), China CropWatch and JRC's Monitoring Agricultural ResourceS Unit (MARS) not only generate these products on behalf of national and regional agencies (on an interim basis), but also help them build national and regional institutional capabilities for doing so themselves. Working through the GEOGLAM structure, members will foster the coordination of product delivery and capacity building efforts for national and regional organizations and the development of harmonized methods and tools.

- **Current Status**

The focus of this component is on near real-time Early Warning Systems that help anticipate potential food security emergencies and mobilize appropriate aid. In some countries food aid is typically not needed, but early estimates of national grain harvest are crucial to manage national stocks and optimize import requirements on a highly volatile global market¹. Key global players in Early Warning

¹ Case of Maghreb countries, facing a 1 to 5 variability of domestic production of rain fed cereals

Systems are UN FAO-GIEWS (Global Information and Early Warning System on food and agriculture), UN WFP (World Food Program), the USAID Famine Early Warning Systems Network (FEWS NET), and the EC JRC MARS (Monitoring Agricultural ResourceS Unit), all partners in the GEOGLAM Community of Practice².

Component 3 involves operational systems providing objective, evidence based assessments for decision making, while reducing as much as possible false positive and false negative determinations. This requires the integrated use of information from multiple sources (crop prospects, livelihoods and vulnerability of households, market prices, public health concerns) and consensus building processes and common analytical methods among stakeholders, national governments, UN, donors, NGO's³.

The GEOGLAM Crop Monitor has achieved success in meeting the needs of the Agricultural Market Information System (AMIS) for regular monthly crop condition information in major grain producing countries of the world. This experience suggests that a similar Early Warning Crop Monitor (EWCM) might be viable for countries "at risk". FEWS NET and UMD have initiated exploratory activities in this regard, including adaptation of the GEOGLAM Crop Monitor web platform for this purpose. Furthermore, dialog has been opened with FAO, WFP, JRC, and RADI regarding their potential participation in an EWCM. Should such a collaborative activity emerge, the addition of regional and national organizations as participants will be sought.

In drought-prone areas, EO indicators on drought severity (status of vegetation, rainfall estimates and water availability) are very useful. These EO indicators and other monitoring tools / systems can also support consensus among analysts. There is a high demand for standardization of products and for specific training materials both from producers and users of drought information as confirmed again by discussions during the IMAAFS conference. The Global Drought Information System (GDIS) being developed through WCRP is potentially relevant to GEOGLAM components and teams (FEWS NET, USDA/FAS, JRC, etc). Another important development is the Global Agricultural Drought Monitoring System -Agricultural Stress Index System (ASIS) established by FAO and based on near real time remote sensing data. The analyses must be done in the context of established national drought management policies, promoted by the recent High-Level Meeting on National Drought Policies held in Geneva in March 2013.

Many countries at risk in semi-arid regions are characterized by **poor data availability**: very sparse meteorological network, little ground information, and/or weak agricultural statistics, which increases the potential contribution of EO. At the same time, inaccurate or non-available agriculture statistics hamper the implementation of yield forecasting, making Early Warning Systems more qualitative than quantitative. EWS depend on and complement agricultural statistics services, which need to be improved through the longer term activities described in Component 2 (National Capacity Building).

A number of international programs such as EUMETSAT Satellite Applications Facilities (SAF networks), NASA LANCE, GEONETCAST, USAID/NASA SERVIR, USDA IPAD (International Production Assessment Division), EU Copernicus – MESA-AMESD) already support the Near Real Time delivery of EO products for agricultural monitoring and early warning. However, many national and regional agricultural institutions in at-risk countries have a limited capacity to generate agricultural monitoring information, or they are often unable to integrate them into a broader assessment of current or near-future food security. At the same time, the avenues available to them for improving their technical capabilities for producing data and information products are limited.

² A growing number of National and Regional Early Warning Systems exists, in particular in Africa at the level of the Regional Economic Communities such as ECOWAS (the Economic Community of West African States), COMESA (the Common Market for Eastern and Southern Africa), IGAD (the Intergovernmental Authority on Development for the Horn of Africa), and SADC (Southern African Development Community), as well as in Central America (SICA Central American Integration System).

³ See for example is the IPC (Integrated Food Security Phase Classification) jointly implemented by 7 agencies (UN FAO, WFP, FEWSNET, JRC, OXFAM, CARE, Save The Children, ACF),,,, <http://www.ipcinfo.org/>

The primary sources of meteorological data are the National Meteorological and Hydrological Services (NMHS) of the world, with the data being communicated through the Global Telecommunication System (GTS). The GTS was established by the NMHS's with the coordination of the World Meteorological Organization. However, more weather data are needed for agricultural monitoring and for the calibration and operational use of remotely sensed products such as satellite rainfall estimates (RFE). In many countries, there are many weather station networks and individual data that are not connected nor disseminated through GTS. The IRI, through the ENACTS⁴ initiative, and FEWS NET have engaged the NMHS of several African countries to develop time-series gridded rainfall data sets as a remedy to the situation. With this approach, the NMHS themselves use gridding software to combine their full station collections with satellite proxy data to produce best-available representations of precipitation climatology in their countries and regions. These in turn can be used by the broader community for studies of climate variability and climate change, without compromising national policies for release of original observational station data.

WMO is working on developing the WMO Information Systems (WIS) which will at first augment and then replace the GTS. WIS encompasses three types of centres. For regional and global connectivity, Global Information System Centres (GISCs) will collect and distribute the information meant for routine global dissemination, while serving as collection and distribution centres in their areas of responsibilities; they provide entry points, through unified portals and comprehensive metadata catalogues, for any request for data held within the WIS. Connected to the GISCs, the Data Collection or Production Centres (DCPCs) will be responsible for the collection or generation of sets of data, forecast products, processed or value-added information, and/or for providing archiving services. National Centres (NCs) will collect and distribute data on a national basis and will coordinate or authorize the use of the WIS by national users, normally under a policy established by the respective national government permanent representative to WMO.

- ***Objectives, Activities and Expected Outcomes***

In particular, Component 3 activities will include:

- Improving ground-based national meteorological networks, to the benefit of EWS, as well as blending of full station data collections with satellite data to produce national and regional time-series gridded precipitation climatology data sets ;
- Collection of in-situ crop information (phenology, yield);
- Development of user-friendly, dedicated software for food security analysts (SPIRITS⁵ and CST⁶ by JRC VITO; GeoWRSI, GeoCLIM, and GeoCOF by FEWS NET; Standalone ASIS and AgrometShell by FAO);
- Application of seasonal climate forecasts to help build agro-climatological working assumptions for food security outlook scenarios;
- Coordination with regional economic communities;
- Strengthen the capacity of national and regional institutions to integrate their climate and crop data collection programs with globally available Earth observation datasets and models to fill gaps and obtain new, more robust agricultural monitoring products;
- Strengthen the capacity of national and regional institutions to apply improved agricultural monitoring to produce timely in-season yield and production figures to support national programs and food security early warning systems.

⁴ IRI : International Research Institute for Climate and Society, ENACTS: Enhancing National Climate Time Series

⁵ "SPIRITS" (Software for the Processing and Interpretation of Remotely Sensed Image Time Series) was developed by VITO for JRC –see <http://spirits.jrc.ec.europa.eu/>

⁶ CST (CGMS Statistical Tool) was developed by Alterra for JRC and is a simple tool for yield forecasts based on regression modeling

GEOGLAM partners will foster the coordination of product delivery, the development of harmonized methods and tools and the capacity building efforts for national and regional organizations, with a key role for technical Regional Centres such as AGRHYMET – Niamey (for CILSS ECOWAS) or RCMRD – Nairobi (for East Africa).

In order to strengthen linkages with decision makers that are the primary target users of the information from the national and regional agricultural monitoring organizations GEOGLAM will coordinate with regional economic communities such as the Economic Community of West African States (ECOWAS), the Common Market for Eastern and Southern Africa (COMESA), the Intergovernmental Authority on Development (IGAD) in Eastern Africa, and the Central American Integration System (SICA), as well as with other continental and global bodies and initiatives dealing with food security, such as the New Partnership for African Development (NEPAD) Planning and Coordination Agency, the Food Security Information Network, the WMO-led Global Framework for Climate Services, and the Global Drought Information System. GEOGLAM members will help to develop these links through a variety of user-training mechanisms, such as regional food security forums and international policy dialogues.

There are also several drought prediction products that are being developed in coordination with the Global Drought Information System (<http://www.drought.gov/gdm/>).

Originally initiated by WMO, National Meteorological and Hydrological Services (NMHSs), regional institutions, and other international organizations, Regional Climate Outlook Forums (RCOFs) were developed to focus on applications of seasonal climate predictions. RCOFs bring together international and regional climate experts to develop consensus-based seasonal forecasts and information addressing questions having critical socio-economic significance. Regional assessments of observed and projected climate change, including the development of downscaled climate change scenario products for impact assessments, are often included in the product portfolio of RCOFs. The core concept of all the RCOFs remains the same: delivering consensus based user-relevant climate outlook products in real-time through regional cooperation and partnership. However, since national and regional capacities are varied and, in some cases, are inadequate to face the task individually, the implementation mechanisms of the RCOFs in different regions have been tailored to meet the local conditions.

The outcome of Component 3 is an improved and harmonized system and tailored agriculture monitoring products for Countries at Risk.

These will include:

- gridded datasets for precipitation, temperature, evapotranspiration, soil moisture, snow water content, and vegetation condition;
- updated crop calendar and cropland area extent, more focused analyses of gridded products;
- collection of moderate and fine resolution satellite observations; and
- generation of up-to-date area-planted statistics, supported by best available remote and on-the-ground survey numbers, to anchor year-to-year estimates of relative change in agricultural production.

- ***Phased approach for Countries-at-Risk***

The phased approach for Countries-at-Risk on Phases 1 and 2 (present-2016) will be based on improving the datasets for early warning system, identifying the data gaps and leveraging resources for solutions and on capacity development (in close coordination with Components 2 and 5). Table 7 provides the list of priorities for datasets, attempts to overcome data gaps and capacity development for at-risk countries

Table 7– Priority data sets, data gaps and capacity development for Countries at Risk

Data Sets	
P1	FEWS NET Global gridded rainfall FEWS NET MODIS ET FEWS NET Pastoralist Water Point Monitoring EUMETSAT LANDSAF products distribution over Africa EU COPERNICUS GIO Land Products (VITO - SPOT VGT –PROBA V) FAO (VITO –JRC) Agricultural Stress Index System (ASIS)
P1	Work with WMO to strengthen national climate station networks
P2	Leverage advanced computing capabilities to apply high- to medium-resolution (5m -30 m) imagery to seasonal monitoring for early warning (Rapid Eye, Landsat 8, Sentinel 2, and others)
Data gaps	
P1	FEWS NET/WMO/GEO Ag CoP Data Workshops Africa (East, West, Southern)
P1	Promote weather data issues with National Met Services (brochure)
P1	Liaise with other projects and GEO tasks (drought, soil moisture)
P1	Promote WMO Information System (WIS) to national and international organizations
P1	Data gap analysis and agro-environmental stratification (FP7 SIGMA)
Capacity development (R&D and training)	
P1	Thematic workshop establishing an R&D agenda (FP7 SIGMA)
P1	National and sub-national crop production shortfall risk profiling – loss exceedence probability functions (FEWS NET, ISDR)
P1	Long time-series agricultural drought indicator (FEWS NET, SERVIR)
P1-P2	Crop mapping, monitoring methods and environmental impacts of agriculture (EC FP7 SIGMA)
P1-P2	Pilot project on the use of Sentinel-2 for agricultural monitoring (ESA Sen2-Agri)
P1	Exploration and application of FEWS NET gridded rainfall and MODIS ETa data sets
P1	FAO-JRC E-learning Course on Crop Monitoring for Food Security with Remote Sensing
P1	JRC VITO training and dissemination MARS Viewer – SPIRITS – CST software's
P1-P2	MSGToolBox training (VITO)
P1-P2	Regional trainings in Africa on GEONETCast data exploitation (FP7 AGRICAB)
P1-P2	National workshops on Agricultural statistics, Early warning and yield forecasting (FP7 AGRICAB)
P1-P2	Regional trainings on Agricultural monitoring (FP7 AGRICAB)
P1-P2	Exploration and application of FAO agricultural stress index (ASI). Deployment and training of Standalone ASIS at country level.
P1-P2	Exploration and application of FEWS NET Pastoralist Water Point Monitoring

• **Phases 1/2 Activities, Schedule and Budget**

The following table lists activities for Phases 1 and 2 happening in 2013 and 2014. Status is categorized as completed, ongoing and planned. The budget is divided into in-kind (resources including salaries and funded activities from existing projects of GEOGLAM partners) and new GEOGLAM projects.⁷

⁷ From agencies (e.g. NASA) and programs such as EC-FP7, GEO members in-country expenditures (China, Brazil, Australia, Argentina...), Regional Development Banks and non-profit Foundations.

Table 8. Countries-at-risk activities for Phase 1/2 (2012 - 2014).

Short Description	Calendar	Status	Institutions/ Teams	Budget category
Global activities				
Start of COPERNICUS Global land Services	Dec. 2012	Completed	VITO (JRC)	EO satellite data
Availability of PROBA V Copernicus services (VGT Gap filler)	Nov. 2013	Ongoing	VITO	EO satellite data
Release of ASIS (Agricultural Stress index System)	Oct. 13	Completed	FAO (VITO – JRC)	Water Stress Index maps
Development of ASIS Standalone Version	2014	Ongoing	FAO	Information system
Release of the MSG ToolBox	Dec. 2013	Ongoing	VITO	R&D best practices
Completion and Release of FAO e-learning on Crop Monitoring for Food Security with remote sensing- Complete e-learning course in 10 modules (English version)	Dec. 2014	Ongoing	FAO -JRC	R&D best practices
FAO e-learning on Crop Monitoring for Food Security - (French version)	July 2014?	Planned	FAO -JRC	R&D best practices
Training on SPIRITS / WFP headquarters Rome	Dec. 2012	Completed	JRC –VITO	R&D best practices
EO Analysis protocol and documentation supporting FAO CFSAM	Since 2012	Ongoing	VITO - FAO	R&D best practices
Regional capacity building workshops (5) on agricultural monitoring	Oct. 2013 – Dec. 2014	Planned	FP7 AGRICAB- VITO	Workshops/ Cap. Develop
Thematic workshop to establish SIGMA R&D agenda	Q1 2014	Planned	FP7 SIGMA	Workshops/ Cap. Develop
<i>Global Drought Information System (GDIS) Workshop</i>	Dec 2014, Pasadena, USA	Completed	WMO, NASA, GEO, WRCP	Workshops/ Cap. Develop
<i>Promote weather data issues with National Met Services (brochures)</i>	Aug. 2013 – Dec 2014	Ongoing	WMO	Global gridded datasets
<i>Liaise with other projects and GEO tasks (drought, soil moisture)</i>	Aug. 2013 – Dec 2014	Ongoing	WMO / GEO	Workshops Cap. Develop
<i>Promote WMO Information System (WIS) to national and international organizations</i>	Aug. 2013 – Dec 2014	Ongoing	WMO	Information system
Sub Saharan Countries (Regional and national)				
Training Workshop on the Utilization of Satellite Products for Agrometeorological Applications	Nov 2012, Niamey, Niger	Completed	WMO/ EUMETSAT/ AGRHMET	Workshops/ Cap. Development
Start of MESA (AMESD 2) 4-year Program / AUC-RECs	March 2013	Completed	FP7	EO satellite data

Training course on the use of satellite products for agro-meteorological applications.	June 2013, Accra, Ghana	Completed	WMO, EUMETSAT, FAO, JRC, PMA-Portugal, TAMSAT, AGRHYMET, Nat Met Agency	Workshops/ Cap. Development
FEWS NET/WMO/GEO Data Workshop in East and West Africa.	2013-2015	Planned	FEWSNET/WMO/GEO	Workshops/ Cap. Develop
Training on MARS Viewer and SPIRIT / 10 countries Ispra	17-21 June 2013	Completed	JRC –VITO-ALTErrA	Workshops/ Cap. Develop
Launching of SPIRITS Software Africa GIS 2013	4-8 Nov. 2013	Completed	JRC –VITO	Information system
Training on the use of satellite products for Agrometeorology	May 2014, Ouagadougou, Burkina Faso	Completed	WMO/ EUMETSAT	Workshops/ Cap. Develop
IMAAFS (Information for Meeting Africa's Agricultural Transformation & Food Security Goals) Conference (replaces 4 th CRAM (Crop and Rangeland Monitoring))	1-3 October 2014	Completed	JRC- FAO FEWSNET- WFP	Workshops/ Cap. Develop
National Capacity building workshops on agricultural monitoring (Mozambique, Kenya, Senegal)	Jan 2013 – December 2014	Ongoing	FP7 AGRICAB, VITO	Workshops/ Cap. Development
WRMF project – Evaluation of Remote sensing for Index insurances in West Africa (Senegal)	Feb. 2014	Ongoing	WFP IFAD VITO (steering involving FEWS NET, JRC, FAO)	R&D Best Practices
Regional ICPAC training on gridded climate data sets	Aug. 2013	Completed	FEWS NET, ICPAC	Workshops/ Cap. Develop
Regional FEWS NET on crop modeling (GeoWRSI) and on improved rainfall estimates (IRE)	Jan. 2013	Completed	FEWS NET	Workshops/ Cap. Development
South Sudan Remote and GIS applications to FS and EWS	Jan.- Mar. 2013.	Completed	FEWS NET	Workshops/ Cap. Develop
Horn of AFRICA USGS/FEWS NET remotely sensed products awareness and availability (<i>Quarterly Greater Horn of Africa – Climate Outlook Forums (GHACOF) workshops</i>)	Feb. & June 2013.	Completed	USGS FEWS NET	Information system
Rwanda and Burkina Faso Training on High Resolution satellite data interpretation in support of crop acreage estimation	June – July, 2013 Nairobi	Ongoing	FEWS NET, RCMRD (Nairobi)	Workshops/ Cap. Development
Regional Development of gridded climate datasets (Geo-Data) for the PREPARED project (USAID/) ICPAC staff	July 2013 UCSB US	Completed	UCSB - FEWS NET ICPAC	Global Gridded datasets

Ethiopia National training on Remote and GIS applications to FS and EWS	2 nd Half 2013 Addis Ababa	Planned	FEWS NET	Workshops/ Cap. Develop
Improvement of satellite based RFE's (CHIRPS)	Sept. 2013	Completed	FEWS NET, WMO	Global gridded datasets
Uganda: National training on Remote and GIS applications to FS and EWS	2 nd Half 2013 Kampala	Planned	FEWS NET	Workshops/ Cap. Develop
Regional SADC- Contribution to capacity development for SADC "at Risk" countries on crop monitoring for an improved sub regional bulletin.	2014	Planned	NEOSS (SA) MESA, JRC	Workshops/ Cap. Development
Ethiopia	TBD	TBD	FAO	Workshops/ Cap. Develop
North African Countries				
Training on MARS Viewer and SPIRITS / DZ Ispra	June 2013 Ispra	Completed	JRC – INRAA	Workshops/ Cap. Develop
Prototype EC MARS Bulletin on 5 North African countries	March 2013	Completed	JRC	Information system
EC MARS Bulletin on 5 North African countries	June 2013	Completed	JRC	Information system
Crop Monitoring and Yield forecast in Maghreb (Mo, TB, DZ)	Nov. 2013	Completed	JRC	R&D best practices
DZ Crop monitoring and Yield forecast Bulletin	June 2014	Completed	INRAA - JRC	Information system
EUROMED workshop on Crop monitoring and area Estimates in Mediterranean Countries	Nov. 2014	Confirmed	JRC –FAO- INRA MO, DZ, CNCT, MinAgris	Workshops/ Cap. Development
Training Model and SPIRIT DZ and small seminar MO, DZ, TN	May 2015	Confirmed	JRC –FAO- INRA MO, DZ, CNCT, MinAgris	Workshops/ Cap. Development
Central Asia and other At-risk countries				
Support to National EWS in Armenia	July 2013	Completed	FAO	Workshops/ Cap. Develop
Support to National EWS in Tajikistan	Dec. 2013	On-going	FAO	Workshops/ Cap. Develop
Support to National EWS in Kyrgyzstan	Dec. 2013	On-going	FAO	Workshops/ Cap. Develop
Support to National EWS in Timor-Leste	Dec. 2014	On-going	FAO	Workshops/ Cap. Develop

Table 9. Indicative budget for at-risk countries for phase1/2 (2012-2014)

		Phase 1 2012	Phase 1 2013	Phases 1/2 2014
Countries-at-risk)	Global Gridded Rainfall	0.2	0.3	0.3
	MODIS ET MAPS	0.2	0.3	0.3
Food security	Water Stress Index Maps	0.2	0.2	0.2
	Workshops/Cap development	0.1	0.2	0.2
	EO satellite data	0.5	0.6	0.6
	R&D best practices	0.1	0.2	0.1
	Information System		0.1	0.1
Sub tot Mio US \$		1.3	1.8	1.8

1.15 Earth Observations

• *Background*

The vision for GEOGLAM initiative is the increased use of both satellite and in situ Earth observations to improve operational agricultural monitoring for the benefit of society. As such, the GEO Partners include UN Agencies such as the FAO and the WMO. GEO has developed a requirements dialogue with the Committee on Earth Observation Satellites (CEOS), a group of the world's civil remote-sensing space agencies, in order to coordinate EO and develop an acquisition strategy to meet the needs of a suite of agricultural monitoring applications. This coordination of space-based Earth observation data comprises the fourth component of the GEOGLAM initiative.

As GEOGLAM also needs meteorological syntheses for short-term and mid-term forecasts, the initiative will liaise with the Coordination Group for Meteorological Satellites (CGMS). The CGMS coordinates access to all data distributed by operational meteorological satellite agencies, including some which are not part of CEOS.. By partnering with WMO Agricultural Meteorology Programme, GEOGLAM will help foster the availability of gridded data sets into WMO Information System (WIS).

• *Current Status*

CEOS has established an Ad Hoc Working Group to work with the GEOGLAM team to support the development of the satellite data requirements. The Ad Hoc Advisory Team is composed of representatives from space agencies, CNES, CONAE, CSA, CSIRO, ESA, INPE, ISRO, JAXA, NASA, RESTEC, as well as from institutions using EO data for agriculture AAFC, UCL, UMD, and USGS. It includes participation from CEOS Agency staff with expertise in satellite mission planning, coordination, and management, and the use of space-based EO data to generate actionable information for agricultural decision-makers. The composition, skill set and expertise of the CEOS Ad Hoc Working Group for GEOGLAM allow the group to develop a coordination framework to address the CEOS SIT actions and initial needs of GEOGLAM. During 2012-2014, the CEOS advisory team supported the user requirements definition, and is contributing to the phased-implementation approach through a co-community effort. Through regular teleconferences and meetings, analysis of requirements for Phase 1 and 2 are being completed.

The CEOS team has been reporting on the GEOGLAM efforts though the CEOS Strategic Implementation Team meetings as well as at CEOS Plenary sessions, at which the CEOS Data Acquisition Strategy for Phase 1 of GEOGLAM was formally endorsed (November 2013). At the next CEOS Plenary, an updated Acquisition Strategy for 2015 will be introduced, which re-envision the Phasing approach originally adopted. To allow for a more flexible development, the original Phases 1-3 have been renamed "Developmental Phases," with annual planning and reporting; similarly, the original Phase 4 has been renamed "Operational Phase," in which GEOGLAM projects and satellite

data needs are mature and self-sustaining. Also at the 2014 CEOS Plenary, it is expected that the Ad Hoc Team for GEOGLAM will be renamed the Space Data Coordination Group for GEOGLAM (SDCG-GEOGLAM) to better represent its mandate and activities.

- ***Objectives, Activities and Expected Outcomes⁸***

The expected outcomes of this component are two-fold:

- a) An improved coordination of satellite Earth observations for agricultural monitoring to respond to the G20 action plan on agriculture and to the GEO strategic targets for agriculture, and;
- b) An improved coordination of and availability of data from in situ agricultural observation networks and meteorological observation and forecasting networks to be coordinated by WMO along with other GEOGLAM partners.

In July 2012, the Ad Hoc Advisory Team met and developed a first draft of a table of satellite data requirements for meeting the needs of a variety of agricultural monitoring applications (Table 10). Since then, this table has been through multiple refinements and iterations as a result of discussions with GEOGLAM scientists. Though this table provides the basic “bones” of the EO requirements to coordinate satellite imagery, in order to be implementable it required additional spatially explicit baseline data, such as a cropland identifying mask (Figure 3, left), field size information (Figure 3, right), growing season timing (Figure 4), cloud cover impacts (for optical imagery, spanning the visible, reflected infrared, and thermal infrared regions), and sampling strategy. To that end, members of the Ad Hoc Team have been working to create these baseline data, with a beta version of the spatially explicit requirements for monitoring having been produced in Spring 2014 and currently under peer review ().

⁸ Although an integral part of GEOGLAM achieving its goals, the meteorological observation activities are being developed in the context of the three main pillars of GEOGLAM and will not be part of this section

Table 10. Earth Observation Requirements Table

A	B	C	D	E	F	G	H	I	J	K	L	M
	Spatial Resolution	Spectral Range	Effective observ. frequency (cloud free)	Extent	Field Size	Target Products						
Req #						Crop Mask	Crop Type Area and Growing Calendar	Crop Condition Indicators	Crop Yield	Crop Biophys. Variables	Environ. Variables	Ag Practices Cropping Systems
	Coarse Resolution Sampling (>100m)											
1	500 - 2000m	optical	Daily	Wall-to-Wall	All			X		L		
2	100-500m	optical	2 to 5 per week	Cropland extent	All	X	X	X	L	L	X	L
3	5-50 km	microwave	Daily	Cropland extent	All			X	X	X	X	
	Moderate Resolution Sampling (10 to 100m)											
4	10-70m	optical	Monthly (min 3 in season + 2 out of season); Required every 1-3 years	Cropland extent (if #5 = sample, else skip)	All	X	L/M					X
5	10-70m	optical	8 days; min. 1 per 16 days	Sample (pref. Cropland extent)	All	X	X	X	X	X	X	X
6	10-100m	SAR	8 days; min. 1 per 16 days	Cropland extent of persistantly cloudy and rice areas	All	X	X	X	X	X	X	X
	Fine Resolution Sampling (5 to 10m)											
7	5-10m	VIS NIR + SWIR	Monthly (min. 3 in season)	Cropland extent	M/S	M/S	M/S					
8	5-10m	VIS NIR + SWIR	Approx. weekly; min. 5 per season	Sample	All		M/S	X		X	X	X
9	5-10m	SAR	Monthly	Cropland extent of persistantly cloudy and rice areas	M/S	M/S	M/S					M/S
	Very Fine Resolution Sampling (<5m)											
10	< 5m	VIS NIR	3 per year (2 in season + 1 out of season); Every 3 years	Cropland extent of small fields	S	S	S					
11	< 5m	VIS NIR	1 to 2 per month	Refined Sample (Demo)	All		X		X			X

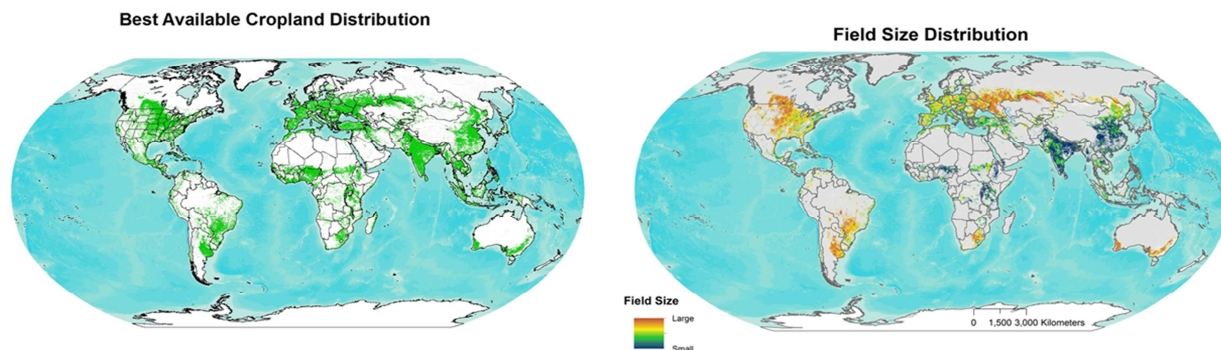


Figure 3. Best available cropland distribution (left) and Field size distribution (Beta version; Fritz et al, IIASA)

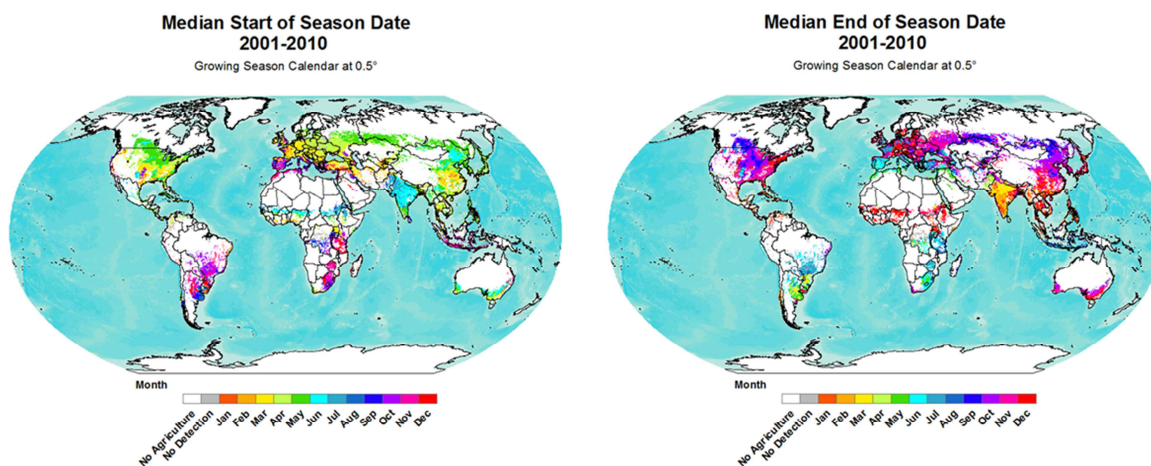


Figure 4. Agricultural Growing Season Calendars; median start of growing season (left) and median end of growing season (right) as observed 2001-2010 (Beta Version; Whitcraft et al., 2014)

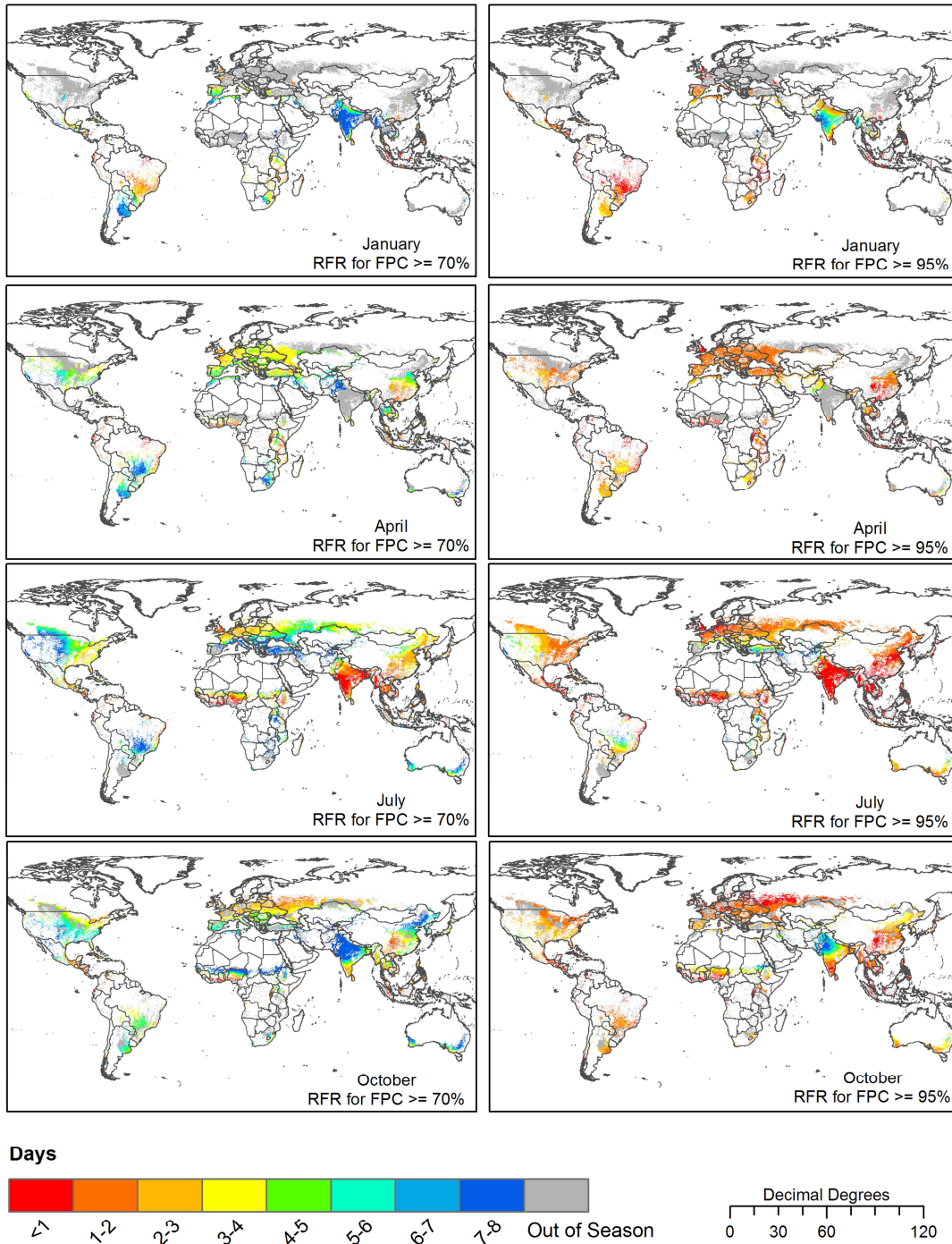


Figure 5. The revisit frequency required (RFR) to yield a view (FPC) at least 70% cloud free (left) or 95% cloud free (right), within 8 days (Requirement #5, Table 10) over in-season cropland locations during 4 representative months (Whitcraft et al., UMD). This facilitates acquisitions and data coordination for GEOGLAM by CEOS.

GEOGLAM Phased Implementation Approach

The proposed approach suggests an implementation strategy in three phases over six years. Each phase will bring with it an increased number of countries, the integration of more sensors, and the increased assimilation of information products into decision making processes. The activities of this component will be phased according to the approach that has been developed over the past year. Since its “go ahead,” the CEOS Ad Hoc Team is continuously working with GEOGLAM leads on the demonstration & early feasibility phase, which spans through 2015, for which initial volumetric assessments and baseline datasets are being developed. GEOGLAM continually seeks synergy with other monitoring initiatives to optimize acquisition efficiency and use.

There are three phases:

Phase 1: Demonstration of Feasibility (2013-2015) For Earth Observations coordination efforts

- Build on exiting activities, engagements with country partners;
- Generation of baseline datasets (growing season calendars, field size distribution, cropland mask);
- Define data requirements and develop a process for requesting imagery from multiple space agencies
- Coordinate data for 4 large/main producers/exporters and 2-4 Countries at Risk;
- Test preliminary sampling strategies and increase scope of effort over time - Asia RiCE has a tandem effort coordinating SAR data for rice growing regions.

Phase 2: Assessment and Expansion (2014-2016)

- Introduce approximately 5 additional main producer countries;
- Development of further baseline datasets (emphasis on utilizing archival data): crop-specific calendars, crop type masks
- Prototype a multi-user data licensing agreement to allow data sharing within GEOGLAM
- Quantify maximum data acquisitions for GEOGLAM for each mission, to facilitate integration of satellite data at GEOGLAM project design phase
- Develop global sampling strategy for main producers;
- Initiate sampling strategy for at-risk countries;
- Integrate new missions (e.g. Sentinels, Amazônia - Brazil, SAR);
- Expand Asia-RiCE Monitoring pilot study plan with available SAR data;
- Demo various prototypes for cloud-based data processing and data distribution
- Generate and disseminate new information products

Phase 3: Pre-operational Details (2015-2017)

- Solidify sampling strategy for at-risk countries;
- Cover at least 5 at-risk countries;
- Increase observation footprint for main producer countries; incorporate all main producer countries; deploy global sampling strategy in main producer countries;
- Integrate additional new missions;

Table 11. Phase 1-2 Countries/Regions, Crops, Data Types, and Time Period of Initiation

Region/Country	Crop	Data Types	Initial Time Period
Argentina (main producer)	Soybeans	Optical	Phase 1
Australia (main producer)	Wheat	Optical	Phase 1
Ukraine (main producer)	Wheat	Optical	Phase 1-2
Russia (main producer)	Wheat, Corn	Optical	Phase 1-2
Tanzania	Multiple	Optical & SAR	Phase 2
Pakistan	Wheat; multiple	Optical	Phase 1-2
Asia- RiCE	Rice	SAR	Ongoing (Phase 1)

- Phases 1/2 Activities, Schedule and Budget category**

Table 12 – Earth Observation coordination activities for Phase 1/2 (2012-2014)

Activity and Short Description	Calendar	Status	Institutions/ coordinating teams	Budget category
Phase 1	2012-2015	In Progress	All	EO satellite data
1.1 Develop baseline datasets	2012-2016	Ongoing	Ad-hoc team; UMD	
1.2 Identify and plan acquisitions for Main producer Countries (See Table 11)	2012-2016	Ongoing	Ad-hoc team; Country partners; Asia RiCE	
1.3 Identify and plan acquisitions for Countries At-Risk (See Table 11)	2013-2016	Ongoing	Ad-hoc team; Country partners; FAO	
1.4 Pilot sampling strategy for Phase 1 main producer countries	2013-2014	Ongoing	Ad-hoc team; UMD	
1.5 Asia RiCE coordinating SAR data for rice growing regions	2012-2015	Ongoing	Asia-RiCE	
Phase 2				EO satellite data
2.1 Incorporate new main producer Countries	2014-2016	Upcoming	Ad-hoc Team; Country partners	
2.2 Develop and pilot global sampling strategy for main producer countries	2014-2016	Planned	CEOS Ad-hoc teams Country partner	
2.3 Initiate sampling strategy for at-risk countries	2014-2016	Planned	CEOS Ad-hoc team	
2.4 Integrate new missions (Sentinels, Amazônia-1)	2014-2016	Planned	CEOS	
2.5 Expand RiCE Monitoring pilot study plan with available SAR data	2014-2016	Planned	Asia RiCE	

The indicative cost for activities in all cross-cutting components is embedded into the main components.

1.16 Research Coordination (R&D) for Monitoring Enhancements

- **Background**

The GEOGLAM monitoring system of systems needs to evolve using best available science and technology. Satellite remote sensing is recognized as one of the main source of information for operational crop monitoring and area estimates. However, there are gaps between the current practices of operational systems and the scientific state of the art. On one hand, gaps are explained by the fact that most scientific experiments cover very limited spatial (often one satellite image) and limited temporal scale (one or two years) and the scaling-up to national or international levels is a very distinct research effort. On the other hand, the poor availability of synchronized relevant in-situ and satellite data over the large scale hampers optimal calibration and validation. In addition, it must be recognized that science and technology are moving targets and that the creation of an operational GEOGLAM will require ongoing improvements based on emerging research and ever-improving and changing satellite data streams and in situ data networks. As such, the goal of the R&D component is to respond to specific GEOGLAM needs as articulated in other sections of this document, harness the development of new methods and identify existing best practices.

- **Current Status**

R&D Coordination requires networking of existing research and experimentation efforts, this is currently done through the GEO Joint Experiments for Crop Assessment and Monitoring (JECAM, www.jecam.org), as the main coordination mechanism. Specific activities are implemented through contributing projects (i.e. EU FP7 SIGMA, EU FP7-IMAGINES, EU FP7 AGRICAB, ESA Sentinel 2-Agri, etc.) and national monitoring initiatives. Coordination, exchange of experience, reporting on scientific progress, and, reaching out to the broader agricultural monitoring community takes place through workshops, formulation of general guidelines and meetings. The aim of the coordination activity is to build consensus on the development of operational prototypes, standards and best practices that will establish the technological foundation for, and continual improvement of GEOGLAM.

JECAM contributes to these activities by developing monitoring and reporting protocols and best practices for a variety of agricultural systems. JECAM strives to establish a convergence of approaches by enabling the global agricultural monitoring community to compare results based on disparate sources of data, using various methods, over a variety of cropping systems around the globe. JECAM will also help facilitate the interaction with CEOS, supporting the development of the GEOGLAM global system of systems for agricultural crop assessment and monitoring.

- **Objectives, Activities and Expected Outcomes**

To achieve the required R&D to meet GEOGLAM goals the following specific sub-tasks are foreseen: 1) Coordination and Networking; 2) JECAM-GEOGLAM Science Activities, and 3) Standards and Best Practices for Global Agricultural Monitoring.

Sub-task 1 - Coordination and Networking, in addition to coordinating the existing JECAM efforts, the task will focus will be on methods to assess environmental impacts of agriculture, as this aspect is currently not sufficiently addressed. This includes:

- Consolidate a common research agenda, in consultation with the other GEOGLAM components, and define specific activities to be implemented under the R&D JECAM R&D agenda
- Make an inventory and keep up to date of state-of-the art scientific developments for crop monitoring as a common resource base for scientists and operational system developers
- Facilitate sharing of experiences and review methods used in various parts of the world and for various agricultural systems;
- Establish a forum for JECAM participants, to facilitate communication, through workshops, science paper collection and JECAM.org website;

- Coordinate interaction with CEOS regarding in particular the multi-year data acquisition over the JECAM sites and the definition of agriculture requirements for future missions;
- Coordinate the available and forthcoming in situ and EO data sets acquired over the research sites, enable the data exchange process, and create minimum data sets for multi-site GEOGLAM research activities;
- Ensure reporting of scientific and technical progress and results to the larger Agricultural Monitoring stakeholder community.

Sub-task 2 - JECAM-GEOGLAM coordinate R&D activities for GEOGLAM based on the specific needs of the other GEOGLAM components and state-of-the art science. The GEOGLAM R&D component builds on other agricultural monitoring initiatives, such as EU FP7 SIGMA, EU FP7-IMAGINES, EU FP7 AGRICAB, ESA Sentinel 2-Agri and national initiatives, and as such leverages and focuses work from the broader agricultural monitoring community. The study sites of these initiatives are commonly labeled “JECAM sites” when activities are in line with the JECAM / GEOGLAM R&D agenda. Through these projects, work will be undertaken to coordinate and harmonize the JECAM in-situ and satellite data sets to facilitate broad usage. As well, research proposals will need to be solicited and funded that address specific GEOGLAM research to operational needs.

The **research to operations (RtO) activities** will be in response to the detailed GEOGLAM plan and as such require further development, and take into consideration capacity development needs. This will be fully articulated in the Phase 1 development of the science plan (Table 6, sub-task 2.1). Notwithstanding this, JECAM ?? research topics include:

- in situ field campaigns:
 - sampling strategy at different scales;
 - measurement methods and instruments;
 - data processing;
 - data models, data management and quality control;
- croplands extent and main crop type mapping;
- crop acreage estimates;
- tools and software’s to facilitate crop monitoring analysis, data handling, processing and collection
- inter-sensor calibration and data consistency
- exploitation and integration of newly available sensors
- crop status indicators, biophysical variable retrieval and environmental variables affecting crop growth;
- data integration or assimilation within crop growth models;
- anomaly, stress and disease detection and time series analysis;
- yield estimates (empirical methods, crop modeling) and forecasts;
- environmental impact indicators and long-term impact analysis of environment-agriculture interactions

Sub-task 3 - Standards and Best Practices for Global Agricultural Monitoring will be developed through thematic workshops and the results of collaborative research studies that integrate applied agricultural monitoring research around the world. Where possible JECAM specific research will be leveraged and JECAM meeting venues will be used to maximize community participation. Further, the staging and priority of these workshops will be based on the needs of GEOGLAM activities. Based on a preliminary assessment of needs, priority thematic areas include:

- a. Best practices for field data collection and EO products validation;
- b. Best practices for yield monitoring and forecasting (agro-meteorological modelling, remote sensing based methods, SAR);
- c. Crop mapping and crop masks (SAR, optical, merged methods);

- d. Improving Agricultural Statistics systems (Area sample frames, statistical methods integrated with remote sensing);
- e. Monitoring and assessment of environmental impact of agriculture.

Deliverables will consist of documentation of 'best practices' that will inform global and national capacity building and the development of monitoring improvements.

- **Phased Approach**

As of today, the phased approach for GEOGLAM R&D towards monitoring enhancements is basically divided into 3:

Phase 1 will concentrate on strengthening the JECAM network and re-focusing efforts towards GEOGLAM requirements. Activities include a series of workshops to address regional and global JECAM activities held in conjunction with workshops to focus on GEOGLAM research needs. These could include national capacity enhancement, SAR for soil moisture monitoring, SAR for monitoring crops in tropical-subtropical regions, sampling frameworks for agricultural monitoring and best practices for crop monitoring, as defined by the needs of the other GEOGLAM components.

Phase 2 and Phase 3 will focus on directed research funding for collaborative research in support of GEOGLAM priorities and the definition of best practices to advise the construction of the agricultural monitoring system of system in later phases of GEOGLAM.

- **Phases 1/2 Activities, Schedule and Budget**

Table 12. JECAM Activities and budget category for Phase 1/2 (2013-2014)

Activity and Short Description	Calendar	Status	Institutions/ coordinating teams	Budget category
1. Coordination and Networking				R&D best practices
1.1 General coordination. Ensure Communication and coordination between the JECAM sites	1/13- 12/14	Ongoing	Canada, JECAM sites	JECAM In-kind coordination
1.2 Annual JECAM Meeting. Review of JECAM experiments and results	12/11/13 Canada	Planned	Canada, JECAM sites	workshops/ R&D
1.3 Support to JECAM database collection and preparation. Develop a minimum standard data set for all sites, data pre-processing, harmonization, in situ database, documentation of data, support for data dissemination	2014-on	Ongoing	FP7 SIGMA, Canada	EO data
1.4 JECAM.org Website. Maintain/update website	01/13-12/14	Ongoing	Canada	JECAM in-kind coordination
1.5 CEOS Meetings. Coordination meetings with CEOS, to facilitate data JECAM data acquisition	As required	Ongoing	Canada	Workshops
1.6 Regional JECAM Workshop. Russia and Eastern Europe	11/13, Russia	Completed	IKI, Canada, JECAM sites	Workshops
1.7 Regional Workshop. Africa. Reviewing status of agricultural monitoring activities in Africa	11/13, Ethiopia	Completed	FP7 AGRICAB Projects	Workshops
1.8 Regional Workshop. Africa. Reviewing status of agricultural monitoring activities in Africa	7/14, Niger, Kenya	Completed	FP7, AGRICAB Project	Workshops

1.9 Additional Regional JECAM workshops. China, Europe, South America	TBD	Planned	Host organization, JECAM sites	Workshops
2. GEOGLAM Research and development Towards Operational Enhancements			Canada (AAFC and CSA), EC-FP7, UCL, IKI, VITO, SIGMA project, JECAM sites, new funding sources TBD	R&D Best Practices
2.1 GEOGLAM Science Plan. Develop the GEOGLAM research agenda by identifying knowledge gaps	01/14	Ongoing	Canada, FP7 SIGMA	R&D coordination
2.2 GEOGLAM Coordination and Research Support.	13/14	Planned	National initiatives in JECAM countries, FP7 SIGMA and AGRICAB, S2Agri,	R&D projects
2.3 GEOGLAM Research Projects to address specific GEOGLAM needs. Project funding based on directed research proposal call	13/14	Planned	Call for proposals	R&D projects
2.4 Travel Support. Funding to help post-doc, student travel costs to attend meetings and workshops	13/14	Planned		R&D projects
3 Standards and Best Practices for Global Agricultural Monitoring			Canada (AAFC and CSA), EC-FP7, UCL, IKI, VITO, SIGMA project, JECAM sites, new funding sources TBD	
3.1 Scientific / Thematic Workshop. Best Practices for Wheat Yield Monitoring and Forecasting	11/13, Russia	Completed	IKI	Workshops
3.2 Scientific / Thematic Workshops. Review.	7/14 Canada	Planned	Canada, National funding, SIGMA EC-FP7	Workshops
3.3 Scientific / Thematic Workshop. SIGMA/JECAM workshop, Methods to generate dynamic crop masks, agro-environmental stratifications, crop statistics, yield forecasting and environmental impacts	Q4 2013, Brussels 9/14 Belgium 9/14 Netherlands 4/14, FAO, Rome, 10/14, China	Completed Planned Planned Completed Planned	SIGMA EC-FP7	Workshops

Budget for components 4, 5 and 6 are embedded in the three main pillars. For clarification purposes, Canada will continue to support the overall JECAM coordination (USD 180 K, in kind). Through the EC FP7 there will be funds available for GEOGLAM research including staffing, coordination, workshops and travel support to many institutions and GEOGLAM teams.

1.17 Data, products and information dissemination

• Background

Data and information dissemination are at the core of the GEOGLAM initiative. GEOGLAM will strongly promote timely and open sharing of the data, products and derived information from all components. A wide variety of data and information from multiple sources are required to effectively monitor the diverse range of agricultural systems at sub-national, national, regional and global scales. These data range from satellite and agro-meteorological observations, to cultivated-area maps, crop calendars, crop models, crop statistics, and soil-moisture measurements. Where possible, access to GEOGLAM data and information will be made openly available, recognizing that data generated through the national capacity-building component may be subject to national data policies. However, in principle, data sets developed through GEOGLAM support will follow GEO data principles. As mentioned under research coordination, dissemination can be optimized by taking advantage of the

geographic and thematic specificities of GEO Agriculture CoP. For instance, CropWatch has broad experience with rice productivity and acreage estimation. Additional spatial specificity can also be achieved by involving some of the above-mentioned regional systems, such as AGRHYMET in CILSS countries and the SADC regional Early Warning System in Southern Africa. JAXA outlook system, JASMIN, based on agro meteorological information has been operating from 2013 to support rice crop outlook in Asia in cooperation with AFSIS.

GEOGLAM will work with the satellite data providers (primarily through CEOS), the national, regional and international agricultural monitoring agencies, meteorological agencies, and researchers to implement a phased, coordinated data and information dissemination approach.

- **Current Status**

The GEO Ag CoP is focusing on organizing the GEOGLAM website with a design being already completed; also under development is the interface for the Global Crop Outlooks, in preparation for starting delivering monthly outputs to AMIS at the end of the third quarter (2013). In 2014, working as appropriate with the GEOSS Common Infrastructure (GCI) team, a dedicated GEOGLAM workshop will be held to develop the requirements and road map for the GEOGLAM information system. For this workshop effort will be made to involve other programs and organizations currently working in this area.

- **Objectives, Activities and Expected Outcomes**

Activities in this component will include: a) Developing a detailed inventory of data (input, intermediate and output data) and methods currently available from the existing agricultural monitoring systems; b) Developing data processing standards, protocols and related metadata that enable the inter-use of data from various platforms, c) Working with the Earth observation data providers to develop, a system for management and dissemination of the Earth observation data required by GEOGLAM, d) Holding training workshops on model and data use, in coordination with Component 2, and e) Disseminating crop condition outlooks and projections through AMIS, in coordination with GEOGLAM Component 1.

The outcomes will be the development of consistent data, products and information strategy

- **Phased Approaches**

Phase 1 activities include the development of the dedicated GEOGLAM website and the interface for the Crops outlooks. Phase 2 (in 2014) will see an activity by a group between the GCI task team and GEOGLAM core team to develop a road map to build the information system.

- **Phases 1/2 Activities, Schedule**

Table 13 Information system activities for Phase 1/2 (2013-2014)

Activity and Short Description Phases 1/2	Calendar	Status	Institutions/ coordinating teams	Budget category
1.1 Develop GEOGLAM website	2012-2013	Ongoing	Agri-food Canada, GEO Secretariat	Information system
1.2 Develop global crops outlooks interface	2012-2013	Ongoing	UMD/	Information system
1.3 Interface with the GCI task team to develop the overall information system	2014-2015	Planned	GEOGLAM coordination office and GCI task team	Information system
1.4 Develop Asia-RiCE crop team website and agro meteorological information dissemination system	2012-	Ongoing	JAXA	Information system

- **LOGIC MODEL FOR GEOGLAM IMPLEMENTATION AND FUNDING**

Recalling the policy mandate given by the G20 Governments to GEO, to bring transparency on the main crop production across the globe through the sustained use of Earth Observation data, one can state that a substantial progress has been made towards reaching this goal. Early demonstration of GEOGLAM added value success can be highlighted:

- MODIS data being made available in near real time to GEOGLAM COP through the LANCE system (NASA). Joint Polar Satellite System (NOAA/NASA) Visible Infrared Imager/Radiometer Suite, being made available globally and in near real-time to GEOGLAM (NASA under development);
- Establishment of a planning process for coordinated acquisitions and joint processing of LDCM and Sentinel 2 data (NASA, ESA under development);
- The GEO Agriculture Community of Practice (AG COP) working with WMO to improve in-situ rainfall observation distribution for Africa;
- Successful targeted national capacity enhancement efforts, e.g. in Pakistan, Argentina, Mexico, Australia, Russia, and Ethiopia;
- Prototypes for agricultural outlooks inputs for AMIS, as done with the Northern hemisphere and Southern Hemisphere crop conditions assessment in 2012;
- Routine inputs on Global crop outlooks to the AMIS market monitor starting in September 2013;
- Continuous development of best satellite based global cropland areas;

Through the document, one can find examples of current and potential national funding (including in kind) for GEOGLAM. More specifically the list below shows strong evidence of support and resourcing for the initiative:

- USA NASA's funded projects related to GEOGLAM operations: Global Soy Area Estimation, Drought monitoring system prototype and wheat Yield Forecasting prototype, and USDA's participation in Pakistan Capacity Building as well as USDA's GLAM operations with NASA;
- Canada will continue to support the JECAM office and might consider seconding staff to the Geneva's GEOGLAM office;
- France, through its Ministry of Agriculture, undergoing final arrangements to second a senior expert (P5 level) for GEOGLAM Coordination office, starting September 1st;
- Mexico and Argentina will continue to support in-country's capacity development;
- Argentina is in the process of setting up a GEOGLAM office to develop the country's capacity and indicate the country's readiness to participate in the development of a regional GEOGLAM effort;
- Brazil, through CONAB, has indicated the country's intention to continue developing its EO Agricultural crop monitoring in collaboration with GEOGLAM partners;
- China has indicated the country's intention to support GEOGLAM coordination office next year, through MOST, in addition to the country's engagement with resourcing CropWatch;
- Germany is in a process of internal coordination with regard to GEOGLAM's funding.

And at regional level:

- The EC funded MARS project is expanding its geographical scope, and participates in many Capacity Development activities;

- European Commission has selected, through a call of 9 Million Euros in the FP7 framework, a proposal (and is undergoing final negotiations) to support GEOGLAM related environmental activities;
- The GEOGLAM Asia Rice Monitoring initiative (www.asia-rice.org) lead by JAXA for JAPAN with AFSIS, sharing information with the Asia Development Bank Technical Assistance Project;
- The GATES Foundation has indicated strong interest in supporting EO capacity development Activities in Africa;
- The World Bank has indicated potential interest in supporting GEOGLAM projects should it be requested by the G20 members.

The logic model for full GEOGLAM implementation and funding being worked out by the GEO Agricultural Community of Practice includes the following steps and activities, with some running in parallel:

- Setup of the GEOGLAM coordination office with seconded/hired staff to be initially co-located with the GEO Secretariat in Geneva, formed by a Program Coordinator, a dedicated expert (P3 or P4) and a staff assistant;
- Setup distributed regional offices to coordinate the GEOGLAM Components. Further planning and coordination needed for this, but preliminary discussions are underway For example USA for Global Component Office; FAO for Capacity Development; EC (JRC) for Food Security and Countries at Risk, Canada for R&D (JECAM), Asia (Asia-RiCE), Australia (rangelands), South Africa (SADC) and South America (Brazil, Argentina);
- Setup up the Implementation Group nominating representatives from the components teams;
- Continue building on national contributions from current and/or new projects, until substantive fund raising activities are in place with the dedicated Program Coordination office;
- Initiate full budget program/proposal development and fund raising activities by the program coordination office working close with the Coordination Group.

Although, detailed budget proposal development will start once the Coordination Office is in place at the GEO Secretariat, it is anticipated that new funding is required for the office itself as well as for the distributed Component Offices (can again include in-kind funding), capacity development targeted workshops and outlook synthesis and coordination. The initial figures are as follows:

- Establish GEOGLAM Coordination Office (US\$800 K/year, including staffing and in-kind support);
- Implementation Team Lead Activities (distributed Component Coordination Offices – US\$250K/year each), likely to be funded by projects (example, prospect of a USDA funded office to manage the country’s participation in the Global systems);
- Core Support for Developing Country Workshop Participation – seed money for workshop follow-up (US\$ 300K/year in P1 and P2 in addition to in-kind ongoing and planned workshops to advance capacity development and food security issues);
- Outlook Synthesis and Coordination (US\$ 500K/year), with dedicated staff.

The ballpark proposed budget for GEOGLAM is in Table 14. The costs are indicative and include in-kind and new funding needs through projects and in-country expenditures. Once the GEOGLAM governance model is implemented and starts operating according to its Terms of Reference (TORs), the coordination office will, working with the components coordination group, establish a process for refining the budget as a fund raising step. It is anticipated that Coordination Office is the primary new need concerning the GEO Secretariat Trust Fund.

Table 14. GEOGLAM Implementation proposed budget (Indicative cost breakdown on the 3 pillars with cross-cutting imbedded)

		<i>Phase 1</i>	<i>Phase 1</i>	<i>Phases 1/2</i>	<i>Phase 2</i>	<i>Phases 2/3</i>	<i>Phase 3</i>	<i>Total (Mio US\$)</i>
	Activities/ deliverables	2012	2013	2014	2015	2016	2017	
Global regional systems (main producers & commodities)	Prototype outlooks	0.5	0.5	0.5				1.0
	Harmonized annual crop outlooks		0.5	1.0	1.0	1.0	1.0	4.5
	Asia Rice Pilot Studies	0.4	1.0	1.0	1.0			3.0
	Asia Rice Forecasts/production	0.2	0.3	0.3	0.3	1.0	1.0	2.9
	Information System	0.1	0.1	0.1	0.1	0.1	0.1	0.5
	R&D Forecast	0.1	0.1	0.2	0.3	0.2	0.1	0.9
	<i>Workshops</i>		<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	1.0
Sub total		1.3	2.7	3.3	2.9	2.5	2.4	13.8
National development (EO data into crop monitoring systems)	Regional assessments	0.1	0.5	0.6				1.1
	Crop area mapping	0.2	0.5	0.3	0.3	0.3	0.2	1.5
	<i>Workshops</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.1</i>	0.9
	EO datasets (Satellite, met, in situ)	0.5	0.6	0.9	1.2	1.2	0.9	4.8
	Infrastructure			0.7	1.5	1.5	0.9	4.6
	Agromet data			0.2	0.2	0.2	0.2	0.8
	Information System		0.1	0.1	0.1	0.1	0.1	0.5
	R&D Best Practices	0.2	0.2	0.2	0.3	0.3	0.2	1.2
Sub total		1.2	2.1	3.2	3.8	3.7	2.6	15.4
Countries-at-risk (Food security)	Global gridded rainfall	0.2	0.3	0.3	0.3	0.3	0.3	1.5
	MODIS ET maps	0.2	0.2	0.2	0.2	0.2	0.2	1.0
	Water Stress Index Maps	0.2	0.2	0.2	0.2	0.2	0.2	1.0
	<i>Workshops</i>	<i>0.1</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	<i>0.2</i>	1.0
	EO datasets (Satellite, met, in situ)	0.5	0.6	0.6	0.8	0.6	0.6	3.6
	R&D best Practices	0.1	0.2	0.2	0.3	0.2	0.1	1.0
	Information System		0.1	0.1	0.1	0.1	0.1	0.5
Sub total		1.3	1.8	1.8	2.1	2.2	1.7	9.6
Secretariat	Program development Staffing (P5, P3+G)	0.3	0.5	0.8	0.8	0.8	0.8	3.7
Total Mio US \$		4.1	7.1	9.1	9.6	9.2	7.5	42.5

- Phase 1 2012 are past cost inferred by participants on their (in-kind) participating at the activities outlined (not added to the total budget).
- Budgets will be adjusted on a case by case with each funder separately - according to needs, their interests and funds available.

	GI-02	GEOBON-Global Biodiversity Observation (GEO BON)	- Implementation Plan

The GEO Biodiversity Observation Network Implementation Plan

1. Executive Summary

Overview

GEO BON's mission is to improve the acquisition, coordination and delivery of observations of biodiversity and ecosystem services to users, including monitoring of changes in marine, freshwater, and terrestrial ecosystems. GEO BON encompasses all scales of biodiversity, including genes, species, populations and ecosystems, across multiple dimensions such as composition and function. GEO BON has working groups dedicated to specific challenges and several sub-global and thematic biodiversity observation networks. GEO BON has close links with major space agencies and integrating remotely sensed and *in situ* measurements is an important function.

GEO BON's vision is by 2025, to be a robust, extensive and interoperable biodiversity observation network covering the major biomes of the globe. The observations derived from this network should contribute to effective and timely conservation, sustainable use, mitigation and adaptation decisions regarding the world's biodiversity and the ecosystem services it provides.

GEO BON's major user communities are **national governments** that are setting up or enhancing biodiversity observation systems, the Convention on Biological Diversity (**CBD**) and other international agreements that define strategies requiring biodiversity monitoring, the **scientific community**, which needs biodiversity observations for model development, and the *Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES)* which requires biodiversity data, information and knowledge for international assessments.

2016 Activities

- Development of the "Essential Biodiversity Variables (**EBVs**)", which are a minimum set of variables that capture the major dimensions of biodiversity change. **EBVs** provide guidance to observation systems at all scales by helping to prioritize observations and identify standard methods for data collection and processing. Also, because they lie between raw observations and indicators (which are used by decision makers), they isolate the indicators from advances in observation science and technology. EBVs will thus enable a more harmonized biodiversity monitoring system that is both efficient and focussed on user needs.
- Development of "**BON in a Box**", which is a regionally customizable online toolkit for facilitating the start-up or enhancement of biodiversity observation systems. **BON in a BOX** gives nations, regions and others a common and scientifically sound set of biodiversity variables, monitoring methods and guidelines, mapping software, and data management, analysis, discovery and

reporting tools and platforms, thereby increasing capacity and the power to detect important biodiversity trends and their underlying mechanisms.

- Facilitating development of and coordinating regional and thematic Biodiversity Observation Networks (BONs) such as the following:

Operational networks:

- The Asia Pacific BON (**AP BON**) is an example of a regional network. It includes most of the countries in the Asia Pacific Region and, via working groups and annual meetings it coordinates many of the biodiversity activities in the region.
- The Circumpolar Biodiversity Monitoring Program (CBMP or **Arctic BON**) is an international network (involving eight 'Arctic' countries) of scientists, governments, indigenous organizations and conservation groups working to harmonize and integrate efforts to monitor the Arctic's living resources. Launched in 2005, the CBMP has developed and is implementing pan-Arctic biodiversity monitoring plans for marine, coastal, terrestrial and freshwater ecosystems. The CBMP is endorsed by the Arctic Council and the CBD and is an official network of GEO BON.

Developing Networks:

- The GEO BON Marine Biodiversity Observation Network (MBON) is an example of a thematic network. The ambition is to create a series of interoperable regional marine networks and thus create a global network of marine biodiversity observation systems, with the first phase being a "Pole to Pole MBON in the Americas" and then moving gradually to a global coverage.
- The Global Wetland Observation System (**GWOS**), developing observations and data for the Ramsar convention, is another thematic BON. GWOS development is currently funded through the EU H2020 project **SWOS** (Satellite based Wetland Observation System) in collaboration with GEO BON following the concept of Essential Biodiversity Variables.
- The GEO BON Global System of Ecosystem Observatories (GSEO) is a developing network of field site networks focused on harmonization and coordination. Core networks within it include the Long-Term Ecosystem Research (*LTER*) network, and A Long-Term Biodiversity, Ecosystem and Awareness Research Network (ALTER Net).

It should be noted that GEO BON will prepare, in the summer of 2016, a new detailed implementation plan for the years 2017-2019. The implementation plans presented here are mostly derived from the 2014-2016 GEO BON Strategic Plan.

2016 Resources

Calculating in-kind contribution as well as projects dedicated to GEO BON by the many GEO BON partners is a challenge, as many partners don't specifically calculate their time spent for GEO BON activities. Therefore, we calculated only the major activities and added estimates from the key partners. All together, more than 16M€ (including estimated in-kind contributions) will be invested in GEO BON activities in 2016.

The GEO BON Secretariat is hosted by the **German Centre for Integrative Biodiversity Research (iDiv)** in Leipzig, Germany which supports the GEO BON Secretariat with an annual budget of 135k€ for personnel costs and 50k€ running budget. **NASA** provides in-kind expertise to GEO and GEO BON, including a full time secondment to the GEO Secretariat, and NASA also supports the marine

biodiversity observation network MBON with about USD5M in 2016. In addition, **Polar Knowledge Canada** supports the Vice-Chair position for GEO BON that is equivalent to 4 person-months (PM) in 2016. Furthermore, the **Global Biodiversity Information Facility (GBIF)** provides an in-kind contribution of 1 PM annually and **Map of Life (MoL)** provides 15PM annually to GEO BON activities. A breakdown of the resources applied to the key GEO BON activities follows (most of these are estimated).

- **EBV development:** 36 PM (funding provided by iDiv/Germany)
- **BON in a Box development:** 15 PM in 2016
- **Coordinating development of National, Regional, and Thematic BONs:** 4 PM in 2016
- **Asia Pacific BON:** 11 k€ in 2016 (funded by Japan Ministry of Environment for APBON activities)
- **Circumpolar Biodiversity Observation Program:** 1900 k€ in 2016 for their activities
- **Marine Biodiversity Observation Network (MBON):** USD6M + 135PM
- **Global System of Ecosystem Observatories (GSEO):** 90 PM in 2016
- **Global Wetland Observing System:** 115 PM in 2016 (Development of the EU SWOS project)

Recommended activities (recommended if additional resources are made available)

Of course, all GEO BON activities could benefit from additional resources as most of them depend on short term funding from projects and on in-kind contributions which are done on a best-effort basis. Additional funding, on the order of 10s of k€, would particularly benefit the BON in a Box toolkit by helping to bring the Latin America version to an operational status. Development of Essential Biodiversity Variables would also benefit from additional resources.

2. Introduction

The Group on Earth Observations Biodiversity Observation Network (GEO BON) is focused on developing an interoperable global biodiversity observation system that delivers enhanced biodiversity information to facilitate better decision-making at multiple scales (from local to global). GEO BON is focusing its efforts on the adoption and implementation of the Essential Biodiversity Variables (EBVs) and related monitoring guidelines and interoperable data management systems. Through targeted capacity building efforts at the national and regional level (e.g. development of a “BON in a Box” toolkit), GEO BON focuses on improved observations to facilitate improved policy and decision-making. This approach reflects the need to provide a top-down design for a global observation system (e.g. EBV’s, monitoring guidelines, interoperable data systems) with the pragmatism of a bottom-up construction process (e.g. through national and regional capacity building).

To achieve an interoperable global biodiversity observation network is an ambitious task. It requires a targeted and iterative approach that builds upon successes and lessons learned, focuses on understanding and responding to user needs, and facilitates the development of national and regional biodiversity observing networks that meet those needs.

GEO BON has developed a global social network and community of practice for biodiversity observations. This network includes many world leaders in biodiversity observations as well as major partner organisations in that field. GEO BON moved into its second phase in 2014 by refocusing on its core goals, and making strategic decisions on where its limited resources should go to achieve those goals.

3. Need for action

The world’s natural systems are undergoing great changes, often leading to degradation of biodiversity and the ecosystem services that humans depend on. Yet, our collective ability to understand the nature of those changes, to develop sound assessments, and to produce scenarios to guide more effective policy is hampered by a variety of gaps in the overall observation system. These gaps include but are not limited to: spatial, temporal, and taxonomic gaps in observations; lack of adequate capacity, particularly in the most biodiverse regions; limitations to data sharing including lack of standards and “closed” data systems; a lack of coordination among many of the organizations collecting and storing the observations; and incomplete connectivity with or usability for decision makers and other users.

At the same time, national and subnational governments are asking for scientifically sound information and knowledge on biodiversity change so they can meet their internal as well as international obligations. For example, parties are required to report on the progress they are making towards meeting the Convention on Biological Diversity (CBD) Aichi Targets. This remains a challenge for most countries with an analysis of the 4th National CBD reports showing that only 36% contained evidenced-based indicators. The Ramsar Convention on Wetlands desires to develop a State of the World’s Wetlands report on a five-year cycle, yet the needed information is largely

unavailable. Also the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) is already developing regional and thematic assessments and their observation needs will increase with time, yet obtaining much of the needed information poses significant challenges.

GEO BON is designed with these needs in mind, focusing on filling gaps, building capacity, making data more accessible and easier to find and use, coordinating existing efforts, and ensuring connections with decision makers.

GEO BONs 2025 vision and goals.

By 2025, GEO BON is a robust, extensive and interoperable global biodiversity observation network. The observations derived from this network are contributing to effective and timely conservation, sustainable use, and mitigation and adaptation decisions regarding the world's ecosystems, the biodiversity they support, and the services provided.

Some of the key GEO BON goals for 2025 include:

- GEO BON has facilitated the development or enhancement of at least 25 national biodiversity observation systems, representing most of the Earth's major biomes, which are coordinated and can contribute to regional and global biodiversity assessments.
- At least 10 regularly updated operational products (e.g. global change detection maps of forest cover; compendium of marine environmental databases) have been developed, providing high quality observations, information and data to scientists, decision-makers and the public at various scales; remotely sensed and *in-situ* data (based on the EBVs) are routinely used as inputs to these observation products and contribute to models that support improved policy assessments and scenarios at multiple scales.
- A strong, balanced and sustained biodiversity observation community is functioning, based on shared resources and increased capacity.

4. User Engagement

We consider three large groups of users to target GEO BON activities: governments, international multilateral agreements and scientists. For each group we describe below how user communities are linked to GEO BON, how stakeholders benefit from GEO BON activities (in particular in developing countries) and how GEO BON products will feed into decision-making processes.

Governments. GEO BON's most important block of users is national governments. Governments need scientifically sound biodiversity data, information and knowledge to meet their national mandates (e.g. national biodiversity plans, recovering species at risk, sustaining ecosystem services) and fulfil their international obligations (e.g. for the Convention on Biological Diversity, the Ramsar Convention on Wetlands, the Convention on Migratory Species, etc.). Essential Biodiversity Variables (EBVs), and BON in a Box will be of great help to national governments since these provide a guiding framework and the tools to set up or enhance observation systems.

Facilitating the development of new national biodiversity observation systems and the enhancement of current systems are two key GEO BON focus areas. GEO BON has developed a set of flexible criteria for endorsement to connect better with the user community. The following countries have a national BON, are in the process of forming a national BON or are active in the Asia-Pacific Regional BON: Colombia, France, South Korea, Japan, Nepal, India, Philippines, Malaysia, Indonesia, Taiwan, Thailand, Vietnam, and Australia. In addition, the following nations belong to the Arctic Council: Canada, Kingdom of Denmark, Finland, Iceland, Norway, Russia, Sweden, USA. These have coordinated their Arctic biodiversity observation systems as part of the Circumpolar Biodiversity Observation Network. As stated earlier, by 2025, GEO BON's goal is to have facilitated the development or enhancement of at least 25 national biodiversity observation systems into coordinated efforts that contribute regularly to regional and global biodiversity assessments, focusing on developing, biodiversity-rich countries, representing most of the Earth's major biomes.

CBD, Ramsar & IPBES. GEO BON has been repeatedly endorsed by the CBD since the 9th session of the Conference of the Parties in May 2008 held in Bonn, Germany, as a key partner for collaboration. Also GEO BON's role in promoting coherent biodiversity observations with regards to data architecture, scales and standards, observatory network planning, was highlighted by the CBD. The CBD is in an urgent need to oversee trends in biodiversity change and most GEO BON publications, EBVs as well as BON in a Box contribute to this effort. In the document UNEP/CBD/COP/12/WG.1/CRP.2, , the CBD *"Invites Parties, indigenous and local communities and other relevant stakeholders to collaborate with the Group on Earth Observations Biodiversity Observation Network (GEO BON) and other relevant organizations that contribute to building observing systems and biodiversity monitoring, to address their priority needs related to biodiversity observations and monitoring"*. The Environmental Affairs Officer of the CBD is an active member of the GEO BON Advisory Board guaranteeing a strong connection. [GEO-BON is an observer organization to the](#) Scientific and Technical Review Panel (STRP) of the Ramsar Convention and GEO BONs freshwater WG and the EU project SWOS, GEO BON contributes to the development of GWOS, a key demand from Ramsar (see below for details). GEO BON is well recognized as a partner organization of the Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES). IPBES recognizes GEO BON in its documents and 25 GEO BON members are or have been active within IPBES, usually as experts. Also, IPBES user needs are triggering the research agenda of many GEO BON partners, as IPBES needs scientific data and information for its reports. GEO BON is especially engaged in the "IPBES Task Force on Knowledge and Data". The Executive Secretary of IPBES is an active member of the GEO BON Advisory Board. Furthermore, GEO BON regularly represents GEO as an accredited observer organization at both CBD and IPBES plenaries.

Scientists. Another key user group of GEO BON is the scientific community that needs sound and reliable data to develop and validate models, study the drivers of biodiversity change, identify new and emerging threats to biodiversity along with effective responses, and create scenarios and assessments of policies to facilitate decision-making. Governments as well as regional and international bodies (such as CBD and IPBES and their experts) depend on the work of scientists, who collect, analyse and publish biodiversity data, information and knowledge. Scientists are the experts who contribute their knowledge to IPBES assessments and CBD reports and publications. Scientists are responsible for developing protocols, guidelines and best practice taking advantage of

the most up to date scientific knowledge. GEO BON includes a global network of experts and scientists developing new methods to observe biodiversity change, developing data standards and technologies for data interoperability and establishing new interoperable networks, which deliver information and knowledge to users. GEO BON has close links with major space agencies that provide critical observations, and integrating remotely sensed and *in situ* measurements is an important function to allow scientists to do their work.

5. Previous development and results

Working Group Products. GEO BON has nine working groups focussed on special topics of biodiversity observation (genetics, terrestrial species, terrestrial ecosystems, freshwater ecosystems, marine ecosystems, ecosystem services, in-situ / remote sensing integration, data integration and interoperability, biodiversity indicators). In these working groups, a major part of the globe's biodiversity observation experts are linked together forming a huge pool of excellence. With GEO BON's first implementation plan in 2010, its working groups agreed to produce a set of deliverables. Since then, 41 products have been delivered. Among these are many scientific papers (see at <http://geobon.org/products/reports-papers>) including some in the prestigious journals *Science* and *Nature* as well as key reports for the Convention on Biological Diversity (CBD) such as the "*Adequacy of Biodiversity Observation Systems to support the CBD 2020 Targets*. UNEP/CBD/SBSTTA/15/INF/8, 2011" and the "*Earth Observation for biodiversity monitoring*, CBD Technical Series 72, 2014". Please see the major GEO BON products at <http://geobon.org/products/>. Additional nine deliverables are in progress as listed in Annex 1.2).

Essential Biodiversity Variables (EBVs). Essential Biodiversity Variables are the key elements required to understand biodiversity change. As such they provide guidance to the observation system by highlighting what aspects of biodiversity are important to measure, and because they sit between raw measurements and the indicators used by decision makers, they isolate those indicators from advances in measurement technology or science. The publication of the EBV concept by a dedicated GEO BON team (*Pereira et al., 2013*) has already made a substantial impact on the biodiversity and ecosystem observation community worldwide. The concept has already been adopted by several regional biodiversity observation initiatives (e. g. New South Wales, Brazil) and the development of EBVs has been adopted or discussed by several project (e. g. EC-funded projects such as GLOBIS-B, EU-BON, ECOPOTENTIAL, SWOS) and has strongly stimulated the development of Essential Variables for other GEO SBAs (through the EC-funded project ConnectinGEO). GEO BON itself has (co)-funded four dedicated projects to develop EBVs in 2014 and 2015 (see details in Annex 1.1) and which had an impact to the global biodiversity observation community by engaging more than 100 experts worldwide in the development of the EBVs framework.

Biodiversity Observation Network in a Box. The development of the concept of BON in a Box has largely finished and the engagement of national governments and other participants has proceeded smoothly and implementation has now begun. This work continues and is discussed in more detail in Section 7.

Regional and Thematic BONs. As discussed above, GEO BON has initiated development or joined forces with a variety of regional and Thematic BONs, including the Asia-Pacific BON, the Circumpolar Biodiversity Observation Network, the Global System of Ecological Observatories, The Marine Biodiversity Observation Network, and the Global Wetland Observing System. This work continues and is discussed in more detail in Section 7.

6. Partners

There are 350 individual members from 45 countries around the world, including scientists and practitioners active in biodiversity observation, of the working groups of GEO BON. Furthermore, about 700 people, regularly receive the GEO BON news and this number has been increasing at a rate of 300 from 2014 to 2015.

Below, we list major GEO BON partner organisations that are deeply engaged in GEO BON activities. These partner organisations provide in-kind funding and support to individuals that represent their organisation in the GEO BON network, as members of the Working Groups or members of the GEO BON Implementation Committee or Advisory Board (see 11 for details on the governance structure). Some of these organizations have also provided direct funding to GEO BON activities.

- **The German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig** conducts top-level research and looks at major topics as well as those of increasing social relevance such as environmental change caused by loss of species and habitat, sustainable development and bio-resource management. iDiv hosts the GEO BON Secretariat since 2014 and supports GEO BON activities financially as well as by providing space, logistics and scientific support.
 - The **US National Aeronautics and Space Administration (NASA)** aims to reach for new heights and reveal the unknown so that what we do and learn will benefit all humankind. NASA conducts and sponsors research, collects new observations from space, develops technologies, and extends science and technology education to learners of all ages. NASA has supported GEO BON from the beginning and has provided large amounts of direct funding to GEO BON in support of All-Hands meetings and other activities.
 - The **United Nations Environment Programme World Conservation Monitoring Centre (UNEP-WCMC)** evaluates and highlights the many values of biodiversity and puts authoritative biodiversity knowledge at the centre of decision-making. The **UNEP-WCMC Species Database** – includes data on 75,720 animals and 88,763 plants of conservation interest, as well as 94,034 sub-species, stocks or synonyms, and the **World Data Base on Protected Areas (WDPA)**, maintained by UNEP-WCMC, contains crucial information from governments and organizations intended for ecological gap analysis, environmental impact analysis and private sector decision-making. Two UNEP-WCMC members are present in GEO BON Implementation Committee and Advisory Board and UNEP-WCMC provides in-kind support on GEO BONs engagement with indicators, EBVs, remote sensing, and other areas.
 - The **Global Biodiversity Information Facility (GBIF)** is a global network of data providers that builds biodiversity information infrastructure and promotes the growth of biodiversity information content on the Internet by working with partner initiatives and coordinating activities worldwide. The GBIF Executive Director is a member of the GEO BON Advisory Board and GBIF provides in-kind funding and expertise on several topics, mostly but not limited to those related to data management.
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- The **ASEAN Centre for Biodiversity (ACB)** is an intergovernmental, regional centre of excellence that facilitates cooperation among the members of the Association of Southeast Asian Nations (ASEAN) and relevant national governments and regional and international organizations on the conservation and sustainable use of biological diversity and the fair and equitable sharing of benefits arising from the use of such biodiversity. ACB is active member of the Asia-Pacific Biodiversity Observation Network (AP-BON) of GEO BON. The Director for Biodiversity Information Management of ACB is a member of GEO BON's Advisory Board.
- The **Ocean Biogeographic Information System (OBIS)** and its global network of regional and thematic OBIS nodes integrates data from many sources over a wide range of marine themes, from the poles to the equator, and from microbes to whales. The OBIS Project Manager is a member of the GEO BON Marine Working Group and the GEO BON Data Working Group, provided as an in-kind contribution from the Intergovernmental Oceanographic Commission of UNESCO.
- **Map of Life** is an online resource for mapping, monitoring and analyzing biodiversity worldwide, endorsed by GEO BON. The Map of Life lead is a member of the GEO BON Implementation Committee and Map of Life is assisting in the implementation of some EBVs.
- The **Southern African Science Service Centre for Climate Change and Adaptive Land Management (SASSCAL)** is a joint initiative of Angola, Botswana, Namibia, South Africa, Zambia, and Germany, responding to the challenges of global change. SASSCAL is assisting GEO BON with its activities in Southern Africa, and its coordinator is a member of the GEO BON Implementation Committee.

7. Activities description

The main GEO BON activities are described below along with their activities for 2016.

7.1 GEO BON Secretariat Operations. The GEO BON Secretariat, located at iDiv in Leipzig, Germany, provides the core organizational structure of GEO BON. It plans and schedules meetings and thematic workshops, maintains the GEO BON website and other communications, and in general provides the basic infrastructure that facilitates GEO BON development and operations. It also acts as the Secretariat for the GEO BON open Science Conference (see below).

- Resources available: 24 PM in 2016 (funding provided by iDiv)

GEO BON Website Enhancements. The new GEO BON website went live in 2015 and additions are planned in the coming year. The GEO BON website long-term goal is to become the main portal to access information on biodiversity observation networks, datasets and analyses globally.

- Deliverables
 - 1) A searchable, geospatially referenced wiki-inventory of existing national and international biodiversity observation networks and programs (*December 2016*)
 - 2) A list of experts and a process for connecting to these experts to support the establishment of national and/or regional biodiversity observation systems, as part of Bon-in-a-Box (*December 2016*)
 - 3) Links to GEO BON products and related products of interest (e.g. China's 30m resolution Landcover Map) (*December 2015*)
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- 4) A data management infrastructure for managing and linking biodiversity datasets is available and linked to the GEO Data Access Broker (*December 2017*)
- 5) The EBV dashboard is online and functional (*June 2016*)

Enhanced Communication Materials. In addition to existing materials such as a quarterly newsletter and GEO BON flyers, a variety of new materials are planned. Most of these communication materials are developed together with the global GEO BON network, especially with the GEO BON working groups.

- Deliverables

2. A promotional video highlighting GEO BON (*September 2016*)
3. Promotional material on how open biodiversity data can lead to better decision-making and two or three stories on how GEO BON has helped establish national and/or regional biodiversity monitoring (*November 2015*)
4. Promotional material on key GEO BON products e.g. BON in a Box, EBVs (*November 2015*)

International Conference. In July 2016, GEO BON will organize a large-scale international **conference on biodiversity observation**. Back-to-back to that conference GEO BON members and partners will meet for an **all-hands meeting** to develop first steps for a new implementation plan as well as decide on new milestones and deliverables for the coming years. The GEO BON network will also discuss in depth about new perspectives how to modernize its structures and Working Groups to better serve user needs as those coming from national governments, CBD, Ramsar and IPBES. The conference and related all-hands meeting will be partly supported by registration fees and several organizations have committed funding.

7.2 Essential Biodiversity Variables (EBVs) are the key measurements needed to understand biodiversity change. Therefore the development of the EBVs framework provides guidance to organizations developing and implementing biodiversity observation systems. The concept of EBVs has been very well received in the biodiversity community. It is being adopted by several regional biodiversity observation initiatives including New South Wales, France and Brazil. GEO BON has identified a list of 23 candidate variables, and is implementing a process to endorse the implementation of each EBV and approve new candidates. The implementation process of each EBV includes: conceptual definition, monitoring methods, data standards, monitoring schemes and datasets. Certain EBVs are likely to reach the implementation phase in 2016. GEO BON itself has (co)-funded four dedicated projects to develop EBVs in 2014 and 2015 (see details in Annex 1.1)). GEO BON members are also involved in projects as GLOBIS-B, EU-BON, ECOPOTENTIAL and SWOS to develop and implement EBVs. GEO BON is developing an online EBV dashboard as a capacity building activity to allow a wide and coordinated user engagement in EBV development.

- Resources available: 36 PM (funding provided by iDiv/Germany)

- Deliverables

1. Criteria for identifying and endorsing EBVs will be finalized and approved by the Implementation Committee (*December 2015*)
2. A first set of data standards and global and sub-global data products for some of the Essential Biodiversity Variables are available (*June 2016*)

- Recommended Additional Activity: To allow a wide community engagement in the development of EBVs, we build an EBV dashboard (resources needed: 2 M€).

7.3 BON in a Box is a capacity building and technology transfer mechanism, functioning as an online, continually updated toolkit for lowering the threshold for a country or region to develop or enhance a biodiversity observation system. Once operational, BON in a Box will allow users to access the latest biodiversity observation design tools, monitoring protocols, data standards and management systems and analysis and reporting tools to facilitate more integrated and interoperable biodiversity observations. BON in a Box is being designed to support countries and both the CBD and IPBES by focusing on these specific clients and their user needs (e.g. supporting CBD National Biodiversity Strategies and Action Plans).

Currently, GEO BON is working directly with Colombia's Alexander von Humboldt Institute and other Latin American regional organizations and governments to develop BON in a Box: Latin America. The first prototype will be launched in November 2015 and the fully functional version will be ready in October 2016. Beginning in 2016, GEO BON will be working with three sub-Saharan countries (Ghana, Uganda and Mozambique) to develop a BON in a Box: Africa version of the toolkit. The toolkit will be tailored with these countries needs in mind but will be accessible throughout all of Africa. BON in a Box: Africa will be fully operational in 2018.

Discussions are currently underway with GEO BON's Marine BON partner organizations and IOC's OBIS to develop a marine version of the biodiversity observation toolkit – serving as a delivery mechanism for more standardized and cost-efficient marine biodiversity observation approaches globally.

- Resources available: 15 PM (funding provided by Alexander von Humboldt Institute, Polar Knowledge Canada, GEO BON Secretariat)
- Deliverables
 1. Fully functional BON in a Box prototype (October 2016)
- Recommended Additional Activity: To make BON in a Box really functional in many countries, considerable investments into national infrastructures are needed. While GEO BON actively search for funding to develop BON in a Box worldwide, additional resources are needed to do so.

7.4 Developing National, Regional, and Thematic BONs. The GEO BON network is structured in working groups as well as in national, regional and thematic Biodiversity Observation Networks (BONs). GEO BON actively facilitates the development of BONs by engaging stakeholders (particularly national governments, institutes, scientists and practitioner) and building capacity. The focus here is on the development of national BONs, which can act as national units bringing biodiversity change data and information together. The development of the national BON's is also directly facilitated through the application of the BON in a Box regional toolkits for biodiversity observations, which helps national governments to assess biodiversity change in a harmonized way. Below, the six most advanced BONs are described. The process is coordinated by the GEO BON Secretariat and overseen by the GEO BON Implementation Committee and Advisory Board.

- Resources available: 4 PM in 2016 (funding provided by iDiv)
- Deliverables

1. Criteria for identifying and endorsing activities and programs under the GEO BON ‘banner’ will be finalized and approved by the Implementation Committee (*December 2015*)
 2. An engagement strategy that identifies the key organizations, funding sources and partners that GEO BON should be engaging. This includes a communications plan that explains how to engage these organizations, sources and partners, and raise GEO BON’s profile. Part of the strategy will be an approach for attracting and including new interested people, networks and organizations to GEO BON (*May 2016*)
- Recommended Additional Activity: To make national BONs really functional and allow them to collect data and make these available considerable investments into national infrastructures are needed.

Colombia National BON. This is a national BON. Colombia (led by the Alexander von Humboldt Institute) is beginning development of a National Framework for Biodiversity Observations and GEO BON has been requested to assist with this process. This represents an opportunity for GEO BON to directly engage with the development of a national biodiversity observation network in a systematic fashion. The collaboration with Colombia will result in the development of a general framework and process that would be published as a report in 2016 GEO BON technical series. The intent of this publication would be to solicit feedback from the CBD Parties and after its adjustment, it is hoped that it would serve as a template, framework and process for establishing a national Biodiversity Observation Network. This project is directly linked with the BON in a Box project for Latin America.

- Resources available: 10 PM in 2016 (funding provided by Alexander von Humboldt Institute)
 - Deliverables
1. Fully functional BON in a Box prototype (October 2016)

Asia Pacific BON. AP-BON is a regional BON. AP-BON is an example of a regional network. AP-BON was organized in 2009 as a regional network related to GEO BON, covering most countries of the Asia-Pacific region and covering all levels of biodiversity and ecosystems. The visions of AP-BON are (1) to establish a coordinated Asia-Pacific network that gathers and shares information on biodiversity and ecosystem services, (2) to provide tools for data collection, sharing/exchange, analysis, and synthesis/ integration, and (3) to contribute to improving ecosystem management, sustainable use of biodiversity, and human well-being. Since 2009, AP-BON had six workshops and published two volumes of books on biodiversity and ecosystems in the Asia-Pacific region. Further, AP-BON has contributed annual GEOSS-AP symposia to tighten linkage with GEO activities in other social benefit areas. AP-BON consists of a Steering Committee and five working groups. Moreover, as a national biodiversity observation network (BON), J-BON is organized in Japan, Sino-BON in China and K-BON in Korea. Several other countries in Asia are on their way to form own national BONs.

- Resources available: 11 k€ in 2016 (funding provided by the Ministry of Environment, Japan)
 - Deliverables:
 1. AP-BON Book 3 (December 2015)
 2. AP-BON Book 4 (December 2016).
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- Recommended Additional Activity: To make national BONs really functional and allow them to collect data and make these available considerable investments into national infrastructures are needed.

Circumpolar Biodiversity Observation Program. Arctic BON is a regional BON. The Circumpolar Biodiversity Monitoring Program (CBMP) is an international network of scientists, government agencies, Indigenous organizations and conservation groups working together to harmonize and integrate efforts to monitor the Arctic's living resources. The CBMP has over 100 organisational partners and 1000 members and involves all eight Arctic countries of the Arctic Council (U.S., Canada, Kingdom of Denmark, Iceland, Norway, Sweden, Finland and the Russian Federation).

CBMP experts are developing and implementing four coordinated and integrated Arctic Biodiversity Monitoring Plans (marine, coastal, terrestrial and freshwater) to help guide circumpolar monitoring efforts. Results are being channelled into effective conservation, mitigation and adaptation policies supporting the Arctic.

- Resources available: 1900 k€ in 2016 (funding provided by CBMP)
- Activities
 1. Data management (the Arctic Biodiversity Data Service)
 2. Capacity building
 3. Reporting
 4. Coordination and integration of Arctic monitoring
 5. Communication, education and outreach

Marine Biodiversity Observation Network (MBON). MBON is a thematic BON in development. Marine biodiversity is a key indicator of ocean health and provides a multitude of essential ecosystem services, yet no global network for organized biodiversity observations is in place. The GEO BON Marine Biodiversity Observation Network (MBON) is envisioned as GEO BON's key pillar for the marine realm. It is a crosscutting activity linking GEO BON with Blue Planet (GEO's overarching marine task), the Global Ocean Observing System (GOOS) and other marine and biodiversity initiatives and data sharing strategies. It will help coordinate many individual programs that monitor various aspects of marine biology and biodiversity and provide the ability to share data, experiences, and protocols to understand species and the status and trends of ecosystem and their services. Thus it will build on existing data infrastructures such as the World Register of Marine Species and the Ocean Biogeographic Information System (OBIS). A Pole-to-Pole MBON in the Americas concept is being planned as the likely first major phase of MBON. Several countries in the Americas have initiated a dialogue to understand the connection between ecosystems along this latitudinal gradient, and it is anticipated that initiatives in other regions will follow.

- Resources available: USD 6M + 135 PM in kind. The dollars fund the three US demonstration projects and TMON; the in-kind contributions are supporting TMON (120 PM), or provided by NOAA, Blue Planet participants, GOOS, and other organizations.

Activities

1. Develop partnerships and engage national governments for the Pole to Pole MBON in the Americas. The focus here is on understanding the need of individual countries and informing them how biodiversity observations provide benefits to local society. This is the key activity for 2016 as it is the path to an expanded network.
2. Refine the MBON concept and plans to ensure they are responsive to the needs of partner countries and that the connection between biodiversity observations and the benefits they will provide is clear.
3. Continue to develop Ocean Essential Biodiversity Variables
4. Facilitate linkages between existing regional initiatives so as to promote formation of a global marine BON. GEO BON facilitate linkages between regional groups, the MBON US Demonstration projects, and the Smithsonian Tennenbaum Marine Observatories Network (TMON). The US demonstration MBONs and the TMON were starting points for the global MBON effort. TMON has sites in Latin America and these and other existing connections will facilitate collaborations for the Pole to Pole MBON in the Americas network.

Global System of Ecosystem Observatories (GSEO). GSEO is a developing thematic BON. It is a emerging network of field site networks focused on harmonization and coordination. The aim of the system is to provide access through GEOSS (e.g. through the GEOSS Access Broker) to a significant set of biodiversity observations from in situ sources (sites), which alone or in combination with other components of GEO BON, will 1) quantify and map the drivers of environmental change and their impacts on biodiversity and ecosystem processes; 2) quantify and map the consequences of biodiversity loss on the services and goods provided by ecosystems and the benefits that would be derived from remediation and restoration of degraded ecosystems; and 3) deliver products to end users to support decision making at local, national and global levels related to the sustainable use of biodiversity and ecosystems. The GSEO will also contribute to several other GEO BON deliverables under development in GEO BON Working Groups on Genetics, Species, Ecosystem, Freshwater, and Remote Sensing. The main GSEO stakeholders will be the data providers and science community who operate sites and networks and deliver products from them.

- Resources available: 90 PM in 2016.

Key activities for 2016:

1. Establish global directory of field sites – provide access through GEO Portal.
2. Gap analysis of sites and review potential of network to address key questions and requirements.
3. Identify and adopt common standards for data sharing for European sites (EC funded)

Recommended Additional Activity: Identify and implement “proof of concept” use-cases to promote development of a functioning network (resources needed: 100k€ for a workshop to ID use-cases, and ~84 PM, mostly in kind, to implement them)

Global Wetland Observing System. The GWOS is a thematic BON. It is a collaborative development and capacity building effort lead by Wetlands International and several GEO BON members to bring together available information on the status and values of wetlands and water in a way that can support policy processes and decision-making at various geographic scales. It will, once full developed, describe extent and condition as well as change and trends over time of a variety of

wetland types. Amongst others it will feed into the Ramsar Convention's "State of the Worlds Wetlands and their Services" flagship publication and their "Global Wetland Outlook". Funding through the EU H2020 project SWOS allows to develop an operational element of GWOS with a geographic focus on Europe but following a global approach. The activities in SWOS will lead GWOS from the planning phase into the first (European) implementation phase 2015-2018. Other projects like the ESA Globwetland Africa Project (starting in late 2015) will also provide funding for development and capacity building activities contributing to the GWOS over the next years.

- Resources available: 115 PM in 2016 (funding provided by EU (SWOS project))
- Deliverables:
 1. SWOS user requirements review and user requirements workshop (Jan 2016)
 2. SWOS Geoportal and mobile App Prototype (Nov 2016)
- Recommended Additional Activity: Making GWOS fully functional at the global scale (resources needed: 20 M€)

8. Planning, milestones and deliverables *(this section has been combined with Section 7)*

9. Data management and policy

The guiding principles that GEO BON follow are based strictly on the GEOSS principles, and include issues such as information sharing, interoperability, standards, user-orientation and scientific rigor. GEO BON adds value to existing data by working with other organizations to derive higher-level analytical products not currently available. GEO BON aims to provide a global, scientifically-robust framework for observations that:

- Detect and monitor biodiversity change
- Provide access to observations, models, assessments and forecast information
- Help build a global system of systems based on the integration of in situ and remote observation systems
- Coordinate aspects of data gathering and the delivery of biodiversity change information
- Ensure long-term continuity of data supply
- Provide a set of innovative and relevant products based on the integration of datasets

Additionally, EBVs and BON in a Box will facilitate data access by encouraging standardized collection and distribution protocols that make it much easier to share data between different organizations. Especially, GEO BON will develop an online guidance for systems, standards, and software to support the access to and dissemination of EBV data. Also GEO BON will develop demonstrations of web-based processing of standardised data into indicators.

10. Management arrangements

GEO BON is a "community of practice". As such, it is a "network of networks", a structure with

minimal parts of its own, designed to help strengthen and coordinate the activities of a diverse set of partners towards a common goal—improved biodiversity information for a wide range of users. The GEO BON standing bodies are its Chair and Vice-Chair, its Working Groups, BONs, its Advisory Board, Management and Implementation Committees.

Management Committee: The Management Committee (seven members) is responsible for GEO BON planning and operations. It meets monthly (mostly virtually) or on demand to discuss technical and substantive issues regarding implementation and coordination.

Responsibilities: daily GEO BON operations; meet monthly to discuss more technical and substantive issues regarding GEO BON implementation and coordination.

Composition: outlined below, includes both the members of the GEO BON Secretariat (Executive Director, Secretary, Programmer), the Chair/Vice-Chair, and other Officers; 3 year terms, renewable once.

- Chair: provide overall leadership, coordination and oversight; representing GEO BON at key meetings; can be attributed a particular set of tasks for coordination⁹
- Vice-Chair: providing leadership; representing GEO BON at key meetings; can be attributed a particular set of tasks for coordination
- Executive Director: engaging WG's and activity leads, overseeing product delivery; coordinating technical development (website, etc.), fundraising, representing GEO BON at key meetings
- GEO Science Officer: manage the link between GEO BON activities and the GEO secretariat; develop
- GEO BON IT Officer: coordination of the Web Page and IT infrastructure
- Secretary: providing assistance with all administrative and management duties

Implementation Committee: The Implementation Committee (28 members) meets quarterly (mostly virtually), and consults electronically between meetings. It has an executive function, although much of the daily operation tasks are delegated to the Management Committee. The GEO BON Chair and Vice-Chair are also the Chair and Vice-Chair of the Implementation Committee. Members of the Implementation Committee are all Working Group leads and co-leads and other engaged persons as well as the members of the Management Committee.

Responsibilities: Implement the deliverables and implementation plan of GEO BON. Approves the annual budget.

Composition: Members of the Implementation Committee are all Working Group leads and co-leads, the leads of the BONs and other engaged persons as well as the members of the Management Committee.

Advisory Board: GEO BON's Advisory Board consists of 17 board members, representing key, global biodiversity observation organizations, governments, and experts, in a geographically balanced composition as well as other influential individuals with good ties to funding. The Advisory Board meets once a year, together with the Implementation Committee, to evaluate the status of GEO BON

and its progress. The AB provides strategic direction and feedback on GEO BON and helps to find funding. Members of the Advisory Board are invited by the GEO BON's implementation committee for a mandate of 3 years, renewable once.

Responsibilities: meets once a year to provide strategic direction and feedback on GEO BON and funding help; elects management committee every 3 years.

Composition: Representatives of organizations, governments, and experts, in a geographically balanced composition; influential individuals and with good ties to funding; 3 year terms, renewable once. It should be composed by around 15 individuals.

Working Groups: The coordination actions of GEO BON are conducted by nine working groups, with a defined purpose and for a limited period. The members of the working groups are experts, acting on a voluntary basis and in their personal capacities, selected to provide the necessary skills, experience and connections to achieve the task.

Responsibilities: Develop and implement specific thematic aspects of GEO BON. An assessment of performance and revision of the current working structure is planned for 2015.

Composition: Any expert may participate in a working group, pending approval by the WG leads based on declaration of interest and submission of Curriculum Vitae. WG leads can be suggested by the MC, but are elected by the members of the WG and confirmed by the IC.

Regional, National and Thematic BONs: As a “network of networks”, two types of constituent networks are especially important for GEO BON to achieve its mission: Regional BONs and Thematic BONs. Please see details in chapter 7.

Responsibilities: Implement and coordinate monitoring activities at the national and regional level.

Composition: The composition is decided by the regional/national networks. A coordinator represent the regional networks in the IC. The national networks should have a coordinator represented in the regional networks.

11. Monitoring and evaluation approach and reporting

GEO BON's **Advisory Board** evaluates the status of GEO BON and its progress once a year. The AB provides strategic direction and feedback on GEO BON and helps to find funding. For 2016, after the 2015 GEO Plenary, an independent assessment of GEO BON's progress and an evaluation of the current Working Group structure of GEO BON is planned. Also, we aim to publish an annual GEO BON report starting in 2016.

12. Committed Resources and annual budget (*When available, this can just summarize the information in Section 7*)

The GEO BON Secretariat is hosted by the **German Centre for Integrative Biodiversity Research (iDiv)** in Leipzig, Germany. iDiv supports the GEO BON Secretariat with an annual budget of 135k€ Euro for personnel costs and 50k€ Euro running budget. More specifically, iDiv provides the salaries for the GEO BON Executive Director, the GEO BON Web Developer and the GEO BON Administrative

Assistant as well as 50.000 Euro annually for GEO BON's running costs. Furthermore, iDiv offers one office room and associated infrastructures, and a considerable part of the working time of the GEO BON chair, Prof. Henrique Pereira. **NASA** provides in-kind expertise to GEO and GEO BON, including a full time secondment to the GEO Secretariat and NASA is also supporting the marine biodiversity observation network MBON with about 1.86 M US\$ annually. In addition, **Polar Knowledge Canada** supports the Vice-Chair position for GEO BON which is equivalent to 34k€ in 2016. Furthermore, the **Global Biodiversity Information Facility (GBIF)** provides an in-kind contribution of 10k€ annually and **Map of Life (MoL)** provides 200k€ annually to GEO BON activities. It is difficult to oversee the in-kind contribution from all members and partners to GEO BON activities. Furthermore, it should be mentioned, that the European Commission actually support GEO BON by funding projects which develop Essential Biodiversity Variables and/or contribute actively to GEO BON by a total of 32 M€ (Globis-B: 1 M€, SWOS: 5 M€, Ecopotential: 15 M€, EU-BON: 11 M€).

13. Transition to operational phase

GEO BON has a functional structure, an Implementation Committee and an Advisory Board and has a clearly defined user community and a wide commitment in the biodiversity community. The GEO BON Secretariat is hosted and supported by the German Centre for Integrative Biodiversity Research (iDiv) in Leipzig, Germany. iDiv will support GEO BON at least until August 2019. GEO BON as a community of practice is already an operational social network. This along with a number of global, regional and national observing initiatives, products and tools coming into force indicates that GEO BON is on the verge of becoming operational on a number of fronts. In the long term, by 2025, GEO BON may become an independent organisation coordinating a Global Biodiversity Observation Network, in cases partners agree this is the best path forward.

ANNEXES

A. Technical Annex

1 List of Products and deliverables.

A. 1.1 List of GEO BON funded project in 2014/15

- Black Listing Invasive Species for Monitoring and Reporting submitted by Monash University
- Developing guidelines for standardised global butterfly monitoring, submitted by UNEP-WCMC and Dutch Butterfly Conservation
- Finalizing, visualizing and communicating global remote-sensing supported species EBVs and change indicators submitted by Yale University.
- Remote sensing of Essential Biodiversity Variables submitted by Twente University

A. 1.2 List of GEO BON deliverables

- A searchable, geospatially referenced wiki-inventory of existing national and international biodiversity observation networks and programs (December 2016)
-

- A list of experts and a process for connecting to these experts to support the establishment of national and/or regional biodiversity observation systems, as part of Bon-in-a-Box (December 2016)
- Links to GEO BON products and related products of interest (e.g. China's 30m resolution Landcover Map) (December 2015)
- A data management infrastructure for managing and linking biodiversity datasets is available and linked to the GEO Data Access Broker (December 2017)
- The EBV dashboard is online and functional (June 2016)
- A promotional video highlighting GEO BON (September 2016)
- Promotional material on how open biodiversity data can lead to better decision-making and two or three stories on how GEO BON has helped establish national and/or regional biodiversity monitoring (November 2015)
- Promotional material on key GEO BON products e.g. BON in a Box, EBVs (November 2015)
- Criteria for identifying and endorsing EBVs will be finalized and approved by the Implementation Committee (December 2015)
- A first set of data standards and global and sub-global data products for some of the Essential Biodiversity Variables are available (June 2016)
- Criteria for identifying and endorsing activities and programs under the GEO BON 'banner' will be finalized and approved by the Implementation Committee (December 2015)
- An engagement strategy that identifies the key organizations, funding sources and partners that GEO BON should be engaging. This includes a communications plan that explains how to engage these organizations, sources and partners, and raise GEO BON's profile. Part of the strategy will be an approach for attracting and including new interested people, networks and organizations to GEO BON (May 2016)
- AP-BON Book 3 (December 2015)
- AP-BON Book 4 (December 2016)
- Deliverables: SWOS user requirements review and user requirements workshop (Jan 2016)
- SWOS Geoportal and mobile App Prototype (Nov 2016)
- Map of global Marine Ecosystems
- Assessing multi-ecosystem service trade-offs
- DataOne network development and contribution to infrastructure
- Species Protection Index
- Protected Area Representative Index

	GI-02	GEOBON-Global Biodiversity Observation (GEO BON)	- WorkPlan 2014-2016

c/o German Centre for Integrative Biodiversity Research (iDiv) Halle-Jena-Leipzig
 Deutscher Platz 5e
 04103 Leipzig
 Germany



GEO BON Strategic Workplan 2014-2016

Towards an Integrated Global Biodiversity Observing Network for a Changing Planet

Mike Gill, Henrique Pereira, Gary Geller and Michele Walters

Version 1.0, 21 March 2014

Introduction

The Group on Earth Observations – Biodiversity Observation Network (GEO BON) is one of nine Societal-Benefit-Areas of GEO, focused on developing an integrated, interoperable global biodiversity observation system that delivers enhanced biodiversity information to facilitate better decision-making at multiple scales (from local to global). Towards this end, GEO BON is focusing its efforts on the implementation and adoption of the Essential Biodiversity Variables (EBVs) and related monitoring guidelines and interoperable data management systems and through targeted capacity building efforts at the national and regional level (e.g. development of a “BON in a Box” toolkit (see below)) focused on improved observations to facilitate improved policy and decision-making. This approach reflects the need to provide a top-down design for a global observation system (e.g. EBV’s, monitoring guidelines, interoperable data systems) with the pragmatism of a bottom-up construction process (e.g. through national and regional capacity building).

To achieve an integrated and interoperable global biodiversity observation network is an ambitious task, requiring a targeted and iterative approach that builds upon successes and lessons learned, focuses on understanding and responding to user needs, and facilitates the development of national and regional biodiversity observing networks that can be sustained with existing national and regional observing capacity and expertise.

In a few short years, GEO BON has created a global network and community of practice involved in biodiversity observations. In the next phase, GEO BON will take an increasingly targeted approach, and to do this, we must stay focused on the ‘art of the possible’ and make careful, strategic decisions on where we put our limited resources to achieve success. GEO BON will narrow its focus onto several carefully selected areas, utilizing and building upon the networks and communities of practice that have already been established.

A User-Driven GEO BON: Defining GEO BON’s Clients and Their Needs

A successful and sustainable global biodiversity observation network must clearly and effectively meet ‘user’ needs. Perhaps the most important block of users is the national governments who are responsible for reporting on the status and trends in ecosystems and the biodiversity they support to meet their national mandates (e.g. national biodiversity plans, recovering species at risk, sustaining ecosystem services) and international obligations (e.g. Convention on Biological Diversity, Ramsar Convention, Convention on Migratory Species, etc.). These users are important because, more than

any other group, they have the ability to enact and change policy and then implement it; both of which are dependent upon better observations, products, and tools than are currently available. Collectively, they have the greatest access to resources to support implementation.

Another key user group of a global biodiversity observation system and the resulting data is the scientific community that needs sound and reliable data to produce and populate models, study the drivers of biodiversity change and distribution, identify new and emerging threats to biodiversity along with effective responses, and that must create scenarios and assessments of policies to facilitate decision-making (e.g. Intergovernmental Platform on Biodiversity and Ecosystem Services).

Many non-governmental (e.g. IUCN) and international organizations (e.g. Arctic Council) are actively involved in conducting biodiversity assessments to facilitate more effective conservation and sustainable use of biodiversity and ecosystem services and thus, are also reliant on high quality biodiversity data.

Currently, our collective ability to detect and understand the status and trends of biodiversity, develop sound assessments, and produce scenarios to guide more effective policy is greatly hampered by a lack of access to high quality observations. GEO BON is concerned with the development of more integrated, efficient and interoperable biodiversity observation networks that can produce more reliable, accessible and timely observations to serve these needs. Being part of the GEO network allows GEO BON the opportunity to connect with the observations and data organized in the other GEO SBA's. These cross-linkages provide an opportunity to produce value-added, integrated tools and products that facilitate more informed and effective policy - going beyond reporting on status and trends to also identifying the causal mechanisms driving biodiversity change and producing predictive models for examining future scenarios.

Considering these various clients, their needs, our current limited capacity, and opportunities from the GEO network, we must prioritize our strategic engagement and capacity building efforts. With this in mind, it is believed that the Convention on Biological Diversity's (CBD) 2020 Aichi Targets provide one impetus for improved biodiversity observations from the national to regional and, ultimately, to the global level. As such, GEO BON has identified the Parties to the CBD as key clients. To date, the CBD Parties have been engaged several times (e.g. pre-SBSTTA 17 workshop; Adequacy of Biodiversity Observation Systems to Support the 2020 Targets report) to raise the profile of GEO BON and gain a better understanding of national biodiversity observation needs with regard to developing useful National Reports and National Biodiversity Strategies and Action Plans. GEO BON will also continue to consider opportunities for cross-linkages with the broader GEO community (e.g. other SBA's), where feasible, to ensure that integrated observations and derived data and information products are achieved. Additionally, GEO BON will continue to engage the newly formed Intergovernmental Platform on Biodiversity and Ecosystem Services, the broader scientific community (e.g. the new international programme on global sustainability, Future Earth), non-governmental conservation organizations, and other relevant biodiversity conventions (e.g. Ramsar Convention, Convention on Migratory Species). While GEO BON will focus on these various entities for efficiency and funding reasons, it must not be done at the expense of supporting useful products and information that may not be well captured by existing national legislation and international conventions, but nevertheless advance GEO BON's mission.

2025 Vision Statement and Goals

GEO BON's mission is to improve the acquisition, coordination and delivery of biodiversity information and services to users, particularly decision-makers. Our vision for GEO BON is:

By 2025, GEO BON is a robust, extensive and interoperable biodiversity observation network covering the major biomes of the globe. The observations derived from this network is contributing to effective and timely conservation, sustainable use, and mitigation and adaptation decisions regarding the world's ecosystems, the biodiversity they support, and the services provided.

Some of the key GEO BON goals for 2025 include:

- GEO BON has facilitated the development or enhancement of at least 25 national biodiversity observation systems, representing most of the Earth's major biomes, that are coordinated and can contribute to regional and global biodiversity assessments.
- At least 10 regularly updated operational products (e.g. global change detection maps of forest cover; compendium of marine environmental databases) have been developed, providing high quality observations, information and data to scientists, decision-makers and the public at various scales; remotely sensed and *in-situ* data (based on the EBVs) are routinely used as inputs to these observation products and contribute to models that support improved policy assessments and scenarios at multiple scales.
- A strong, balanced and sustained biodiversity observation community is functioning, based on shared resources and increased capacity.

A strategic plan for 2014-2016

Coinciding with the three-year Chair and Vice-Chair appointment, it is necessary to outline a strategic work-plan that covers this period. In this section, we outline a strategy for the 2014 to 2016 period—a crucial time for GEO BON that would put us on the path to the 2025 vision outlined above. We start by outlining the importance of having a strong performance of GEO BON at the **GEO Plenary in 2015**, GEO's decadal assessment year. We identify the **products and tools** we would like to have in place for 2015 as a showcase of GEO BON's capabilities and present a **funding approach** for the next two years to develop these products and tools. We then describe our additional **goals for 2016** building on the success and momentum of the 2015 deliverables.

In order to implement this strategic plan, we believe that a **revised governance structure** for GEO BON should be adopted. A proposal for the new governance structure is detailed in a separate document.

Getting to the 2015 GEO Plenary

GEO BON has been developing as a network for some years now and, as a result, has developed a strong community of biodiversity specialists around the globe organized in nine Working Groups and four Regional Biodiversity Observation Networks. These Working Groups and Regional BONs have been actively developing a number of tools (e.g. data management systems and services), monitoring guidelines (e.g. Essential Biodiversity Variables for freshwater, marine and terrestrial biomes and other themes) and products (e.g. global ecosystem classifications, etc.) that can be used to both enhance capacity for, and interoperability of, biodiversity observations across the globe, as well as delivering existing data in useful formats (e.g. change detection maps) to raise awareness of the status and trends in biodiversity and the most important threats.

In 2015, the Group on Earth Observations will be ten years old and, as a result, will be conducting an assessment on the progress made within the nine Societal Benefit Areas. GEO BON needs to highlight many of these developing products in a compelling fashion (e.g. visualizations, media products) to raise the profile of GEO BON's successes to date, of the added value of GEO BON products for national, regional and global decision-making fora, and to secure continued and expanded support for GEO BON in the next ten years. GEO BON needs to further develop and solidify its 'brand' as a network of global and regional biodiversity organizations producing value-added and integrated products that both advance GEO BON's mission and vision whilst co-supporting and enhancing the work of the organizations within the network. This may be done, in large part, through showcasing high-profile, visually compelling results that illustrate the power and opportunity of integrating biodiversity observations to facilitate better conservation and adaptation decisions. In many ways, the 2015 GEO Plenary provides both the motivation and the platform to effect this. In addition, there is also an opportunity to better use our network of member organizations to both promote GEO BON and the work of these organizations. To do this, we need to equip our members with materials (e.g. standard power-point slides, brochures, video, etc.) to better promote GEO BON and highlight contributions from these organizations as part of GEO BON events and presentations.

Key Products and Tools to have in place by 2015 GEO Plenary

- A new GEO BON website that provides greater visibility to the program and our partners and useful observation products and information targeting our key users.
- A 'BON in a Box' (Biodiversity Observation Network in a Box) prototype that serves as a customizable, menu-driven toolkit for facilitating the establishment of national and regional interoperable biodiversity observation networks building upon many of the deliverables being developed by the Working Groups.
- Monitoring, metadata and data standards for some of the Essential Biodiversity Variables.
- Handbooks and monitoring guidelines for biodiversity monitoring based on the EBV's and the GEO BON Working Group themes (e.g. freshwater biodiversity, ecosystem services, etc.).
- Global and sub-global data products available via the new website.
- Metadata and data management infrastructure for managing and linking biodiversity datasets, available via a new website (linked to GEO Data Access Broker).

Additional products and tools to those above are detailed in Appendix I and a milestone calendar is presented in Appendix II. It is believed that achieving these deliverables and activities and providing a means to promote and deliver this information via the website portal and through other means (e.g. BON in a Box, application programming interfaces, visualizations of data and metadata, presentations and promotional material) will further the GEO BON 'brand' and that of its partner organizations, providing an efficient means by which to access high quality biodiversity observation-based data and metadata, information and resources as well as the expertise for supporting enhanced biodiversity observations.

Short-term funding approach for product and tool development for GEO Plenary in 2015

We believe that in order to have these key products and tools in such a short amount of time we need to use much of the financial resources currently available to GEO BON (approximately 200k€ for 2014-2015), as seed funding for certain targeted activities. Therefore, instead of having an "all-hands meeting" we will make a call for proposals from working groups to provide some funding for the development and delivery of key products and tools. The intent of this funding is to help ensure that, by the 2015 GEO Plenary, GEO BON has an appropriate suite of exciting products to demonstrate via its new website. This will involve a staged process for developing and refining these products. For example, for documents a solid outline, and for data products a rough zero order version delivered by January 2015, with incrementally improving deliverables following that with final products in July 2015 and supporting communications tools in place by the November 2015 GEO Plenary.

Goals for 2016

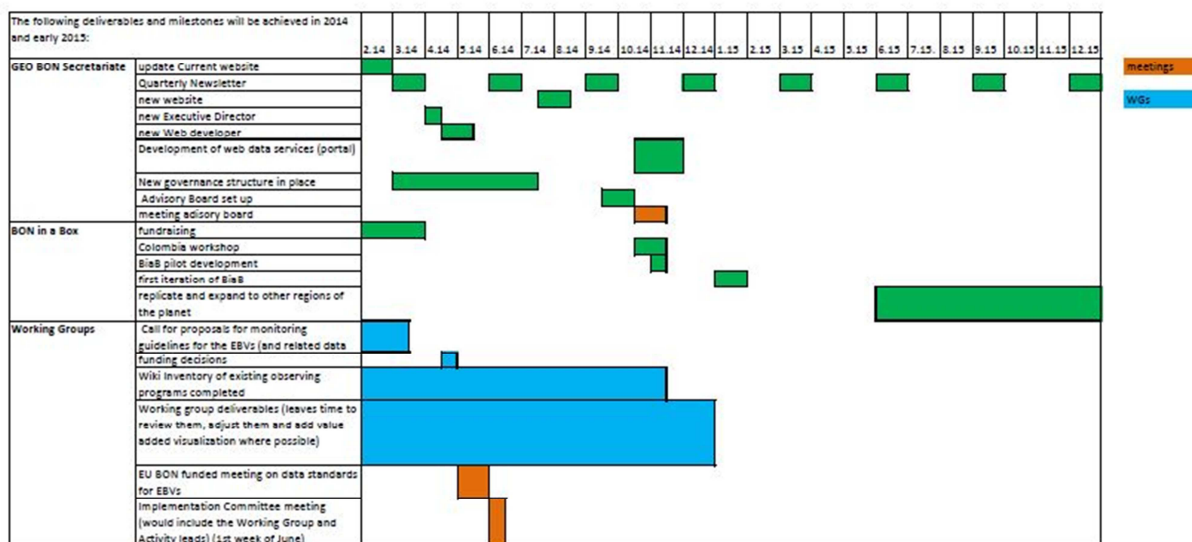
Considering the fact that the new Chair/Vice-Chair appointments extend beyond the 2015 GEO Plenary until the end of 2016 and with an eye on the 2025 goals, we present a forward look with some additional goals. By the end of 2016, GEO BON will have achieved the following:

- The GEO BON website provides further access to some key new products and is increasingly being used as a portal to access information on biodiversity observations and analyses linking to various projects occurring across the globe;
 - Monitoring, metadata and data standards for some additional EBVs in place;
 - Regional Capacity Building workshops have been organized and completed in some regions of the planet;
 - A capacity-building toolkit (BON in a BOX) containing guidelines and tools, such as monitoring guidelines and database structures for EBVs, has been further developed; and,
 - GEO BON has begun facilitating development and/or enhancement of national and regional biodiversity observation programs.
 - GEO BON has strategically addressed key data and knowledge gaps in relation to IPBES needs.
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Appendix I - Additional tools and activities to develop by 2016

- Web-site based:
 - A searchable, geospatially referenced wiki-inventory of existing national and international biodiversity observation networks and programs;
 - A list of experts and a process for connecting to these experts to support the establishment of national and/or regional biodiversity observation systems;
 - Links to other products and programs of interest (e.g. China's 30m resolution Landcover Map);
 - Communication material
 - A quarterly newsletter;
 - Twitter account and/or blog highlighting program developments and partner news;
 - A new logo and tag-line;
 - Standard power-point slides on GEO BON for WG members and partners to use when presenting at relevant forums;
 - A promotional video highlighting GEO BON;
 - Promotional material on how open biodiversity data can lead to better decision-making and two or three stories on how GEO BON has helped establish national and/or regional biodiversity monitoring;
 - Promotional material on key GEO BON products e.g. BON in a box, EBVs.
 - A strategy on how to engage existing and establish new Regional and National Biodiversity Observation Networks; efforts to facilitate the development of these networks in priority areas will have been initiated.
 - An engagement strategy that identifies the key organizations, funding sources and partners that GEO BON should be engaging; this will include a communications plan that explains how to engage these organizations, sources and partners, and raise GEO BON's profile. This will include, as part of the strategy, an approach for attracting and including new interested people, networks and organizations to GEO BON.
 - Criteria for identifying and endorsing activities and programs under the GEO BON 'banner' will have been created and adopted by the Implementation Committee.
 - After the 2015 GEO Plenary, an independent assessment of GEO BON's progress and an evaluation of the current Working Group structure of GEO BON.
-

Appendix II - 2014-16 Calendar



The following deliverables and milestones will be achieved in 2014 and 2015:

- Mailing lists (WG's, Implementation Committee, Management Committee, etc.) done by March;
- Current website updated by end of March;
- Call for proposals for monitoring guidelines for the EBVs (and related data products) by mid-March; funding decisions by end of April;
- Quarterly Newsletter initiated in April;
- Web developer hired by April/May;
- New Implementation Committee in place by May;
- EU BON funded meeting on data standards for EBVs in May ;
- BON in a Box – fundraising (spring);
- Implementation Committee meeting first week of June (would include the Working Group and Activity leads);
- New website (1st iteration) by July/August;
- BON in a Box Colombia workshop and development in fall 2014;
- Development of web data services (portal) initiated in the fall;
- Advisory Board set up by October with a meeting with them in October;
- Wiki Inventory of existing observing programs completed by December;
- First iteration of BiaB by March 2015; then replicate and expand to other regions of the planet in 2015/16;
- Independent, periodic review of GEO BON established in 2015;
- Initial working group deliverables delivered by July 2015 (leaves time to review, test, integrate with GCI, update, and include value added visualization where possible); and,
- Key Conventions such as CBD and Ramsar are engaged on an ongoing basis and where necessary.

Appendix III – List of Working Group Deliverables for 2015

ID	Short Name	Description	2015?	Date Avail
0-1	Handbook for Biodiversity Observation Systems	A practical guide to establishing and refining biodiversity observation systems, geared towards biodiversity specialists	Y	2014-06
0-4	BON in a Box	A collection of materials to assist governments in establishing and refining their observation systems, including the Handbook, tools, templates, examples, and other reference material	Partial	Partial by TBD
1				
2-2.1	Species population trend dataset	A global, spatially explicit dataset of trends in species abundance	Y	2014-07
2-3.1	Policy brief on species monitoring	A policy brief on why biodiversity monitoring is essential and on how to develop a monitoring program	Y	2014-01
3-4	Global ecosystem mapping and stratification	A new map of global ecosystems at 250 m resolution built from the integration of four major ecosystem structural elements (landforms, lithology, bioclimate, and surface moisture)	Y	On-going
4-4	Citizen science wetland monitoring trial	Protocols, tools and frameworks to facilitate public participation in monitoring and scientific research in wetlands. The funded component will provide a protocol for determining wetland boundaries, a data base containing volunteer observations, and a phone app for uploading data to the database	Partial	Preliminary protocol and App by Dec 2013, final by July 2015
5-2	Compendium of global environmental data layers	Downloadable set of global marine environmental data layers at standard spatial resolution from one website	Y	Y
6-1	Framework for observing ecosystem services and change	Framework for observing ecosystem services and reporting change at the national scale published in Bioscience	Y	2012
7-1	Global estimation of biodiversity retention	Global model-based estimation of change in retention of terrestrial biodiversity as a function of observed change in habitat condition & climate	Partial	Partial by TBD
7-2	Global assessment of protected area representativeness	Global model-based assessment of change in representation of terrestrial biodiversity within protected areas	Y	2014-12
8-8	SAEON End-to-End Demonstrator: Marine Data Sets	Prototype of 5-2, downloadable set of global marine environmental data layers at standard spatial resolution from one website	Y	Partial by 2013

GI-03	GFOI Global Forest Observation Initiative	- Detailed description

GFOI Description for the Updated GEO 2016 Transitional Work Programme

GFOI Leads and Contributors: Australia, CEOS, FAO, Norway, United States

1. Executive Summary/Short Report (3 pages)

Overview (and past activities)

Robust national forest monitoring based on objective observations and measurements is widely accepted as a pre-requisite for countries to participate in international agreements and incentive mechanisms related to forest carbon. To operate efficiently and sustainably, National Forest Monitoring Systems (NFMS) require a continuous, timely and affordable supply of observations.

The Global Forest Observations Initiative (GFOI) aims to foster the sustained availability of observations for national forest monitoring systems as well as to support governments that are establishing national systems by providing a platform for coordinating observations, providing assistance and guidance on utilising observations, developing accepted methods and protocols, and promoting on going research and development; working with national governments that report into international forest assessments such as the national greenhouse gas inventories reported to the UN Framework Convention on Climate Change (UNFCCC) using methods of the Intergovernmental Panel on Climate Change (IPCC). National Forest Monitoring Systems also have direct influence on decision-making in other fields such as resource management and agriculture.

GFOI is led by: Australia, Norway, the USA (USGS/SilvaCarbon), SilvaCarbon, The Food and Agriculture Organization of the United Nations (FAO), and the Committee on Earth Observation Satellites (CEOS). The involvement of CEOS is led by the European Space Agency (ESA), with management support provided by Australia. Other national space agencies engaged to date include those of Argentina (CONAE), Brazil (INPE), Canada (CSA), China (CRESDA, NRSCC), France (CNES), Germany (DLR), Japan (JAXA) and the USA (NASA/USGS).

The work of GFOI is undertaken by five components: Methods & Guidance, Space Data, Capacity Building, R&D, and Administration and Coordination (the GFOI Office).

In the period 2011 – 2015, the CEOS SDCG has prepared and coordinated: the initial implementation of a coordinated global baseline data acquisition strategy for EO data (Element 1) involving a number of space-based ‘core’ data that can be used and shared free-of-charge for GFOI purposes; a coordinated strategy for national data acquisitions (Element 2) which accommodates countries that have specific technical requirements or heritage and experience on working with a particular EO data source or type; and a data acquisition and supply strategy in support of GFOI R&D activities (Element 3). The SDCG for GFOI has produced a Three-Year Work Plan for 2015 – 2017, which was recently endorsed by CEOS. The Work Plan has been prepared to map out the activities of the SDCG covering the finalisation and implementation of the space data supply for GFOI.

The first version of the GFOI Methods & Guidance Documentation was released in January 2014 and has been applied in a range of countries including, but not limited to Ghana, Columbia, Cambodia, Fiji, Kenya, Papua New Guinea, facilitated by the UN-REDD programme, SilvaCarbon, the World

Bank Forest Carbon Partnership Fund and bilateral programmes. Training materials, decision support tools and rapid response guidance modules have been developed to support the MGD since its publication.

Since 2011 the US Government SilvaCarbon Program has been developing capacity in all aspects of forest monitoring in four regions (Latin America, SE Asia, Central America and Central Africa), and 25 countries across those regions. SilvaCarbon has developed bilateral work plans with 10 of these countries focusing on their forest inventories and remote need sensing needs. User engagement is typically through the Capacity Building component and handled by SilvaCarbon and FAO, although individual governments such as Australia and Norway have their own focused programmes with partner countries (eg Indonesia and Kenya) for the development of national capacity.

Significant achievements and contributions of the GFOI R&D Component are the release of the 'Review of Priority Research & Development Topics' (Dec, 2013); completion of a 'Landscaping Study' (July, 2014) that maps out priority R&D topics against the interests of potential research and partner organisations and identifies possible funding sources for them; organisation of three expert workshops that provided a forum for identifying actions to progress specific R&D topics towards operational use (including sensor interoperability (June, 2014), forest degradation (Oct, 2014) and vegetation biomass estimation (Feb, 2015); and support to the (parallel) development of the SDCG Element-3 Strategy, which is a coordinated multi-sensor data acquisition strategy dedicated to supporting GFOI priority R&D.

The **GFOI Office** provides the necessary management functions to ensure coordination and communication across the range of stakeholders including advisory, leadership and “parent” bodies, the participating science and technology community, the forest countries GFOI wishes to serve, the UN bodies intended as recipients of forest country reports, potential donors, etc. The **GFOI Lead Team** has responsibility for project implementation and strategy and a larger **Advisory Committee** exists to provide a broad base of experience and advice for GFOI activities.

GFOI is unique in that it directly engages and brings together space data providers (CEOS agencies), forest monitoring/remote sensing experts (MGD, Capacity Building), and in-country partners (FAO, SilvaCarbon) in support of countries and their NFMS/MRV ambitions.

Activities (Future)

Building upon a substantial body of foundational and initial implementation work completed since 2011, in the period 2015-17 each of the GFOI components will be working to improve existing outputs and to build new capacity in the following directions:

- **Space Data:** Continued coordination of data streams and the addition of new data streams and products to ensure multiple annual global coverages of the world’s forested areas by 2016; continued development of data services tools and Pilots for data acquisition planning, data storage, data processing and delivery of tailored data packages (such as cloud computing based tools and Data Cubes); expansion of R&D data supply and coordination, including provision of space data supporting the priority activities outlined in the GFOI R&D Plan, and implementation of an effective private sector engagement mechanism; development of the SDCG Global Data Flows Study which will evaluate alternate solutions for reducing barriers to effectively accessing and using satellite data; and closer integration with MGD and Capacity Building activities.
 - **Methods and Guidance:** Development of basic methodological guidance documents in several languages; translation of methodology into a hands-on user-driven MGD Web Application, which will target MRV in-country technical specialists, present material tuned to individual needs based
-

on guidance presented in the MGD, and provide linkages between pillars of GFOI such as available tools and training materials; continued generation of MGD Rapid Response Modules and Training Materials to respond to new technologies and emerging reporting approaches; and production of MGD Version 2.0 as an update and improvement on V1.0, increasing its ease of use for non-specialists.

- **Capacity Building:** Continued GFOI regional capacity building workshops with increased MGD integration, based on regional capacity building needs and requests from countries; development of a bilateral capacity building plan for 10 countries to support specific MRV technical capacity needs; increased contributions to the MGD; preparation of training materials; and hosting of the Second GFOI Capacity Building Summit to assess progress on the *Manual for Best Practices to Implement Capacity in REDD+ Countries*, which was recommended as an outcome of the first Summit.
- **R&D:** R&D component management; initialisation and coordination of R&D activities in parallel with SDCG Element-3 strategy implementation; manage participating (external) research teams and reporting; coordinate Expert workshops and organise a GFOI Science meeting; update the GFOI Review of Priority R&D Topics and R&D Plan; contribute to the update of the GFOI MGD and the REDD Sourcebook.

All of these tasks will be underpinned by strong component coordination from the GFOI Office, which is working with GFOI's partners to address country engagement as a priority. The GFOI Office is in the process of moving from Geneva to a home within FAO HQ in Rome to promote its transition to operations.

2. Introduction

The Global Forest Observations Initiative (GFOI) aims to:

- Foster the sustained availability of observations for national forest monitoring systems;
- Support governments that are establishing national systems by providing a platform for coordinating observations, providing assistance and guidance on utilising observations, developing accepted methods and protocols, and promoting on going research and development;
- Work with national governments that report into international forest assessments such as the national greenhouse gas inventories reported to the UN Framework Convention on Climate Change (UNFCCC) using methods of the Intergovernmental Panel on Climate Change (IPCC).

The work of GFOI is undertaken by five components: Methods & Guidance, Space Data, Capacity Building, R&D, and Administration and Coordination (the GFOI Office).

3. Need for Action

Robust national forest monitoring based on objective observations and measurements is widely accepted as a pre-requisite for countries to participate in international agreements and incentive mechanisms related to forest carbon. To operate efficiently and sustainably, National Forest Monitoring Systems (NFMS) require a continuous, timely and affordable supply of observations. GFOI addresses this need and the requirement for forest measurement, reporting and verification

(MRV) that is robust, reliable, achievable at reasonable cost and supports planning for national development priorities including, climate change mitigation and adaptation.

Specifically, GFOI addresses needs for:

- sovereign states to operate NFMS in support of payments through REDD+ and related mechanisms;
- sustained observations for national forest monitoring systems and a platform for coordinating these observations;
- assistance and guidance on utilising observations;
- promotion of on going research and development.

GFOI is unique in that it directly engages and brings together space data providers (CEOS agencies), forest monitoring/remote sensing experts (MGD, Capacity Building), and in-country partners (FAO, SilvaCarbon) in support of countries and their NFMS/MRV ambitions.

4. User Engagement

User engagement is typically through the Capacity Building component and led by SilvaCarbon and FAO, although individual governments such as Australia and Norway have their own focused programmes with partner countries (eg Indonesia and Kenya) for the development of national capacity.

SilvaCarbon has an extensive programme of workshops and training sessions worldwide for the development of national capacity in all the key areas relating to NFMS and the use of observations – including the key GFOI deliverables of space data and the GFOI Methods and Guidance Documentation (MGD). SilvaCarbon and the CEOS Space Data Coordination Group regularly collaborate on Country Days to help promote the role of space data in support of NFMS.

GFOI fosters the sustained availability of observations for NFMS and supports governments that are establishing these systems. These NFMS directly feed into decision-making, as they underpin countries' ability to measure, report and verify GHG emissions and removals in an IPCC-compliant manner to the UNFCCC, REDD+ and future carbon markets. NFMS also have direct influence on decision-making in other fields such as resource management and agriculture.

5. Previous Development and Results

Space Data: In the period 2011 – 2015, the CEOS SDCG has prepared and coordinated: the initial implementation of a coordinated global baseline data acquisition strategy for EO data (Element 1) involving a number of space-based 'core' data that can be used and shared free-of-charge for GFOI purposes; a coordinated strategy for national data acquisitions (Element 2) which accommodates countries that have specific technical requirements or heritage and experience on working with a particular EO data source or type; and a data acquisition and supply strategy in support of GFOI R&D activities (Element 3).

MGD: The first version of the GFOI Methods & Guidance Documentation was released in January 2014 and has been applied in a range of countries including, but not limited to Ghana, Columbia, Cambodia, Fiji, Kenya, Papua New Guinea, facilitated by the UNREDD programme, SilvaCarbon, the World Bank Forest Carbon Partnership Fund and bilateral programmes. Training materials, decision support tools and rapid response guidance modules have been developed to support the MGD

since its publication. Additionally the MGD has been translated into Spanish and French and brochures and videos have been released.

Capacity Building: Since 2011 the US Government SilvaCarbon Program has been developing capacity in all aspects of forest monitoring in four regions (Latin America, SE Asia, Central America and Central Africa), and 25 countries across those regions. SilvaCarbon has developed bilateral work plans with 10 of these countries focusing on their forest inventories and remote need sensing needs. For the rest of the countries the program develop a regional strategy for capacity building thought hands on training, technical assistance by US scientists in countries, and promoting and supporting South – South cooperation activities. Accomplishments of the program:

- Since 2011, SilvaCarbon has organized 13 regional technical workshops in Latin America, 3 in SE Asia, and 2 in Central Africa
- SilvaCarbon is supporting bilateral capacity building efforts with Colombia, Ecuador, Peru, Philippines, Vietnam, Nepal, DRC, ROC, Gabon and Cameroon. A series of training workshops and technical assistance has been targeted to improve the design of forest inventories and development of forest cover maps in these countries.
- SilvaCarbon organised the first GFOI capacity building summit, bringing donors and countries together to promote coordination in capacity building efforts. A Best Practice Guidance on capacity building document with examples of lesson learned in each region will be released at the end of 2015.
- SilvaCarbon has supported bilateral collaboration among academia in the United States and developing countries.
- The programme has supported US scientists to participate in the development of the MGD and training materials that are being used in capacity building activities across the region, such as the training materials for accuracy assessment of activity data developed by Boston University.
- SilvaCarbon has funded 11 research proposals internationally that are exploring new methods for forest monitoring and carbon accounting.
- SilvaCarbon, FAO, and GOF-C-GOLD have been coordinating efforts to developed training materials that support the MGD and the REDD+ Sourcebook.
- Supported the attendance of country representatives at bi-annual meetings of the CEOS SDCG and the GFOI Plenary meetings

R&D: During the last years of operation, significant achievements and contributions of the GFOI R&D Component can be reported:

- Of most significance is the release of the 'Review of Priority Research & Development Topics' (Dec, 2013), which identifies the operational status of key remote sensing derived forest map products needed by countries as they establish their National measurement, reporting and verification Systems (MRV), and the additional, prioritised R&D that is needed to improve the accuracy and reliability of each product.
 - Completion of a 'Landscaping study' (July, 2014) that maps out priority R&D topics against the interests of potential research and partner organisations and identifies possible funding sources for them.
 - Organisation of three expert workshops that provided a forum for identifying actions to progress specific R&D topics towards operational use. Workshop topics included Sensor Interoperability (June, 2014), Forest Degradation (Oct, 2014) and Vegetation Biomass Estimation (Feb, 2015).
 - Support to the (parallel) development of the SDCG Element-3 Strategy, which is a coordinated multi-sensor data acquisition strategy dedicated to supporting GFOI priority R&D.
 - Identification of relevant forest map products and R&D needs/issues in collaboration with the MGD component. With the common mandate of continuous improvement of MRV systems, the results of the R&D programme will be incorporated in future revisions of the MGD.
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- An assessment of country R&D needs in collaboration with the Capacity Building component (SilvaCarbon). SilvaCarbon has supported the organisation of expert workshops and participation of developing country representatives. Country specific needs are built into the R&D Programme.
- A summary of archive data acquired over GFOI R&D study sites 2009-2011.

6. Partners

GFOI is led by: Australia, Norway, the USA, SilvaCarbon, The Food and Agriculture Organization of the United Nations (FAO), and the Committee on Earth Observation Satellites (CEOS). Experts from the United Nations Framework Convention on Climate Change (UNFCCC), the greenhouse gas inventory programme of the Intergovernmental Panel on Climate Change (IPCC), the World Bank Forest Carbon Partnership Facility, Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) and institutions in GEO member countries are represented on the Advisory Committee. The UK supports participation of the Chair of the Advisory Group for the Methods and Guidance Documentation.

CEOS has committed resources from the world's space agencies to provide a systematic contribution of observations to meet the needs of countries participating in GFOI. This coordination is being led by the European Space Agency (ESA) and the United States Geological Survey (USGS) with management support provided by Australia. Other national space agencies engaged to date include those of Argentina (CONAE), Brazil (INPE), Canada (CSA), China (CRESDA, NRSCC), France (CNES), Germany (DLR), Japan (JAXA) and the USA (NASA).

7. Activities description

SPACE DATA

7.1 Activity name: Continued Baseline Global Data Acquisition Coordination

7.1.1 Description: To ensure multiple annual global coverages of the world's forested areas by 2016, the SDCG is working with mission planners to make sure that the acquisition plans of the Landsat and Sentinel programs (primarily, but also other core data streams) are supporting this goal.

7.1.2 Partners: SDCG members from USGS and ESA are the linkage between SDCG and their respective agencies and mission planners. Their efforts result in the necessary acquisitions being made and also deliver annual Global Baseline Data Acquisition Strategy Implementation Reports.

7.1.3 Resources: In-kind, time commitment from SDCG members in addition to the data itself.

7.1.4 Challenges and uncertainties: Mission continuity is required, as well as the successful launch and operation of Sentinel-1B and 2B. Engagement of the core agencies via the SDCG must be maintained, and this is managed through on going endorsement of the SDCG by CEOS.

7.2 Activity name: Global Data Flow Study and Proof of Concept

7.2.1 Description: The Global Data Flow Study will evaluate alternate solutions for reducing barriers to effectively accessing and using satellite data – such as Data Cubes and Analysis Ready Data – to implement measurement, reporting and verification (MRV) methodologies within national forest monitoring systems (NFMS) in support of REDD+. The study will be followed by an operational proof of concept based on the findings.

7.2.2 Partners: USGS (Study Lead), ESA/EC, GA, CSIRO, GFOI Office, MGD Component (Supporting/contributing to the Study), NASA/CEOS SEO (contributing to Study and proof of concept)

7.2.3 Resources: In-kind, time commitment from members, funding for proof of concept activities.

7.2.4 Challenges and uncertainties: On going support and engagement from the stakeholders identified above is required, however the risk of having members withdraw is minimal, as the Study and the outcomes are inherently important to each of the stakeholders' own work. NASA funding continuity for the CEOS SEO is required in order to implement the proof of concept.

7.3 Activity name: GFOI Space Data Services Definition, Implementation and Integration with MGD and Capacity Building Activities.

7.3.1 Description: Continued development of data services tools for acquisition planning, storage, discovery, access, processing and analysis of space-based data from Earth-observing satellites to support country needs. In addition, the SDCG is exploring a new Data Cube concept for improved analysis and product generation.

There is currently no effective overview or integration of the country support activities carried out among SDCG, SilvaCarbon, FAO and World Bank. For GFOI to become established, the SDCG's products and services need to be better integrated into the in-country activities of these provider agencies. In 2015, SDCG will seek to establish integration of the Space Data Services with new interactive MGD2.0 and in 2016 aim to deliver services in coordination with FAO, World Bank, and SilvaCarbon.

7.3.2 Partners: NASA/CEOS SEO (development of data services tools), MGD Component (integration of space data services into the MGD2.0), SilvaCarbon, FAO (identification of country needs, integration of space data services into capacity building activities)

7.3.3 Resources: NASA funding for the CEOS SEO, in-kind support from the MGD and Capacity Building Components and FAO to provide the necessary feedback and integration with their work plans.

7.3.4 Challenges and uncertainties: NASA funding continuity for the CEOS SEO is required to implement the Space Data Services. The Capacity Building and MGD Components are closely engaged, and the GFOI Office is managing the interface effectively. Feedback and assistance from the FAO, as the in-country contact, is crucial, and is actively being worked by the GFOI Office.

7.4 Activity Name: Pilots Investigating Fundamental Issues Around The Provision Of Cloud Computing And Creation Of A Model National GFOI Cloud Computing Processing System.

7.4.1 Description: Tasks within this activity in 2015 and 2016 include: a study of the strategic issues around cloud computing-based MRV support; closer collaboration between SDCG and FAO on SDMS; development of pilots investigating the fundamental issues around the provision of cloud computing; further progression of the SDMS including pilot activities and the engagement of multiple GFOI countries; exploration of the Kenya Data Cube and SDMS as model national system (with a view to results by COP21); and exploration of the ESA Mexico TEP and incorporating the lessons learned into related GFOI activities.

These tasks all support the provision of space data to countries.

7.4.2 Partners: NASA/CEOS SEO (implementing the SDCG Pilots), ESA/EC (implementing the TEP), FAO (deploying the SDMS with in-country partners, providing feedback on the tools), GA, CSIRO (developing the Data Cube core technology, assisting the SEO in its application to GFOI)

7.4.3 Resources: NASA funding for the CEOS SEO, in-kind support from the FAO to provide the necessary feedback, continued engagement of GA/CSIRO.

7.4.4 Challenges and uncertainties: GA and CSIRO are actively promoting the Data Cube architecture within CEOS, and there is little risk to a discontinuation of their work. The CEOS SEO has also developed an independent capacity to initiate, develop and maintain the Data Cube.

Feedback and assistance from the FAO, as the in-country contact, is important. However, the GFOI Office is actively working the relationship with FAO.

7.5 Activity name: Space Data Component Research & Development Activities

7.5.1 Description: In 2015 and 2016 this activity covers finalisation of the Element 3 acquisition strategy in support of the GFOI R&D Plan; provision of space data supporting the priority activities outlined in the GFOI R&D Plan, and implementation of an effective private sector engagement and SDCG mechanism for brokering space data requests in support of national forest monitoring.

7.5.2 Partners: GOF-C-GOLD (GFOI R&D Component coordination) JAXA, ESA (Leads for SDCG R&D activities), ASI, CNES, CONAE, CSA, DLR, INPE, JAXA (supply of space data for R&D)

7.5.3 Resources: GFOI R&D Component coordination funding will be supplied by ESA, allowing GOF-C-GOLD to undertake the necessary coordination activities for the Component. JAXA are financially supporting the coordination role for SDCG R&D. Provision of data from CEOS space agencies is required for R&D activities.

7.5.4 Challenges and uncertainties: CEOS has continually supported the SDCG/GFOI and annually endorsed the ad hoc team at its Plenary, and as such no sudden withdrawal is expected. SDCG agencies remain committed and active, attending the meetings of the SDCG every 6 months. Funding continuity for the Lead roles is critical and has recently been renewed by ESA and JAXA.

7.6 Activity name: GFOI Component Coordination and Country Engagement

7.6.1 Description: SDCG continues to work with the MGD and Capacity Building Component Leads to understand country requirements for space data and to develop a coordinated plan for providing the most efficient provision of GFOI deliverables to priority countries. The effective management of country interfaces is an on going critical activity.

Priority countries are also engaged in the implementation of all previously mentioned activities via all channels available, and in particular in coordination with the GFOI Lead Team (i.e. FAO) and the other GFOI components (i.e. R&D, MGD).

7.6.2 Partners: GFOI Office (coordination), SilvaCarbon (Capacity Building activities), FAO (in-country contact), MGD Component (MGD2.0 development)

7.6.3 Resources: In-kind support from the MGD and Capacity Building Components and FAO to provide the necessary feedback and integration with their work plans. GFOI Office funding is required to coordinate the activities.

7.6.4 Challenges and uncertainties: The Capacity Building and MGD Components are closely engaged, and the GFOI Office is managing the interface effectively. Feedback and assistance from the FAO, as the in-country contact, is crucial, and is actively being worked by the GFOI Office.

METHODS & GUIDANCE DOCUMENTATION

7.7 MGD Web Application

7.7.1 Description. The MGD web application will provide information about Forest Management, Reporting and Verification (MRV) systems in developing countries and contribute to the capacity to participate in REDD+.

The interactive web application will:

- provide on-line interactive training and guidance accessible to non-specialists, based on the formal MGD documentation;
- have a logical synergy with the MGD foundation document;
- target MRV in-country technical specialists (opposed to country engagement/capacity building organisations, although it can be used by such organisations);
- present material tuned to individual needs based on guidance presented in the MGD foundation document;
- provide linkages between pillars of GFOI such as available tools / training materials / workshop dates / R&D topics and publications;
- enable collection of user statistics (most viewed pages / most downloaded / time spent) for GFOI to prioritise actions.

7.7.2 Partners. The development of the MGD web application is being funded and lead by the Australian Government. Prof. Jim Penman, the Chair of the MGD Advisory Committee that plays a key role in the overall development of the MGD products is supported by the UK government. Other GFOI partners are providing human resources for the review of the web application. Country engagement partners will incorporate the web application into their programs.

7.7.3 Resources. The development of the web portal is fully funded by the Australian Government. The MGD Component Manager, whose position is also funded by the Australian Government, is responsible for the Project Management and delivery of the portal. It is foreseen that the on going hosting and management of MGD web application will be a responsibility of the GFOI office.

7.7.4 Challenges and uncertainties. 1) Development schedule overruns – software development has inherent risks and schedule overruns are being managed by the MGD Component Manager using details scope documents and regular liaison with the development team.

2) Country engagement partner support of tool – to ensure the web application is a useful country engagement tool for GFOI partners, early engagement by GFOI partners in the web application review stage is planned.

7.8 MGD Rapid Response Modules and Training Materials

7.8.1 Description. To rapidly respond to new technologies and emerging reporting approaches and experiences as well as facilitate capacity building, rapid response guidance modules and training materials are being developed based around the GFOI Methods and Guidance Document.

7.8.2 Partners. The Australian government, SilvaCarbon, The Norwegian Government, FAO and GOFC-GOLD are all involved with the development of guidance modules and training materials.

The need for rapid response guidance modules is identified by the MGD Component (lead by the Australian Government). Expertise within other partner organisations is identified and drawn upon as authors /reviewers of the modules. These modules are generally 5-10 page pdf documents which the MGD Component Manager makes available on the GFOI website and notifies all partners of their availability for use in their country engagement programmes.

The process is similar for the development of training material however this is primarily driven by SilvaCarbon/UNREDD/FCPF and supported with technical expertise from the MGD Component which identifies authors/reviewers.

7.8.3 Resources. Currently, various GFOI partners have been financially supporting the development of rapid response modules and training materials either through supporting the time of authors/reviewers or small project financing for specific training material development once it has been identified. To improve this co-ordination of resources, a workshop is being held in the last quarter of 2015 to identify priority training material and a plan for resourcing and developing these materials.

7.8.4 Challenges and uncertainties. The MGD relies on input and expertise from a large number of authors and reviewers. Allowing for adequate time in the development of new text and training materials reduces the risk of schedule overruns.

7.9 MGD Version 2.0

7.9.1 Description. Since the publication of MGD Version 1.0 many countries have progressed REDD+ reporting and submitted FRELs and documentation to the UNFCCC and bilateral partners. Additionally, a number of advancements in technology have occurred or are emerging. To maintain the relevance of GFOI methods and guidance the GFOI Leads and MGD Advisory committee endorsed the production of MGD Version 2.0 in February 2015.

7.9.2 Partners. The Australian Government is leading the updating of the MGD through the financial contribution to the MGD Component Manager. Who is doing the activity? What, exactly, are each partner's responsibilities and what will they deliver?

7.9.3 Resources. Authors and reviewers are required for updating MGD Version 2.0. Many authors and reviewers who are associated with the GFOI partners are giving their time to contribute their experiences and expertise.

7.9.4 Challenges and uncertainties. The MGD relies on input and expertise from a large number of authors and reviewers. Engaging early with experts and allowing for adequate time in the development of new text and training materials reduces the risk of schedule overruns.

CAPACITY

BUILDING

7.11 Activity name: GFOI Regional Capacity building workshops organized by SilvaCarbon

7.11.1 Description: SilvaCarbon has been organising regional workshops since 2011. The themes of the workshops are based on regional capacity building needs and requests from countries. There are two modalities for these workshops, hands-on training, and a showcase of new methods. These meetings are also a platform for south-south collaboration and are an opportunity to present hands-on,

new, non-operational approaches that countries wish to explore. Hands-on workshops are only in operational methods. For these workshops, SilvaCarbon relies on university partners of GFOI to show current research, and field techniques, their downside and their potential for inclusion in an operational system for monitoring .

7.11.2 Partners: SilvaCarbon organised these workshops through USGS with support from other US governmental agencies, FAO, the government of Australia, GOF-C-GOLD, and universities around the world that are willing to participate as trainers.

7.11.3 Resources: Organisation and travel are funded by SilvaCarbon, time is in-kind contribution from governmental organisations, non-governmental organisations, FAO, and universities. SilvaCarbon has resources to continue organising regional GFOI workshops throughout October 2016.

7.11.4 Challenges and uncertainties: Follow up activities are always requested by countries participating in the training. Resources are limited for intensive training as a follow up activity. SilvaCarbon has been able to find resources or contributing partners for follow up, but it is a challenge and funding is uncertain.

7.12 Activity name: Bilateral plan to developed capacity in 10 countries

7.12.1 Description: SilvaCarbon has been working bilaterally with 10 countries (Colombia, Ecuador, Peru, Philippines, Nepal, Vietnam, ROC, DRC, Gabon and Cameroon). Each programme has been designed according to scoping trips where SilvaCarbon identified the most urgent needs for capacity that will assist the country to advance in the development of their Forest Monitoring System. The bilateral SilvaCarbon program is design to provide support for countries that are already in the way to build their MRV system, and need assistance in specific technical capacity.

7.12.2 Partners: SilvaCarbon works directly with the US Forest Service bilateral program in the country and the USAID missions in the countries.

7.12.3Resources: SilvaCarbon has allocated resources for each country depending on needs. The funding for implementing activities is divided among the US Forest Service and the USGS SilvaCarbon program. The amount of funding for each country is different. For example, the program for Colombia, Ecuador and Peru will be reaching its end in 2016.

7.12.4 Challenges and uncertainties: Coordination among others donors in the country is a challenge. SilvaCarbon has regional coordinators that help with that coordination. Funding is also uncertain after October 2016.

7.13 Activity name: Authors contribution to the MGD, and preparation of training materials

7.13.1 Description: SilvaCarbon has been supporting members of academia, and other organisations involved in REDD+ to participate as authors of the Methods and Guidance Document, and also preparation of training materials in support of the MGD and the Capacity Building component

7.13.2 Partners: SilvaCarbon works directly with Boston University and Conservation International - supporting their participation as MGD authors. The government of Australia leads the effort.

7.13.3Resources: SilvaCarbon has allocated resources for a couple of scientists at Boston University and Conservation International to be involved in the development of the MGD, training materials and bringing the link between the training materials, MGD, and country monitoring system development stages.

7.13.4 Challenges and uncertainties: Funding and continuation is uncertain after October 2016.

7.14 Activity name: Second GFOI Capacity Building Summit

7.14.1 Description: SilvaCarbon organised the first capacity building summit for GFOI in Colombia in 2014. This summit aimed to bring together donors and REDD+ practitioners to evaluate the efforts of capacity building implementers, and to rate the outcomes of this effort. A second meeting is scheduled for 2016, after some of the recommendations have taken place. One of the recommendations was that SilvaCarbon will publish a manual for best practices to implement capacity in REDD+ countries. The manual will be a tool to share with new programmes globally. The second meeting will review the progress.

7.14.2 Partners: All GFOI components, members of academia involved in capacity building, governmental country partners, FAO, UNREDD, and the World Bank FCPF Program.

7.14.3 Resources: SilvaCarbon Program has allocated resources for the organisation of this meeting, and the participation of developing countries.

7.14.4 Challenges and uncertainties: The major challenge is to find a date and region for all the desired attendees to this meeting. The meeting is scheduled for 2016, but the meeting progress relies on the best practices document that SilvaCarbon will publish. Funding for other donors will have to come from their own programs.

7.15. R&D Component

7.15.1. Description: The GFOI R&D Component identifies priority areas for research and development targeted at improving and operationalizing of inputs to support emissions estimation and reporting. The research focuses on progressing priority R&D topics to an operational status for integration in future revision and development of the GFOI Methods and Guidance Documentation (MGD) resources. In addition, the R&D component has fostered relationships with external organisations such as USGS, and FAO, who have similar overarching objectives.

Specific R&D needs were expressed by GFOI countries and identified through expert workshops and former contacts of the GEO Forest Carbon Tracking (FCT) programme. Together with the R&D Review, these form the drivers for the GFOI R&D Programme and SDCG Element-3 Strategy, which is being developed in parallel with it. The outcomes of the R&D Programme are aimed to serve the MGD and Capacity Building components of GFOI by helping deliver robust and cost-efficient methods that satisfy UNFCCC requirements and enable continuous improvement of MRV systems in developing countries.

7.15.2. Partners: The R&D Component is expected to interact with all GFOI Components. Interactions with the FAO (capacity development), SilvaCarbon (capacity development, R&D), the World Bank FCPF (capacity development) will continue. We will aim to expand our relationships with new research groups to better cover the different fields of expertise and methodological approaches.

Capacity development activities will require input from us based on country needs. Partners involved in R&D activities will provide feedback on their respective research activities. The SDCG will require input from us regarding the use of EO data provided for R&D activities. The MGD developers will require input on methods proven to be operational, for inclusion in the document.

7.15.3. Resources: The Lead Office of the R&D Component is located on the campus of Wageningen U. in The Netherlands. Dr. Brice Mora coordinates the activities of the Office under the supervision of Prof. Martin Herold. Dr. Ake Rosenqvist and Dr. Anthea Mitchell, previously involved in the coordination of the Component, continue to provide scientific and technical support and expertise, along with Erika Romijn from Wageningen U. Funded by Norway until 2014, ESA currently supports the planned activities (including salaries) until December 2016. Available financial resources will be

sufficient to carry out the planned activities in the allocated timeframe. Continuation of the activities (post-2016) is uncertain.

7.15.4. Challenges and uncertainties: There is a risk of time overrun since some activities require the input from several persons, on a voluntary basis. The organisation of some workshops in due time may be difficult because of potential conflicts with other meetings (conferences etc.). Finally, some R&D activities may suffer from the lack of EO data if these fail to be acquired (bad weather conditions, technical failure of new sensors). Planning activities in advance should ensure the success of all individual activities. Alternative and similar datasets may be used as surrogates to carry out the planned research activities.

8. Planning, Milestones and Deliverables

Space Data: The SDCG for GFOI has produced a Three-Year Work Plan for 2015 – 2017, which was recently endorsed by CEOS. The Work Plan has been prepared to map out the activities of the SDCG covering the finalisation and implementation of the space data supply for GFOI.

The purpose of the GFOI Space Data coordination efforts for the period 2015 – 2017 will be:

- Continued coordination of core data streams and addition of new core data streams and products;
- Continued development of data services tools for data acquisition planning, data storage, and data processing to support country needs;
- Expansion of R&D data supply and improved coordination of efforts; and,
- Engagement of priority countries in the implementation of the above via all channels available, and in particular in coordination with the GFOI Lead Team (especially FAO) and the other GFOI components (R&D, MGD).

MGD: The Methods and Guidance documentation represents one of the major tangible deliverables for countries interested in participating in GFOI. Development of a version 2.0 and an Online Portal are underway. The second version of the MGD will be more user-friendly, with step-by-step instructions and less technical language, and will also include more linkages to training and decision support tools.

An MGD Online Portal is being developed and aims to turn the MGD into a tool, providing more country-focused, customised support.

Capacity Building: SilvaCarbon will:

- Continue to provide a link between the countries and the GFOI/SDCG meetings, in particular by providing financial assistance to country representatives;
 - SilvaCarbon will continue to host a series of in-country capacity building workshops, and will seek to further integrate the MGD into their workshops;
 - The capacity building component will work on becoming more closely coordinated with the space data and MGD components; and,
 - Will work with the GFOI Lead Team and GFOI partners, such as the FAO, to try and develop a coordinated country engagement plan and stock take of country priorities and MRV status.
 - SilvaCarbon will publish the best practices for capacity building manual that will guide new practitioners with case studies and lesson learned from three regions
 - SilvaCarbon will organized the second GFOI capacity building summit that aimed to bring together organizations working on capacity building efforts for REDD+ to seek collaboration
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R&D: The following key activities are foreseen in 2015-16:

- R&D component management;
- Initialisation and coordination of R&D activities in parallel with SDCG Element-3 strategy implementation;
- Manage participating (external) research teams and coordinate reporting and communication of results to space agencies and other GFOI components;
- Coordinate Expert workshops, and organise a GFOI Science meeting;
- Update the GFOI Review of Priority R&D Topics, and R&D Plan;
- Contribution to the update of the GFOI MGD and the REDD Sourcebook;
- Liaison with other GFOI components; and,
- Science review paper on forest degradation mapping techniques, and other key R&D topics, as appropriate.

9. Data Management and Policy

The data being accumulated as part of SDCG's global baseline data acquisition strategy is held within the archives of the individual agencies responsible for the respective satellite systems. By definition, these data are 'free and open' so that all countries are able to access and utilise the necessary coverage for their territory. Until 2013 the sole 'core data stream' was from Landsat-7. This was joined in 2013 by Landsat-8, in 2014 by Sentinel-1A, and in 2015 by Landsat-2A.

Access to these data varies depending on the specific archive arrangements and policies but is typically through on-line systems. SDCG offers space data access guides and support to assist countries in understanding and navigating the space data options in support of their NFMS.

10. Management Arrangements

The **GFOI Office** provides the necessary management functions to ensure coordination and communication across the range of stakeholders including advisory, leadership and "parent" bodies, the participating science and technology community, the forest countries GFOI wishes to serve, the UN bodies intended as recipients of forest country reports, potential donors, etc. As of August 2015, the GFOI Office is in the process of moving from Geneva to a home within FAO HQ in Rome, reflecting the important role of FAO in supporting countries with an interest in participating in GFOI.

The **GFOI Lead Team** has responsibility for project implementation and strategy and meets by teleconference several times a year, and face-to-face at least once annually during the annual meeting of the GFOI Components (GFOI 'Plenary') (note that in 2015 the GFOI Lead Team met face-to-face twice, in February (Sydney) and October (Rome)).

A larger **Advisory Committee** exists to provide a broad base of experience and advice for GFOI activities. It meets on an ad-hoc basis and responds as required to the Lead Team.

Managers are also appointed to ensure implementation of the activities of each of the components.

11. Monitoring and Evaluation Approach and reporting

N/A for GEO WP

12. Committed Resources and annual budget(s)

GFOI has moved past the incubation phase within GEO and resources are planned and managed by the Lead agencies. N/A for purposes of GEO WP.

13. Transition to Operational Phase

It was always foreseen that the GFOI Office would be integrated within an operational agency such as the FAO to promote its transition to operations. The relationship between FAO and GFOI continues to be an active area of discussion, including the migration of the GFOI Office to be hosted and staffed at FAO/Rome.

DRAFT

GI-04	Global Observing System for Mercury and Persistent Pollutants	- Draft Implementation Plan

Executive Summary

The task HE-02 "Tracking Pollutants" was established as a part of the 2009-2011 work plan of the Group on Earth Observations (GEO) and aimed to develop global observation systems for mercury and persistent organic pollutants (POPs). This task was meant to support an achievement of the goals of GEOSS, as well as the international conventions on toxic compounds (i.e. Stockholm Convention (SC), UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP)) and on-going international programmes (e.g. UNEP Mercury Program, Global Monitoring Plan (GMP) of SC on POPs, European Monitoring and Evaluation Programme (EMEP)). This effort was motivated by the fact that there was no coordinated global observation network for mercury and POPs that could be used by the modelling community or to establish recommendations to protect human health and ecosystems on a global scale. On-going national/regional monitoring networks were inadequate for a global scale assessment.

The Global Mercury Observation System (GMOS) is aimed to establish a worldwide observation system for the measurement of atmospheric mercury in ambient air and precipitation samples. GMOS will include ground-based monitoring stations, shipboard measurements over the Pacific and Atlantic Oceans and European Seas, as well as aircraft-based measurements in the UTLS.

The GMOS data sharing infrastructure is based on an ad-hoc developed Spatial Data Infrastructure (SDI). The SDI is the corner stone of an integration architecture where additional components can be plugged in. Open-source components have been used to build the SDI. PostGis and Geoserver are used for geographic data storage, export geographic web services and manage metadata, respectively; whereas Javascript libraries embedded in OpenLayers are used to display geographic information. A brokering tool, GI-cat is used as endpoint for the infrastructure. This approach enable the construction of the SDI as pluggable system: a system built through components plugged together. Services and provided processes are controlled through an Information Infrastructure (GeoInt), designed and developed at CNR-IIA, which wraps most useful processes in order to provide high level services (e.g. data integration and management) to final users.

The aim of the Global Monitoring Plan (GMP) for POPs was to establish an effective and sustainable global system for monitoring of POPs concentrations in core media over time, and support the effectiveness evaluation of the SC measures. The mandate for this project is Article 16 of the SC and decision SC-5/18. The first phase of the GMP on POPs was implemented between 2005 and 2009 and covered the 12 initially listed POPs. The first monitoring reports, using data collected over the period 1998-2008, have been published in 2009 and provided a baseline against which concentrations in core matrices will be studied over the long-term.

For the second phase of the GMP (2010-2015), particular attention was given to gathering baseline data for the eleven new POPs listed in the SC in 2009, 2011, and 2013, filling existing regional data gaps, and enhancement sustainability of ongoing monitoring activities to enable assessment of how POPs concentrations evolved since the first monitoring reports. The GMP Data Warehouse (GMP DWH) has been developed based on Chapter 6 of the Guidance on the GMP for POPs (UNEP/POPS/COP.6/INF/31) and applied for standardised data collection from the regions for the purpose of the second report. The final Regional reports were submitted to the COP-7 in May of 2015 where the GMP DWH was also officially launched. The GMP DWH (www.pops-gmp.org) was registered under the GEOSS portal.

New POPs added to the list in 2015 (polychlorinated naphthalenes, pentachlorophenol, hexachlorobutadiene) are posing additional challenges including new consideration of the SC core matrices, development and standardisation of sampling and analytical methods, further development of the GMP DWH to support data collection and analysis and setting up the baseline levels for these compounds. All of these will require close collaboration of existing monitoring programmes.

The overarching goal of the task GF-04 (Global Observing System for Mercury and Persistent Organic Pollutants (POPs) of Transitional Work Programme for 2016-2017 is to further develop the global observation systems for mercury and POPs by harmonizing standard operating procedures for monitoring of these substances in air, precipitation, surface water, soil, sediments, vegetation, and biota and support sharing of standardized data. Open access to comparable long-term data from the existing networks will enhance our understanding of temporal and spatial patterns in releases, distribution, transport, deposition to, and evasion from, terrestrial and aquatic ecosystems. Such data will support the validation of regional and global atmospheric models for use in the evaluation of different policy options for reducing pollution impacts on human health and ecosystems. The data sets, validated models and interoperable system produced within this task will support the policy making process in the framework of the UNEP Governing Council activities, Stockholm, Minamata, and UNECE-LRTAP Conventions. The task builds upon the contributions of the European Monitoring and Evaluation Program (EMEP), the Task Force on Hemispheric Transport of Air Pollutants (TF HTAP), the Global Mercury Observation System (GMOS) project, UNEP Mercury Programme, the Global Monitoring Plan (GMP) of the SC on POPs, MercNet/AMNet initiative in USA, CAMNet in Canada, Global Air Passive Sampling (GAPS), Monitoring Networks (MONET) in Europe and Africa and other international monitoring and modelling efforts, as well as previous activities carried out in frames of GEO.

Aims:

- To increase the availability and quality of Earth observation data and information needed to track chemical pollutants and anticipate changes to the environment;
- To harmonize standard operating procedures for monitoring priority pollutants, such as POPs and Hg, and their compounds in air, atmospheric deposition, water, soil, sediments, vegetation and biota.
- To understand temporal and spatial patterns of chemical pollutants transport and deposition to, and evasion from, terrestrial and aquatic ecosystems;
- To support the validation of regional and global atmospheric pollutant models for use in evaluations of different policy options;
- To evaluate the effectiveness of international efforts to reduce releases of pollutants.

1. Introduction

The task HE-02 "Tracking Pollutants" was established as a part of the 2009-2011 work plan of the Group on Earth Observations (GEO) and aimed to develop global observation systems for mercury and persistent organic pollutants (POPs). This task was meant to support an achievement of the goals of GEOSS, as well as the international conventions on toxic compounds (i.e. Stockholm Convention (SC), UNECE Convention on Long-Range Transboundary Air Pollution (CLRTAP)) and on-going international programmes (e.g. UNEP Mercury Program, Global Monitoring Plan (GMP) of SC on

POPs, European Monitoring and Evaluation Programme (EMEP)). This effort was motivated by the fact that there was no coordinated global observation network for mercury and POPs that could be used by the modelling community or to establish recommendations to protect human health and ecosystems on a global scale. On-going national/regional monitoring networks were inadequate for a global scale assessment.

Recognizing that TGM and Hg in wet deposition are spatially heterogeneous, several studies have aimed to set up monitoring networks in order to compare trends between sites in the same region, between regions, and to determine the influence of local and regional emission sources. There is also interest in understanding the processes that contribute to Hg variability on a diurnal, weekly, seasonal, and annual basis. In 1995, Fitzgerald argued for and defined the basic requirements of an Atmospheric Mercury Network (AMNet). This has partly been accomplished on a regional scale within the Canadian Atmospheric Mercury Network (CAMNet), which may be considered as seminal in this respect. Part of the CAMNet contributes also to the Arctic Monitoring and Assessment Program (AMAP) under the Ministry Council of Circum Polar Countries and where there is also contribution from the Scandinavian countries, e.g. on Greenland. Nevertheless, although the number of atmospheric Hg monitoring stations has increased, the database is sparse, especially in remote locations.

In Europe atmospheric mercury measurements have been performed since the early 80's at selected northern European sites as part of the European Monitoring Evaluation Program (EMEP) of the UNECE-LRTAP convention. This network detected the decrease in atmospheric Hg concentrations and Hg in precipitation which occurred when Eastern European countries went into economic decline in the late 1980's leading to the closure of a significant number of industrial installations. Later, as part of three European Commission funded projects, (MAMCS, MOE and MERCYMS) a first attempt was made to establish a Europe-wide measurement network. One of the major outcomes of these EU projects was that for the first time, simultaneous measurements of speciated mercury were performed at 10 measurement sites located across Europe during several two-week intensive campaigns at both ground-based and off-shore site. The results of these projects allowed, among other things, the preparation of the European Position Paper on Mercury which provided the scientific background of the 4th Daughter Air Quality Directive. One of the major findings of these projects was a better understanding of the role of Marine Boundary Layer (MBL) in the oxidation of elemental Hg. Oxidized Hg compounds are more readily deposited to surface waters and terrestrial ecosystems than elemental Hg leading to a variation of the atmospheric lifetime of elemental mercury with latitude. Relatively few observations of atmospheric Hg have been carried out in the Southern Hemisphere. The few observations to date, with the exception of those at Cape Point in South Africa and some oceanographic campaigns, have mostly been carried out near to, or downwind of, major sources. This includes mining, industrial facilities and biomass fires. For nearly all South American observations, measured TGM concentrations were substantially greater than the accepted global background level.

Programs such as the World Meteorological Organization's Global Atmosphere Watch (GAW) have made substantial efforts to establish data centres and quality control programmes to enhance integration of air quality measurements from different national and regional networks, and to establish observational sites in under-sampled, remote regions around the world. Similarly, the International Global Atmospheric Chemistry project (of the International Geosphere-Biosphere Programme) has strongly endorsed the need for international exchange of calibration standards, and has helped coordinate multinational field campaigns to address a variety of important issues related to global air quality. Following the lead of these programs, the incorporation of a well-defined Hg monitoring component into the existing network of sites would be the most expeditious and efficient approach to

realise a global Hg monitoring network. Close coordination of the global modelling community with the global measurement community would lead to major advances in the global models, and also advance our understanding of Hg science, while at the same time decreasing the uncertainties in global assessments for Hg entering aquatic and terrestrial ecosystems.

The GMOS data sharing infrastructure is based on an ad-hoc developed Spatial Data Infrastructure (SDI). The SDI is the corner stone of an integration architecture where additional components can be plugged in. Open-source components have been used to build the SDI. PostGis and Geoserver are used for geographic data storage, export geographic web services and manage metadata, respectively; whereas Javascript libraries embedded in OpenLayers are used to display geographic information. A brokering tool, GI-cat is used as endpoint for the infrastructure. This approach enable the construction of the SDI as pluggable system: a system built through components plugged together. Services and provided processes are controlled through an Information Infrastructure (GeoInt), designed and developed at CNR-IIA, which wraps most useful processes in order to provide high level services (e.g. data integration and management) to final users.

S&T components of relevant interest are:

- an international observation system, which provides a consistent and standardized set of long-term data on ambient concentrations and deposition fluxes of atmospheric mercury in its various forms;
- ad-hoc off-shore investigations to assess gas exchange of mercury between the surface waters and the atmosphere;
- dedicated aircraft studies with ongoing project (i.e. CARIBIC, NOMADSS/SAS, ETMEP) and vertical profiling and plume identification/tracking with improved temporal and spatial vertical profile of mercury species concentration;
- the development of an interoperable system to facilitate data integration, data re-use, and data exchange within and beyond the GMOS by means international standards for data and spatial schema's (ISO19107, ISO14825), for metadata (ISO19115:2003, ISO/DTS19139:2005, ISO15836) and for services (WMS 1.1.1, WFS 1.0, SLD 1.0, GML 3.1).

For POPs, the effectiveness evaluation of the SC on POPs is defined in Article 16 of the Convention (<http://chm.pops.int/>). A 1st edition of the Guidance for the GMP for POPs (<http://www.chem.unep.ch/gmn/guidancegpm.pdf>) outlined appropriate sampling, analytical and reporting techniques for POPs in environmental media. The Conference of the Parties (COP) adopted the initial framework as a starting point at their second meeting in 2005 (COP2, Decision SC-2/13) and decided that the first GMP report (GMR1) would be delivered at COP4 in 2009. Based on decision of COP2, an international ad hoc technical working group further developed the elements and modalities of the GMP and decided that the GMR1 should focus on two core media - air and human tissues (i.e. milk and blood).

It became obvious that the relatively few existing air monitoring programmes (e.g. EMEP in Europe and Integrated Atmospheric Deposition Network (IADN) in North America) cannot provide globally representative information on the spatial and temporal trends of atmospheric POPs. Recognizing a need for the development of cheap and simple air sampling devices that would allow for establishment of the large-scale air monitoring projects, attention of the researchers turned to further improvement of passive air sampling (PAS) techniques. This assisted coordinated development of several regional and global networks to help ensure the sustainability of the GMP. The Global Air Passive Sampling (GAPS) Network operated by Environment Canada with the support of its volunteers and partner institutes is the only global-scale program under the GMP. It has been supplemented by several regional networks: MONET is a MOnitoring NETwork

operated by Masaryk University focused on filling the gaps and building monitoring capacities in Central and Eastern Europe, Africa, Asia and Pacific. LAPAN is a Latin American Passive Air Network coordinated by Federal University of Rio Grande. These programs are intended to fill data gaps and to provide data useful for assessing long-term spatial and temporal trends of POPs. Comparable data (coming from the same lab) on regional and global-scale data is invaluable for testing and validating global transport models for POPs. Additional short- and long-term PAS monitoring projects have been developed either as spin-offs from the above mentioned programmes or independently at national and regional levels (e.g. in Spain, China and others)

GMR1

(<http://chm.pops.int/Implementation/GlobalMonitoringPlan/Overview/tabid/83/Default.aspx>) was presented to delegates at the COP4 in 2009. The report summarized data from long-term air monitoring programmes as well as from short-term campaigns in five UN regions, and established baseline levels of POPs upon which future trends should be established. An on-line data visualization tool was developed consequently to facilitate search over and work with the reported GMP data (www.pops-gmp.org). The browser provided easily accessible information on global and regional coverage, and reported data sorted by matrices, time periods, and compounds. However, discrepancies in reported data have been identified in the review process as a result of missing standardization of reporting format/process among the countries and the regions.

To address this problem, the GMP Data Warehouse (GMP DWH) has been developed under the guidance of the GMP Global Coordination Group for a purpose of the 2nd Global Monitoring Report based on Chapter 6 of the Guidance on the GMP for POPs (UNEP/POPS/COP.6/INF/31). It is a two-level system for the GMP collection, evaluation, and presentation. Complete primary data from major passive air monitoring networks (GAPS, MONET, and LAPAN) as well as from the UNEP/WHO human biomonitoring programme are publicly available from the GENASIS database (www.genasis.cz) while complete officially reported data from the five regional organization groups are presented in the GMP DWH. The GMP DWH data reporting module offers compiling and archiving primary GMP data of each region in the regional data repositories but also compiles and archives aggregated data (including supplementary data) in cases where no primary data was made available.

The following attributes are embedded in the multi-modular GMP DWH:

- Fully parametric data sheets - harmonized data and information structure to improve the quality of information reported from particular monitoring activities, supporting their broader comparability;
 - Standardized data structure, handling and outputs - the GMP DWH is designed to work with data from a wide range of heterogeneous sources, such as national monitoring programmes or large international monitoring networks, without compromising incoming information;
 - Compatibility check - GMP DWH contains only completed and validated data records;
 - Regional data repositories- automatic tools for storage, archiving of both primary and aggregated data;
 - Multilayer data validation procedure - compatible data records stored in the GMP DWH are considered by members of the respective regional organization group and validated for further use in the publication;
 - Data visualization- presentation of data in a uniform format;
 - Public access to the data once the validation process and preparation of regional reports is completed.
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2. Need for action

The overall goal of GMOS is to develop a coordinated global observation system for mercury, including ground-based stations at high altitude and sea level locations, ad-hoc oceanographic cruises over the Pacific, the Atlantic and the Mediterranean, and free tropospheric mercury measurements. This will then provide high quality data for the validation and application of regional and global scale atmospheric models, to give a firm basis for future policy development and implementation.

The specific objectives of GMOS are:

- a) To establish a Global Observation System for Mercury able to provide ambient concentrations and deposition fluxes of mercury species around the world, by combining observations from permanent ground-based stations, and from oceanographic and UTLS measurement campaigns.
- b) To validate regional and global scale atmospheric mercury modelling systems able to predict the temporal variations and spatial distributions of ambient concentrations of atmospheric mercury, and Hg fluxes to and from terrestrial and aquatic receptors.
- c) To evaluate and identify source-receptor relationships at country scale and their temporal trends for current and projected scenarios of mercury emissions from anthropogenic and natural sources.
- d) To develop interoperable tools to allow the sharing of observational and models output data produced by GMOS, for the purposes of research and policy development and implementation. This will also support the advances in scientific understanding in the nine Societal Benefit Areas (SBA) established in GEOSS.
- e) During the GMOS development it will be investigated the possibility of transition of GMOS infrastructure to an operational research (ESFRI) infrastructure.

GMOS will closely cooperate with major international programs including the UNEP Global Partnership Area on Atmospheric Mercury Transport and Fate Research (UNEP F&T), the Task Force on Hemispheric Transport of Air Pollutants (TF HTAP) of the UNECE-LRTAP convention, the GEO Task HE-02 "Tracking Pollutants" and AMAP. The results of past EU funded projects (i.e., MAMCS, MOE, MERCYMS) will provide a solid basis of knowledge in terms of state-of-the-art atmospheric models, monitoring methodologies, interoperable tools management and environmental policy analysis instruments.

Regarding POPs, the listing of eleven new chemicals in the Stockholm Convention in 2009 (penta-, hexa- and octabromodiphenyl ethers, perfluoro octane sulfonate, alpha-, beta- and gamma-HCHs, pentachlorobenzene, chlordacon) 2011 (endosulfan) and 2013 (hexabromocyclododecane) brought additional complexity in the implementation of the Convention. For the second phase of the GMP, particular attention was given to gathering baseline data for the ten new POPs, in addition to covering existing regional data gaps and ensuring sustainability of ongoing monitoring activities to enable assessment of how POPs concentrations evolved since the first monitoring reports. New POPs added to the list in 2015 (polychlorinated naphthalenes, pentachlorophenol, hexachlorobutadiene) are posing additional challenges including new consideration of the SC core matrices, development and standardisation of sampling and analytical methods, further development of the GMP DWH to support data collection and analysis and setting up the baseline

levels for these compounds. All of these will require close collaboration of existing monitoring programmes.

Further consideration should be given to

- (a) necessity to ensure internal consistency of data within programmes; at the same time, to strive for comparability of data among programmes so that data sets can be combined;
- (b) consideration of long-range transport and climate effects on atmospheric levels of POPs;
- (c) acknowledgement that the response in air concentrations to control measures may be subject to a time lag due to the persistence of POPs;
- (d) call for monitoring of newly listed POPs so that adequate baselines are established as soon as possible;
- (e) recommendation that new programmes for addressing data gaps for POPs in air should take advantage of partnerships with existing programmes;
- (f) suggestion that a specimen banking strategy should be considered if current analytical capacity is an issue.

3. User engagement

The primary stakeholders are: parties to the Stockholm, Minamata and other Conventions, governments, IGOs, NGOs; the scientific community in related fields shares the interest within the scope of the project and could contribute to gathering information and mobilizing social groups; the civil society in general, benefitting from communication of risks associated with POPs and Hg releases, contamination and exposure.

- Continuous strategic partnerships in the implementation of the GMP and GMOS;
- Further development of monitoring activities through collaboration with partners to sustain and supplement ongoing projects;
- Communication on status of monitoring activities and publication of interim results are the most important activities towards better engagement of stakeholder groups.

4. Previous development and results

For mercury

- Installation of GMOS monitoring sites
- Measurement programmes over oceans, and in the troposphere
- Development of a Spatial Data Infrastructure for mercury in the environment, with a classical three layer architecture: a Data Storage Layer (DSL), a Business Logic Layer (BLL) and an Application Layer
- Design of the SDI architecture
- SDI implementation
- Historical information collection
- Quality control of collected datasets and uncertainty assessment
- Dataset upload into the RDBMS

For POPs

- Revised GMP Guidance document to include the 11 new POPs in the GMP submitted to the COP-6 and published
- Including new POPs to some existing monitoring programmes to establish their baselines
- Establishment of new monitoring projects and networks
- Launching the second milk survey
- Development of the GMP DWH composed of three layers: data layer for data import, online data collection, data standards (code lists) and archiving, core layer for data management, validation, recoding, transformation, and background for data services (GIS, analytical and statistical tools, data processing, workflow); and presentation layer for visualization portal, presentation tools and web services
- Standardized collection of available regional data by the Regional Organising Groups using the GMP DWH
- Submission of the Regional reports to the COP-7
- Official launching of the GMP DWH at the COP-7: The GMP data visualization portal facilitates user friendly browsing and analysis of POPs data on the global scale regarding spatial coverage, data availability, summary statistics, or time series analysis. It contains information on POPs concentrations in ambient air, human tissues (breast milk and maternal blood) and surface water as a new core matrix for water-soluble POPs (perfluorooctane sulfonic acid, its salts and perfluorooctane sulfonyl fluoride) collected in the framework of the GMP and validated by the regional organization groups of the five UN regions
- Registration of the GMP DWH (www.pops-gmp.org) and GENASIS (genasis.cz) under the GEOSS portal

5. Partners

- Italy - CNR (Nicola Pirrone)
- UNEP (Katarina Magulova) Mercury Programme, the Hemispheric Transport of Air Pollutants Task Force (TF HTAP);
- Czech Republic, Masaryk University (Jana Klanova)
- CARIBIC, Germany
- GEF – Global Environmental Facility of the World Bank
- European Monitoring and Evaluation Program (EMEP);
- MercNet/AMNet initiative in USA;
- CAMNet in Canada, and other international monitoring and modeling efforts.
- RECETOX

6. Activities description

- Increase the availability of Earth observation and information needed to track pollutants and anticipate changes to the environment.
 - Harmonize standard operating procedures for monitoring pollutants and their compounds in air, atmospheric deposition, water, soil, sediments, vegetation and biota.
 - Understand temporal and spatial patterns of pollutant transport and deposition to, and evasion from, terrestrial and aquatic ecosystems.
 - Support the validation of regional and global atmospheric pollutant models for use in evaluations of different policy options.
 - Evaluate the effectiveness of international efforts to reduce releases of pollutants.
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8. Planning, milestones and deliverables

- Finalizing and publishing 2nd Global Monitoring Report (based on the Regional reports presented at COP-7): 2015
- Revised Guidance document to include new POPs
- Development and standardisation of the analytical procedures for new POPs
- Further standardisation of passive sampling techniques including intercalibration and data interpretation for old and new POPs
- Adoption of new POPs to existing monitoring programmes in accordance to the revised guidance
- Upgrading the GMP DWH to include new POPs
- Adoption of procedures for the GMR3
- Third Regional Reports due 2021

Capacity Building

- Capacity building and training to assist regions in implementing new features of the GMP and filling existing data gaps (i.e. by means of the annual summer schools)
- Sustain and maintain monitoring coverage of regions with limited capacity through partnership with strategic partners
- Capacity building for sampling and analysis of new POPs in core media and training provided in regions with limited monitoring capacity

9. Data policy (sharing and management)

- The GMP DWH together with the GENASIS primary database have been registered under the GEOSS portal
 - www.pops-gmp.org
 - www.genasis.cz
- Data from the 2nd GMP regional reports publicly available. The GMOS SDI has been registered under the GEOSS portal
 - <http://www.geoportal.org>
 - <http://www.eurogeoss-broker.eu/>

10. Management arrangements

The GMOS and GMP related activities will be coordinated by the HE-2 leads.

11. Monitoring and evaluation approach and reporting

Standardisation of sampling, analytical, QA/QC, data management, analysis and reporting procedures is crucial. This will be carried out with a support of new ERA NET project.

12. Committed Resources and annual budget(s)

In-kind (human resources)

- Secretariat staff time; Staff time of the regional organization groups and global coordination group members, strategic partners.

Financial

- Resources from small projects of the Stockholm Convention Secretariat, contributions from strategic partners, contributions of the participating countries through resources necessary to operate the contributing POPs monitoring programmes (Canada, Czech Republic).
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Other

- GEF medium sized projects on analytical procedures for new POPs, capacity building for the implementation of the GMP in the regions.
- H2020 ERA-NET Projects, UNEP, projects funded in US, Japan, China as well as other national funded projects.

13. Transition to operational phase

The overarching goal of the task GF-04 (Global Observing System for Mercury and Persistent Organic Pollutants (POPs) of Transitional Work Programme for 2016-2017 is to further develop the global observation systems for mercury and POPs by harmonizing standard operating procedures for monitoring of these substances in air, precipitation, surface water, soil, sediments, vegetation, and biota and support sharing of standardized data. Open access to comparable long-term data from the existing networks will enhance our understanding of temporal and spatial patterns in releases, distribution, transport, deposition to, and evasion from, terrestrial and aquatic ecosystems. Such data will support the validation of regional and global atmospheric models for use in the evaluation of different policy options for reducing pollution impacts on human health and ecosystems. The data sets, validated models and interoperable system produced within this task will support the policy making process in the framework of the UNEP Governing Council activities, Stockholm, Minamata, and UNECE-LRTAP Conventions. The task builds upon the contributions of the European Monitoring and Evaluation Program (EMEP), the Task Force on Hemispheric Transport of Air Pollutants (TF HTAP), the Global Mercury Observation System (GMOS) project, UNEP Mercury Programme, the Global Monitoring Plan (GMP) of the SC on POPs, MercNet/AMNet initiative in USA, CAMNet in Canada, Global Air Passive Sampling (GAPS), Monitoring Networks (MONET) in Europe and Africa and other international monitoring and modelling efforts, as well as previous activities carried out in frames of GEO.

While this process critically depends on reliable temporal trend data, the network reporting data is often an unsustainable, short-term ‘proof of concept’ project which needs sustained long-term support to achieve its function. It is envisaged that the currently established core network of contributors should be strengthened which would allow the needs of developing countries to also be addressed. Such capacity building should proceed in a step-wise manner over the short and long-term by: (i) establishing top-quality joint infrastructure; (ii) providing open access for experts within/outside the network; and (iii) securing long-term funding to support participants from developing countries. Further development of a publicly available databases is crucial to enhance visibility of this process and to facilitate improved interpretation, spatial visualization, and modelling of available monitoring data.

GI-05	Global Carbon Observation and Analysis System	- Draft Implementation Plan

GEO FLAGSHIP FOR GLOBAL CARBON AND GREENHOUSE GASES OBSERVATIONS AND ANALYSES TOWARD SUSTAINABLE DEVELOPMENT AND CLIMATE STABILISATION

INTRODUCTION

Climate change is one of the most important challenges that humanity will have to address in the coming decades. The Intergovernmental Panel on Climate Change (IPCC) has concluded that a large part of the observed rise of global temperature is very likely due to increasing greenhouse gases (GHG) in the atmosphere, driven by man-made emissions overtaking the natural cycles of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). The perturbed global biogeochemical cycles of these greenhouse gases are a major driving force of current and future climate change. The primary agents of these perturbations are fossil fuel combustion and modifications of global vegetation through land use change, in particular deforestation. Deeper understanding of the driving forces of climate change requires full quantification of the GHG cycles. Regional GHG flux patterns, tipping-points and vulnerabilities can be assessed by long-term, high precision in-situ observations in the atmosphere and at the ocean and land surface. They are complemented by in-situ and satellite observations of carbon pools as well as total column observations from satellites. CEOS (Committee on Earth Observation Satellites) has responded to the GEO Carbon Strategy and provided coordination to all the national and regional satellite agencies; GCP (Global Carbon Project) has provided annual updates of the global carbon budget and coordinating many global and regional efforts, in particular by establishing the mean carbon balance of large regions in the RECCAP (REgional Carbon Cycle Assessment and Processes) project.

This document proposes a GEO Carbon and GHG Flagship (hereinafter called **GCGF** without anticipating any final name and acronym) that will contribute to the implementation of the next GEO Strategic Plan for the period 2016-2025. The flagship will address important issues needed to build a connected and interoperable global network for carbon cycle (CC) and greenhouse gas (GHG) observations in the atmospheric, terrestrial ecosystem and oceanic domains.

In particular the GCGF will address these questions:

- What kind of carbon cycle and GHG observations are urgently needed to support the Sustainable Development Goal: "Take urgent action to combat climate change and its impacts" (and partly the Goal: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss")?
- Where are we coming from, i.e. what are the most important recent achievements in terms of science and infrastructural capacity?
- Where do we want to go, i.e. what remains to be done in the framework of GEO for the next 10 years? In particular, how can we ensure that achieved capacities can be fully explored for multiple needs and not just for the specific circumstances they were developed for?
- Who will be the important data providers, integrators and users?
- How can a sustainable structure be achieved? What is fundamental, what is desirable, what would be nice to have but not essential?
- What are the most urgent needs for integration between different information sources and across methodologies, between different regional networks and from data providers to users? What is the intent of integration? Blending? Coupling? Transforming? How do we assess

integration methods in light of relevant objectives? How can different data sources and modeling approaches be used to evaluate our understanding of processes and their emergent properties?

OBJECTIVES

The main objectives of this flagship are:

- to provide more inclusive coordination among the main actors monitoring carbon cycle and GHG at global level;
- to further develop inter-operability between satellite observations; in-situ infrastructures and integration networks by
 - Data harmonization (data and metadata formats),
 - Further development of full and open data sharing,
 - Long-term sustainability of data centers and model result repositories,
 - Understanding and quantifying scale issues and process information across in-situ measurements and satellite platforms;
- to support the development of Model Data Fusion to improve parameter optimization;
- to envisage a GEO role in organising and backing intercomparison exercises;
- to establishing standard datasets for synthesis and dissemination of policy-relevant information on global carbon cycle and GHG:
 - to raise awareness and promote data use e.g. towards UNFCCC Subsidiary Body for Scientific and Technological Advice (SBSTA);
 - to liaise science with policy and provide decision makers with timely and more reliable policy-relevant information
- to coordinate the periodic update and supply of comprehensive carbon budgets (covering also less studied region/ecosystems, and unknown sources, with progressively reduced uncertainty) at different levels (global, regional, domains, etc.) and integrating different approaches;
- to provide knowledge that assures the quality of national inventories and to secure the effectiveness of UNFCCC.

Other objectives for the GEO flagship process:

- to support for sustaining, developing and exploiting existing as well as promoting new observing platforms and infrastructures;
- to harmonize existing protocols for biogeochemical data collection and analysis, as well as full and open sharing;
- to contribute data to cost-benefit analyses that show the costs of better informed actions versus inaction;
- Promote further consistency of observations and specification of uncertainty that is fully traceable and accepted by the community.

NEED FOR ACTION

The natural carbon cycle offers a discount by absorbing about half of the anthropogenic emissions of the most important GHG CO₂. It is not clear, however, how these CO₂ sinks will operate in the future under a changing climate and increasing human impacts. Unexpected responses of oceans or terrestrial ecosystems might result faster or slower reductions of the GHG concentrations in the atmosphere than anticipated. Societies may win or lose time for mitigation and adaptation and societal costs may,

therefore, be higher or lower than anticipated. A global interoperable and connected monitoring network for GHG fluxes and concentrations is needed that provides constant monitoring of oceans and terrestrial ecosystems and integrates these data to information for adapted target levels as time and our knowledge progresses.

A better understanding of the global carbon cycle together with more reliable data and information will have significant policy-relevant implications, allowing:

- to determine defensible, feasible and effective emission reduction pathways;
- to verify the effectiveness of mitigation policies, necessary to meet the objectives of future climate treaties (scientific results allow an independent verification of emission reduction);
- to determine baselines of carbon pools and fluxes;
- to improve the ability to predict future changes (including those due to the implementation of the GHG management strategies);
- to develop the ability for constant review and science-based development of adaptation actions (according to the provisions based on the analysis of the observations).

USER ENGAGEMENT

A large proportion of the in-situ data is already well integrated into global data integration networks of GHG. Data from the Ocean observational network have been integrated by the global network SOCAT (Surface Ocean Carbon Atlas). Data from stations observing GHG exchange between ecosystems and the atmosphere have been integrated into FLUXNET – a global network on ecosystem flux data. Atmosphere data are integrated by the World Data Centre for Greenhouse Gases (WDCGG) under WMO's Global Atmosphere Watch program. However, many data still lack accessibility or standardization and will be targeted through the Geo Carbon and GHG Flagship Initiative. There will be a huge impact through harmonization and standardization of measurements and data formats including improves QA/QC standards and data protocols. Primarily, these efforts supported the research community, but industry and policy makers will also benefit from these efforts on the long run since they will have easy access to high quality standardized data. Combining satellite lidar, airborne lidar, and ground plot data for biomass provides strong constraints and verifications to estimate the amount and distribution of terrestrial carbon budget. Users on the highest level of integration such as the Global Carbon Project (GCP) will engage in the Flagship Initiative.

While data up to now have mainly been used for early stage basic research we expect a stepwise transition to knowledge products that can be used for e.g.:

- verification of inventories or reduction efforts,
- regional planning and scenarios on transport or energy production,
- life-cycle assessments of products in the food and bioenergy sectors,
- assessments of ecosystem responses to climate change and climate extremes that can be used for food security estimates,
- decision support systems for GHG mitigation actions.

The Geo Carbon and GHG Flagship Initiative will help users to define the information needed to support these efforts and will actively support the exchange between users and data providers.

PREVIOUS DEVELOPMENT AND RESULTS

The Carbon Community, working inside and outside the GEO frame, has in recent years achieved significant progresses that improved our scientific understanding of the global carbon cycle and GHG fluxes. Policy makers were provided with useful information to address climate change policies. Some example of these recent achievements are:

- The annual update of the Global Carbon Budget (both CO₂ and CH₄).
- Regional syntheses of GHG emissions and sinks for continents and oceans.
- New modelling products and Carbon Cycle Data Assimilation Systems (CCDAS) for carbon cycle analysis and projections.
- The launch or planning of new important satellite missions, like (respectively) OCO₂, Carbonsat and Biomass.

In parallel, large achievements have been made on other initiatives:

- Construction of regional Research Infrastructures (RIs) with a long-term perspective for acquisition of relevant carbon and GHG data;
- Development and integration of databases on GHG concentrations in atmosphere, GHG fluxes between oceans and the atmosphere as well as terrestrial ecosystems and the atmosphere into these RIs;
- Increased inter-operability of these RIs via common standards, meta-data formats etc.

There have been many initiatives, ended or still ongoing, long lived or more recent, that have already given a fundamental contribution to the observation of the global carbon cycle improving its understanding.. Most of them were somehow are linked to GEO in some way or have even directly worked to contribute to it. One of the GEO Carbon Flagship's aims is to provide a cross coordination among all of them, in order to derive an improved, comprehensive, integrated picture of the global carbon (and GHG) cycles and budgets.

PARTNERS

The following partners have indicated their interest to actively contribute to the Flagship Initiative.

(List will be provided later)

ACTIVITIES DESCRIPTION

The first step is to decide task's titles and contents, and the working structure.

The main building blocks could be the following:

- Define the elements for an optimal global carbon observing system, including the needed infrastructure
 - Collect and harmonize (to make them interoperable) all the possible available observations (in different domains, from different platforms, etc.) from past series to the currently operational networks
 - Improve assimilation systems and modelling efforts to ingest and process these observations and provide relevant products
 - Deliver new information products, tailored to the final users (particularly decision makers)
-

- Develop and maintain an information portal, fully linked to the GEO portal, where all these data, information and products are visualized and freely shared
- Assess the cost and benefits of an improved global carbon observing system

DATA MANGEMENT AND POLICY

The Flagship Initiative will promote the GEOSS Data Sharing Principles and follow them as much as possible. There shall be full and open exchange of data, metadata and products shared within GEOSS, recognizing relevant international instruments and national policies and legislation. All shared data, metadata and products will be made available with minimum time delay and at minimum cost. All shared data, metadata and products being free of charge or no more than cost of reproduction will be encouraged for research and education.

Observations related to the global carbon cycle and GHG have already been shared very much in line with the GEOSS data sharing principles. Many initiatives have led to an increasing availability of well harmonized data. National or regional institutions or research infrastructures (e.g. NOAA, NEON, ICOS, TERN, AsiaFlux, CGER/NIES (list will be completed) will further improve these efforts. The World Meteorological Organization (WMO) has established the World Data Center for Greenhouse Gases (WDCGG) as data portal for atmospheric concentrations, global networks on in-situ ocean and ecosystem data are also operational. Building on existing data portals, the flagship initiative will endorse the harmonization of all portals into a common virtual metadata portal, fully linked to the GEOSS portal and support data harvesting approaches.

A common framework for attribution and citation of the data by the users is currently under development in the framework of the Research Data Alliance (supported by the European Horizon 2020 Projects ENVIplus and EUDAT) to allow fully flexible and transparent referencing and citations to of data and dynamic datasets. The Flagship Initiative will closely connect to these efforts and also work on a common framework for harmonized data licensing and voluntary user tracking.

MANAGEMENT ARRANGEMENTS

The Flagship Initiative will define tasks and work packages in detail during the first year (2016). The initial management will comprise a Steering Committee (SC) where ideally all important contributors, all regions, and different domains (in-situ and satellite observations, data management, modelling, data assimilation, ...) will be represented. Out of the SC a coordination team will be elected.

Contributions to the Flagship will be mostly in-kind, partly in-cash and also comprise data, products and services. A detailed financial planning will be developed during the first year.

GEO-XI – 13-14 November 2014

AfriGEOSS Implementation

Document 13

Plan

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1. FOREWORD

The main purpose of this document is to provide an update on the progress in the implementation approach for AfriGEOSS and on the planned way forward to make it one of the key initiatives for the next decade of GEO, to 2025.

The AfriGEOSS Working Group, represented by ten African countries (Egypt, Ethiopia, Gabon, Ghana, Madagascar, Morocco, Niger, Nigeria, Senegal, and South Africa) and three Africa-based Participating Organisations (AARSE, RCMRD and UNECA), with contributions from non-GEO Members, developed this top-level Implementation Plan for AfriGEOSS. The plan addresses the coordination framework from the national to global level, key focus areas of activities, and the governance structure, including the composition and definition of Terms of Reference of the Steering Committee, national focal points and the Coordination Team.

2. INTRODUCTION

GEO is a voluntary partnership of 94 governments and 77 international, Participating Organizations (POs) aimed at coordinating efforts to build a Global Earth Observation System of Systems (GEOSS). GEO was launched in response to calls for action by the 2002 World Summit on Sustainable Development and by the G8 leading industrialized countries. The GEOSS 10-Year Implementation Plan focuses on nine Societal Benefit Areas: agriculture, biodiversity, climate, disasters, ecosystems, energy, health, water and weather. In addition to these nine areas, GEO has made major strides in developing and implementing Data Sharing Principles which call for open access to publicly funded data at, preferably, no cost, or the cost of reproduction.

For nearly a decade, a number of GEO programmes, initiatives and projects have focussed on or included Africa in their scope. These activities included responding to societal benefit requirements and accessing Earth observation (EO) data, such as free and open access to Landsat, CBERS and, now, SPOT and Sentinel datasets. These GEO initiatives need to support the continuously growing African Earth observation community, which is establishing its presence in the region and in the global arena, benefitting from national and regional programs, as well as from on-going cooperation initiatives with a great number of external Partners. The development and uptake of Earth observations data and information to improve the socio-economic status of the African continent is a prominent and fast-growing part of these activities.

The GEO Africa membership (made up of 24 Member States and five Africa-based Participating Organisations, Annex A) have recognized in the implementation of GEOSS, the opportunity to consolidate the above process. The concept of the AfriGEOSS initiative was fully endorsed by the GEO-IX Plenary in November 2012, with several GEO Members and POs expressing their willingness to provide contributions. The background of the initiative and its conceptual approach was described in Document 10 [“AfriGEOSS: An Initiative to Build GEOSS in Africa”](#), presented at GEO-IX.

The official launch of the AfriGEOSS initiative took place on 5 November 2013 during the joint Africa GIS 2013 and GSDI 2014 Global Geospatial Conference in Addis Ababa, Ethiopia.

The AfriGEOSS initiative, developed within the GEO framework, will strengthen the link between current GEO activities and existing capabilities and initiatives in Africa. It will provide the necessary framework for countries and organizations to access and leverage on-going national and international bilateral and multilateral EO-based initiatives across Africa, thereby creating synergies and minimizing duplication for the benefit of the entire continent.

3. VISION AND STRATEGIC OBJECTIVES

AfriGEOSS is a coordinated GEO initiative to enhance Africa's capacity to produce, manage and use Earth observations, while enabling the Region's participation in, and contribution to, GEOSS.

4.1 Vision

The AfriGEOSS vision is for a continent where decisions on policy and implementation programs, involving the production, management and use of Earth observations, are taken with the involvement of all stakeholders through a coordination framework that enables country-to-region-to-continent linkages.

4.2 Goal

AfriGEOSS aims to provide a coordination framework for all Earth observation activities in Africa. The mechanism will allow for coordination amongst various programmes, projects and activities across the continent to reduce duplication of effort and address gaps in data and capabilities. This will be achieved through establishing national-based coordination mechanisms that will in turn feed into regional coordination mechanisms.

4.3 Objectives

To achieve the above, a set of overall objectives has been defined for AfriGEOSS:

- Coordinate and bring together relevant stakeholders, institutions and agencies across Africa that are involved in GEO and other Earth observation activities;
- Provide a platform for countries to participate in GEO and to contribute to GEOSS;
- Assist in knowledge sharing and global collaboration;
- Identify challenges, gaps and opportunities for African contributions to GEO and GEOSS;
- Leverage existing capacities and planned assets and resources;
- Develop an appropriate strategy and participatory model for achieving the above goals; and
- Develop a strategy of communicating Earth observation data throughout Africa.

AfriGEOSS aims to support Africa in achieving open and affordable access to EO data, operational use of EO data in daily pursuits of national mandates and for evidence based decision making; collaboration on systems development and ICT infrastructure establishment around EO; skills, capacity and competencies to exploit fully the advantages of EO and Africa's involvement in GEO and other international initiatives.

4. OPERATIONAL APPROACH

The AfriGEOSS implementation approach will be two-fold: "bottom-up" by coordinating national activities and expanding their reach through regional and continental level mechanisms; and "top-down" by tailoring GEO global initiatives to address Africa's needs.

The following lines of action will be followed to achieve the identified approach:

- Re-establish strong contacts with the current GEO Principals and enlarge the GEO partnership in Africa. Expanding these relationships will ensure support from decision makers for national activities and global contributions;
 - Address both the infrastructure and the services/application components, based on the development of regional networks that form the backbone of a continental network and, in parallel, define options for a coordination framework at the regional level;
 - Develop an extensive inventory of current and planned initiatives and available resources. The audit of what is happening in Africa will contribute to a map of on-going activities related to
-

the AfriGEOSS objectives and assist in managing overlaps, identifying gaps and opportunities, as well as leveraging resources to meet objectives;

- Link existing initiatives, not yet connected to GEO, to the GEO Work Plan, clearly indicating contributions to GEOSS;
- Influence upcoming initiatives to ensure that Africa receives full benefit from, and makes a contribution to, GEO global initiatives;
- Engage African communities, on a continuous basis, using the existing networks and through specific measures such as development of an AfriGEOSS website, exhibitions, side events and a periodic GEOSS in Africa conference; and
- Periodically assess progress towards the objectives.

4.4 Initial Recognitions

In addition to the endorsement by GEO Plenary, AfriGEOSS has subsequently received recognition from regional, continental and bilateral formal structures, such as:

- Africa and European delegation at the GMES and Africa Validation Workshop declaration, Johannesburg, October 2013 (*GMES & Africa Validation Workshop Declaration*) ... *“AfriGEOSS is Africa’s contribution to GEO”*;
- African Heads of State and the European Union at the Africa-European Union Strategic Partnership, 4th EU-Africa Summit, Brussels, April 2014 (*Africa-European Union 2014 – 2017 Roadmap*), *“....development of Earth Observation activities in Africa so that space strategically contributes to Africa’s socio-economic development... in order to deliver services in priority domains for Africa ...”*;
- At the margins of the 4th EU-Africa Summit of Heads of State and Governments, Brussels, April 2014, Cooperative Arrangement of on GMES and Africa was signed by the European Commission and African Union Commission ... *“Welcomed the outcome of the October 2013 GMES and Africa Validation/Consolidation Workshop in South Africa and Stress that the implementation of this outcome should build on and be in line with Earth Observation initiatives such as AMESD, MESA, TIGER and AfriGEOSS, should enhance collaboration and should strongly address issues such as policy, human, institutional and technical capacity building, infrastructure, governance, financial management, and monitoring and evaluation...”*;
- The Joint Meeting of SADC Ministers of Science, Innovation & Technology and Education & Training, Maputo, Mozambique, 16 – 20 June 2014, Ministers:
 - o *Approved the initiation of the partnership between the SADC Secretariat and the GEO Secretariat;*
 - o *Agreed to support Africa's contribution to GEO under AfriGEOSS;*
 - o *Directed the SADC Secretariat to provide member states with all required information to consider membership to the GEO and to submit a status report at the next meeting in 2015.*
- The World Meteorological Organisation (WMO) at its 66th Executive Council, Geneva, June 2014, recognised the value of AfriGEOSS and encouraged engagement with National Meteorological and Hydrological Services (NMHSs) to effectively meet government and societal needs. It further stated in its WIGOS document, *“The Council reiterated that collaboration and coordination with partners, including AfriGEOSS, the European Commission and many other non-WMO, non-NMHS communities, is a priority for WIGOS and will need additional attention in order to build synergy and avoid unnecessary duplication of effort.”*

5. AREAS OF ACTIVITY

4.5 Introduction

The work needed to meet the AfriGEOSS objectives has been organized into the six major areas identified below. The definition of these areas is driven both by the specific needs of the initiative (mainly points 5.2, 5.6 and 5.7 below), and by the need to ensure that the initiative will connect effectively to overall GEO activities and relevant processes (as defined in Sections 5.3, 5.4 and 5.5).

For each of the Areas of Activity, the Plan describes the nature of the activities and the major achievements planned for the phases to come (Definition, Implementation and Initial Operations). Detailed Work Plans will be developed once the Implementation Plan is endorsed by GEO-XI Plenary in November 2014.

It is important to note that the proposed structure of the activities:

- complies with the current definition of GEO Work Plan tasks and task components;
- ensures a basic level of coordination; and
- allows a progressive increase in the number of activities and their scope as soon as additional resources become available.

4.6 Continental and Regional Coordination

This is the essential component for the implementation of AfriGEOSS. The coordination will take place along different axes:

- a. Inside the continent, from national to regional to continental, through the development of regional networks that will form the backbone of a continental network and, in parallel, define options for a coordination framework at the regional level;
- b. African contributions to global initiatives (GEO/GEOSS, UN framework conventions, etc.);
- c. African benefits from African-scale global initiatives (such as the GEO global initiatives);
- d. Priorities and activities to address the infrastructure, services/applications and capacity building needs as identified through extensive regional inventories and roadmaps.

Results from these activities, and a clearer picture of African needs and priorities, will constitute the input for the main AfriGEOSS components, (from 5.3 to 5.7) which, through periodic revisions, will provide the basis for coordinating the on-going activities and influencing upcoming initiatives.

4.7 User Needs and Applications

Meeting user needs and coordinating the development and demonstration of related applications, is the ultimate objective of GEO and, by definition, AfriGEOSS. They cover a number of thematic areas, corresponding to the nine Societal Benefit Areas of GEO and beyond.

A key, recurring activity will be a periodic review of user needs on the basis of the inputs provided by the coordination network. The results of these assessments will strongly influence the actions to be taken in other areas.

The second line of activity will be progressive inclusion of specific projects into the AfriGEOSS framework by creating relationships with on-going initiatives and by bringing together new actors to define and implement new activities.

User needs analyses at different levels, and the content and plans of the GEO global initiatives, will constitute the starting point to progressively address the different application areas of priority.

The continent has a number of activities that have already identified major thematic areas, such as disaster management (especially floods and fires), food security and water resource management that will readily connect with GEO activities.

In addition, GEO currently has five global initiatives (Blue Planet, GEO Biodiversity Observation Network (GEOBON), GEO Global Agriculture Monitoring (GEOGLAM), Global Forest Observation Initiative (GFOI), and Global Land Cover), to which AfriGEOSS has started developing linkages.

4.8 Data and Infrastructure

This activity area complements the ability of the GEOSS Common Infrastructure (GCI) to provide end users with access to data, information, products and services.

1.1.3 Coordinated Earth observation satellite data over Africa

The ability to downlink satellite data directly for processing will strongly support the development of timely downstream applications, products and services. This will substantially expand access to, and the use and application of, Earth observation data for policy- and decision-making. Such services will provide significant societal benefits, particularly in the areas of disasters (fires, floods), disease outbreaks and natural resources management. Several ground stations already exist, but because they are not interoperable their full potential for supporting research, applications and human capital development has not been realised. To remedy this situation, AfriGEOSS can provide a coordination mechanism to promote interoperability involving interfaces, common file formats, common dissemination standards, etc.

This component is expected to be made up of the countries and space agencies in charge of the ground stations in Africa, including Algeria (ASAL), Egypt (NARSS), Gabon (AGEOS), Nigeria (NARSDA), South Africa (SANSA), Malindi (Italy) station in Kenya and SEAS (IRD) on Reunion Island.

This component can be further developed by incorporating:

- A summary of African capabilities;
- Satellite missions being considered;
- Areas of intervention and related objectives;
 - Satellite data acquisition networks;
 - Data mining in existing archives;
 - Data processing;
 - Data archiving;
 - Data dissemination and delivery, including understanding connectivity status and plans in Africa.

The progressive implementation of the GEOSS Data Sharing principles is creating the proper conditions for the definition and subsequent successful implementation of a number of coordinated initiatives that have the objective of building an historical archive of satellite data over Africa and of ensuring sustained access to ongoing missions data. This particular initiative builds on the opening of the SPOT archives (from SPOT 1 to SPOT 5) for free access to data (at least five years old and with resolutions greater than 10 meters), which has been granted by France. The objective of the initiative is to progressively develop regional historical archives of SPOT data together with a number of simple but robust “test cases” on the use of these data in informing decisions in different societal areas. Under the Data & Infrastructure Activity, AfriGEOSS aims to develop this initiative to cover other open access satellite data archives.

The provision of education and training programmes focusing on the development of open-source software and open systems, and the development of acquisition and dissemination mechanisms, need to take into consideration the challenges of limited bandwidth in many developing countries. To accurately identify the scope of data and infrastructure capabilities and needs, this component needs to include engagement with other non-Earth observation entities, such as The East African Submarine System (EASSy) programme and the Infrastructure Consortium for Africa (ICA), to ensure that issues of connectivity across the continent are addressed in support of Earth observations data dissemination.

1.1.4 Coordinated in-situ observations network for Africa

GEOSS is not only concerned with satellite observations but also *in-situ* observations. There is a need to bring attention to this element with regard to data acquisition activities in Africa. Further, though the GEO data sharing principles have had major successes in opening access to satellite observations, the same cannot be said for *in-situ* observation data and information for Africa.

Africa, unlike Europe, for example, does not have an institution responsible for coordinating access to *in-situ* measurements. This is something for which Africa can aspire. This sub-component will bring *in-situ* data custodians and providers into the GEO community and promote open access to *in-situ* measurements and information.

4.9 Human Capital Development

Collaboration on establishing and/or strengthening regional capacity-building networks has already taken place through the GEO Institutions and Development Board (IDB) and the Committee on Earth Observation Satellites (CEOS) Working Group on Capacity Building and Data Democracy.

The current GEO POs in Africa: the African Association of Remote Sensing of the Environment (AARSE), and the Environmental Information System (EIS-Africa), African Centre of Meteorological Information for Development (ACMAD, Niger), the Regional Centre for Monitoring of Resources for Development (RCMRD, Kenya) and the UN Economic Commission for Africa (UNECA), each with extensive experience in geospatial activities, will contribute to this component by using their programmes and networks to ensure that effective and well-coordinated education and training activities are established. They will also support the creation of networks amongst other relevant agencies, such as the United Nations and other national and regional training centers.

Further, this component is expected to align its activities to support the, yet to be established, Pan African University (PAU) for Space Science and the potential role it can play in addressing human capacity constraints on the continent. PAU, to be hosted by Southern Africa Region, will establish nodes across the continent. The AfriGEOSS community must be proactive in identifying and supporting the inclusion of Earth observation components within each node.

4.10 Resource Contributors Coordination

This component will look at a coordination mechanism for resource contributors to African initiatives.

The resource contributors range from entities such as the European Commission, international development agencies, international development banks, research institutions and governments. This component aims to bring together and engage with all the main actors having Africa-focused support programs and plans in the AfriGEOSS priority areas of acquisition, processing and use of Earth observations.

4.11 Communication and Outreach

Raising awareness and outreach to African communities on a continuous basis, using the existing networks and through specific measures such as development of an AfriGEOSS website, exhibitions, side events and a periodic GEOSS in Africa conference, are key elements of the communication and outreach strategy.

AfriGEOSS will organize dedicated events to promote and leverage other type of events to promote AfriGEOSS, GEO and GEOSS such as those organized by AARSE and EIS Africa through its AfricaGIS conference and other forums. The focus will be on encouraging African countries to become GEO Members and to actively participate in GEO tasks.

6. THE COORDINATION FRAMEWORK

4.12 Introduction

Building a proper and sustained coordination framework is essential to ensure that AfriGEOSS' objectives will be met.

Once in place, this framework will enable coordination inside the continent, allow the definition and implementation of coordinated African contributions to global initiatives, and ensure greater benefits for Africa from initiatives at the global scale.

The coordination framework needs to address geographical representation, political representation and functional areas.

The proposed AfriGEOSS coordination framework is comprised of two different but cooperating components:

1. A standing Coordination Network of national and regional focal points, ensuring systematic geographical representation;
2. A dedicated coordination structure, referred to as the AfriGEOSS Management Arrangement, which, in this initial phase, constitutes the continental coordination layer and covers the political representation and functional areas.

The GEO Africa Caucus will ensure oversight of the development and implementation of the AfriGEOSS coordination framework.

4.13 The Coordination Network of national and regional focal points

The main function of this network is to ensure continuous, two-way communication from national to regional to continental levels, and vice versa.

The network will be used to circulate very different types of communications, such as general information of potential interest to the different countries/organizations (e.g., newsletters), progress reports on AfriGEOSS coordinated initiatives, and definition and consolidation of new initiatives and projects. More specifically, the Coordination Network will serve to:

- a) Engage all stakeholders at the national level;
- b) Provide linkages between AfriGEOSS coordinated activities and national activities;
- c) Provide national contacts as may be required by the AfriGEOSS Management; and
- d) Undertake communication and outreach activities at the national level, such as dissemination of information.

The components of the Coordination Network include the following:

- a) National Coordinators (NCs), appointed by the GEO Principals where the country is a GEO Member, or through an exchange of letters between the GEO Secretariat and the interested institution;
- b) Regional Coordinators (RCs), based on partnerships with Regional Economic Communities (RECs) and other regional representative structures where applicable (for example, the regional coordination mechanism may appoint a RC from the NCs); and
- c) Continental Coordination, constituted by the AfriGEOSS Management in this initial phase of AfriGEOSS Implementation. In the medium term, this is envisaged to be accomplished through continental institutions, such as the African Union Commission, or UNECA, once dedicated internal structures have been established in those organizations (e.g., the space secretariat within AUC).

It is important to underscore that the identified focal points will have the responsibility of ensuring involvement of all national institutions interested and/or involved in the use of EO for decision making, thus building a permanent national coordination.

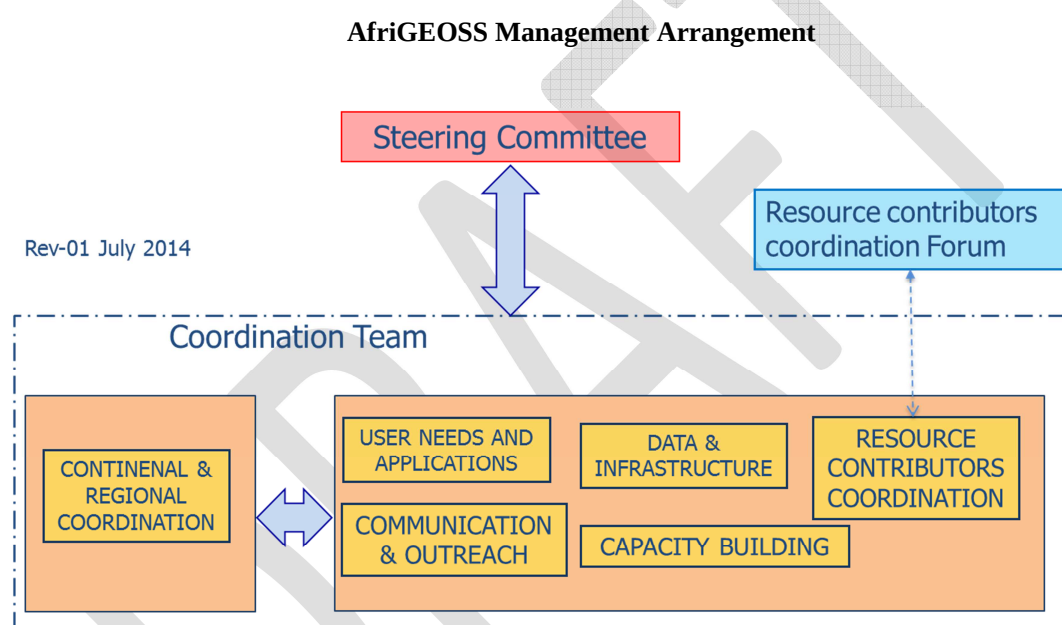
The network will be progressively built by incorporating representatives from countries and organizations ready and willing to join, keeping in mind the need to have balanced geographical coverage of the continent.

4.14 AfriGEOSS Management Arrangement

The main function of the AfriGEOSS Management Arrangement will be to coordinate the execution of the agreed activities in each of the areas of intervention, and to ensure the achievement of the agreed objectives.

The proposed AfriGEOSS Management Arrangement is summarized in the following diagram and includes:

- Steering Committee;
- Coordination Team;
- Resource Contributors Coordination Forum.



1.1.5 AfriGEOSS Steering Committee

The Steering Committee will provide guidance for AfriGEOSS Implementation on key issues, such as objectives, policy decisions, priority actions and resource allocation. It meets normally once a year or when needed and operates by consensus.

The composition of the Steering Committee includes 11 members, as follows:

- Six seats for GEO member countries representing the six African regions;
- One seat for the African Union Commission (HRST) Human Resources, Science and Technology);
- One seat for UNECA;
- Two seats for GEO Participating Organizations based in Africa;
- One seat for the Director of the GEO Secretariat.

At its first meeting, the Committee will designate two Co-Chairs, each with a one-year mandate.

The African Caucus will be responsible for appointing members for positions a) and d) on a one-year rotation basis.

1.1.6 AfriGEOSS Coordination Team

The Coordination Team will be responsible for the overall coordination of AfriGEOSS activities. In particular, it will ensure: 1) technical coordination; 2) securing of resources; 3) reporting; 4) institutional linkages; and 5) planning.

The Coordination Team reports to the Steering Committee for overall guidance and, working through the GEO Secretariat, is responsible for preparing and presenting annual reports to the GEO Plenary and to the GEO Executive Committee, as required.

The Coordination Team structure fully reflects the areas of AfriGEOSS activities and is comprised of the Team Coordinator, plus the leaders of the five areas of activities. – The Team Coordinator is responsible for the sixth area, continental and regional coordination. In the initial phase of AfriGEOSS implementation, the Coordination Team is led by the GEO Secretariat expert, the “Team Coordinator” specifically seconded by South Africa for this purpose.

The Team coordinator is hosted at the GEO Secretariat, which will also provide administrative support to the Team, and will ensure a technical and planning interface to the GEOSS Common Infrastructure (GCI). The remaining five area leaders may perform the agreed activities from their home location, with the understanding that they will devote to this duty a substantial amount of their time. The first step, through a call for contributions to GEO African Members and POs, would be to identify and ensure availability of the five leaders, one for each area of activity.

The Coordination Network will be developed over time based on available resources. As soon as specific projects or initiatives are consolidated under each activity area, a dedicated “coordination arrangement” will be put in place.

1.1.7 Resource Contributors Coordination Forum

The Resource Contributors Coordination Forum will bring together, once a year, all the main actors having Africa-focused support programs and plans in the AfriGEOSS priority areas of acquisition, processing and use of Earth observations.

The forum’s main objectives are the definition of coordinated support plans at the regional and continental level, the identification of direct contributions to the AfriGEOSS initiative, and review of the results of the coordinated actions.

7. RESOURCE ALLOCATION

Dedicated resources will be needed to achieve the objectives of developing the AfriGEOSS coordination framework and reaching, under GEO, its initial operational capabilities. These resources may be contributed in the form of cash contributions, allocation of dedicated personnel, and/or support of specific activities. These resources are expected to be a small fraction of the overall resources that are committed by a great number of resource contributors, to actually develop projects on the African continent.

The resources will be used to ensure the governance of the AfriGEOSS initiative and the execution of the agreed activities for the five AfriGEOSS components. These needs include, but are not limited to:

- Team member participation costs and related expenses (including travel);
 - Support for meetings, workshops and symposia;
 - Support for participation of African countries and organization representatives at meetings, workshops and symposia;
 - Undertaking specific studies or activities;
-

- Producing outreach material and events;
- Implementing communication actions and materials.

As with similar GEO initiatives, such as GFOI and GEOGLAM, it is proposed that a specific budget line in the GEO Trust Fund be used to manage the cash contributions received from donors.

8. PHASING, DELIVERABLES AND PLANNING

The described process began in 2012 and is expected to last through 2025 through the following phases:

Phase	Years	Main Deliverables
Concept Phase (completed)	2012-2013	AfriGEOSS Concept (Documents to GEO-IX and GEO-X).
Definition Phase	2014	AfriGEOSS Implementation Plan; Initial elements of the coordination framework in place.
Implementation Phase	2015-2025	Progressive establishment of the AfriGEOSS coordination framework, through national, regional and continental mechanisms; Progressive increase of the contributions to the Activity Areas; Progressive increase of coordination for decisions and initiatives at national, regional and continental level; Periodic adjustment of AfriGEOSS Management Arrangements.

ANNEX A

As of August 2014, the GEO membership included 94 countries plus the European Commission. The 24 Members from Africa are:

Algeria	Madagascar
Burkina Faso	Mali
Cameroon	Mauritius
Central Africa Republic	Morocco
Congo, Republic of the	Niger
Cote d'Ivoire (Ivory Coast)	Nigeria
Egypt	Senegal
Ethiopia	Seychelles, Republic of
Gabon	South Africa
Ghana	Sudan
Guinea-Bissau	Tunisia
Guinea, Republic of	Uganda

Five of GEO's 77 Participating Organisations are based in Africa:

- African Association of Remote Sensing for the Environment (AARSE);
 - African Centre for Climate Monitoring and Applications Development (ACMAD);
 - Environmental Information System (EIS-Africa);
 - Regional Centre for Monitoring and Remote Sensing Development (RCMRD); and
 - United Nations Economic Commission for Africa (UNECA).
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GI-07	Ocean and society - Blue Planet	- Draft Implementation Plan

7. Executive Summary (2 pages max)

The GEO Strategic Plan 2016-2025 identifies eight societal benefit areas. The oceans play a vital role in every one: Disaster Resilience; Food Security and Sustainable Agriculture; Water Resources; Energy and Mineral Resources; Public Health Surveillance; Biodiversity and Ecosystem Sustainability; Sustainable Urban Development; and Infrastructure and Transportation. For example, ocean-related hazards such as tsunamis, storm surges, and extreme waves require ocean observations for early warning systems and to prepare for and mitigate the effects of disasters. Because of their role in climate, ocean observations also provide important information for the forecasts of precipitation and drought, the source of replenishment of water supplies, and of climate events that can lead to public health incidents or changes in energy demand. Ocean biological observations are critical in monitoring the health of ocean ecosystems and biodiversity, and the way ecosystem services are being impacted by a changing environment. They are also important in managing fisheries and aquaculture. In addition, observations of the ocean are critical for monitoring climate variability and change, and for generating forecasts and projections of climate that can be used in climate services. Ocean observations help improve predictions of longer-range forecasts of weather. Finally, oceans impinge on various cross-cutting initiatives in GEO, such as system architecture and capacity building.

Blue Planet will build on its initial success as a Task in the GEO 2012-2015 Work Plan, in galvanising the ocean observing community and enhancing the visibility of ocean observations within GEO. In its next phase, it will add value to the work already being carried out, by developing synergies between its different components and with other parts of the GEO Work Programme, and by strengthening its focus on delivering products and services to the user communities. This was agreed at the 2nd Blue Planet Symposium, which was hosted by the Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Cairns, Australia, from 27 to 29 May 2015.

8. Blue Planet envisions an informed society that recognises the oceans' crucial role in Earth's life-support system and is committed to stewardship of the oceans for a healthy, safe and prosperous future for all.

Blue Planet's Mission is to advance and exploit synergies among the many observational programmes devoted to ocean, coastal and inland waters; to improve engagement with a variety of users for enhancing the timeliness, quality and range of services delivered; and to raise awareness of the societal benefits of ocean observations at the public and policy levels.

"Oceans and Society: Blue Planet" will add value to existing observational programmes by:

- Facilitating and encouraging collaboration among them for mutual benefit, and with the broader Earth observation community;
- Improving their connections with the users of ocean observation-derived products, information and knowledge;
- Enhancing their impact within the Group on Earth Observations and other intergovernmental arenas; and
- Promoting their communication with decision makers and with the general public regarding the societal benefits of ocean observations.

9. Introduction

We live on a Blue Planet, and the Ocean benefits many sectors of society. It is only through the collective efforts of all nations that we can observe the oceans, to understand and predict better their role in the Earth system.

The ocean makes 50% of the oxygen we breathe. It is the biggest reservoir on planet Earth of heat, water and carbon. Rates of change of these variables influence the environmental conditions we experience on land, such as our weather and climate, but many key properties of the oceans are changing rapidly. We rely on the oceans for food, transport and recreation. However, the oceans are subject to a diversity of threats, including pollution, ocean warming, loss of ice cover, reduction of bio-diversity, habitat loss, overfishing, hypoxia and ocean acidification.

We already know how to observe the ocean in all its aspects, including physics, chemistry, geology, and to a lesser extent biology, at the required time and space scales. We have the ability to sample the remotest parts of the oceans, from pole to pole and into the deepest ocean trenches. However, the sustained network of coastal and deep-sea observations is unevenly distributed, and has serious gaps. There is therefore an urgent need for the scientific community to agree on the variables that need to be measured (Essential Ocean Variables) and to implement these in a systematic, sustained and globally-distributed manner.

Although various successful marine activities were conducted under earlier GEO Tasks, they were uncoordinated and often overlooked. In short, oceans did not receive the prominence they deserved. Furthermore, the distribution of the tasks in multiple SBAs did not facilitate integration and synergy between elements. The Partnership for Observation of the Global Oceans (POGO) worked hard to have this situation reversed, so that oceans would be accorded their proper place in the GEO arena. In addition, from a communications point of view, it was felt that speaking with a common voice for the oceans would be more effective than fragmented messages.

The creation of the “Oceans and Society: Blue Planet” Task was started by the Partnership for Observation of the Global Oceans (POGO) in 2011, to coordinate all the existing ocean observation programmes within GEO, to add new ones to the GEO portfolio, and to create synergies between them. Over the next two years, the new Task was developed further by POGO, in collaboration with other marine interests, notably the Committee on Earth Observing Satellites (CEOS), the Global Ocean Data Assimilation Experiment (GODAE) OceanView and the Global Ocean Observing System (GOOS). It was introduced formally into the 2012 Work Plan of GEO (as SB:01) to coordinate the marine work under GEO and develop synergies between its various components, with a view to the generation of information and services for societal benefit. A related goal was to raise awareness of the societal importance of observing the ocean, both in situ as well by remote sensing.

10. Need for action

Although progress has been made, there is much more work to be done to galvanise the ocean observing community, to highlight the importance of the ocean observations for policymakers and for society-at-large, and to bring products and services to users that are tailored to their needs.

As stated by the European Space Agency (ESA), “What is needed now, that GEOSS will help achieve, is to integrate the outputs from these various marine monitoring and observation efforts into a cohesive system of systems which will enable researchers, resource managers and policy makers to rapidly assess what is known about a particular marine region.”

Blue Planet is the ideal facilitator to enhance the coordination among the different global initiatives relevant to ocean observations and is also the ideal place to identify and reach actual end users and jointly work with them to understand and address their needs. We believe Blue Planet, through GEO, provides the right framework for creating synergies among different groups and, most importantly, linking them with policy makers.

11. User engagement

In its new phase, the Blue Planet Initiative will have a stronger focus on user engagement and will facilitate the two-way communication between data and information providers and various user communities, by 1) identifying the users for different types and sources of data and information, (2) actively seeking their feedback on what they need and how and in what format it should be delivered to them, and (3) sharing information, advice and best practices on user engagement within the Blue Planet community. This coordination and advisory role will be taken on by a dedicated User Engagement group/component within the new structure.

Current examples of user engagement:

- MyOcean regularly engages with its users for information, training and feedback
- User workshops, eg. MyOcean User Workshops, Bluelink Use Workshops

Intermediate end users:

- scientists: climate, ocean physics, chemistry, biology and ecosystems
- ocean synthesis and forecast systems
- seasonal and longer-term climate forecasts and projections

Ultimate end users:

- Civil protection authorities
- Regulators
- Industry
- IPCC/UNFCCC
- Climate services
- IPBES/CBD
- World Ocean Assessment
- Sustainable Development Goals

12. Previous development and results

- Blue Planet White Paper (2013)
- "Oceans and Society: Blue Planet" book (2014)
- Report from Blue Planet Kick-Off Symposium 19-21 November 2012, Ilhabela, Brazil
- Video prepared for 10th GEO Plenary and Ministerial Summit, outlining importance of Earth Observations for society, particularly in the areas of water access, food security, disaster management and renewable energy.
- 2nd Blue Planet Symposium, 27-29 May 2015, Cairns, Australia

13. Partners

International organisations:

- Partnership for Observation of the Global Oceans (POGO)
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- Global Ocean Observing System (GOOS) of the Intergovernmental Oceanographic Commission (IOC)
- Committee on Earth Observation Satellites (CEOS)
- Global Ocean Data Assimilation Experiment (GODAE) OceanView
- Coastal Zone Community of Practice (CZCP)
- The Institute of Electrical and Electronics Engineers (IEEE)

Regional organisations:

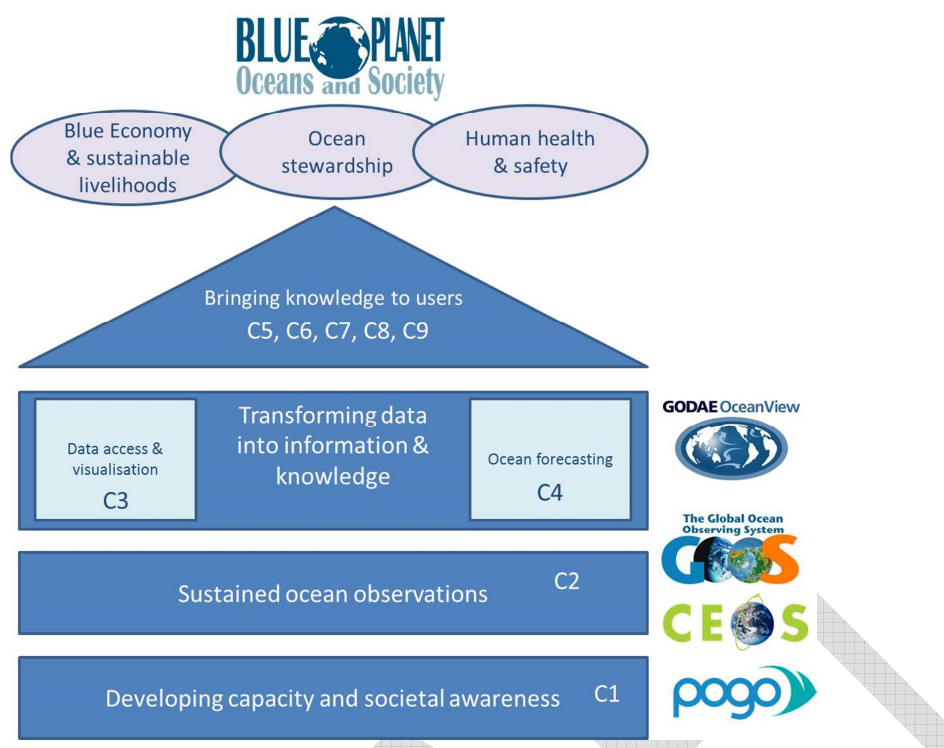
- European Space Agency (ESA) –ESRIN
- EUMETSAT
- European Commission (EC)

National institutes:

- Plymouth Marine Laboratory (PML)
- National Oceanic and Atmospheric Administration (NOAA)
- Department of Marine and Coastal Sciences (Rutgers, USA)
- Stevens Institute of Technology (USA)
- Consejo Superior de Investigaciones Científicas (CSIC) [ss1]
- Japan Agency for Marine-Earth Science and Technology (JAMSTEC) Japan Aerospace Exploration Agency (JAXA)
- Commonwealth Scientific and Industrial Research Organisation (CSIRO)
- and other POGO member institutes (<http://ocean-partners.org/members>).

14. Activities description

Blue Planet seeks to create an end-to-end service that (1) builds the capacity required for ocean observations, (2) collects data from observations, (3) manages the data and makes them widely available, (4) transforms the data into information, products and services to be used by a variety of stakeholders for the benefit of society, as shown in Figure 1. This requires a close collaboration between the different partners contributing to Blue Planet. In particular, POGO, IODE and SCOR play a significant role in developing the capacity required to expand ocean observations worldwide. GOOS and POGO are responsible for a large fraction of the deployment and coordination of observing systems in the open ocean; CEOS is responsible for coordination of global space-based observation of ocean and coastal zones across 31 space agencies; and CZCP focusses on the coastal zone. GODAE Ocean View coordinates the ocean forecasting efforts. A number of programs are involved in the “bringing knowledge to users” section of the diagram, although no single organization has emerged so far to lead and coordinate these efforts. The post-2015 phase of Blue Planet will focus strongly on this aspect, which is central to its objectives.



C1. Developing capacity and societal awareness

The main purpose of this component is to maintain, develop and expand capacity-building in the field of ocean observations. It is initiated by first identifying deficiencies in knowledge and skills, and then determining efficient and effective approaches to address these gaps. The principal outcome will be a larger pool of trained personnel, more representative of the world scale of the demand for such personnel, and more highly trained in the collection and interpretation of ocean data, both in situ and remotely sensed.

Because the ocean transcends national boundaries, and because it is so vast and challenging to access, oceanographic research requires international collaboration by its very nature. Furthermore, capacity building requires at the very least two-way interaction between developing and developed countries, for example through exchange of personnel, knowledge and expertise between countries. Such exchanges are facilitated by international organisations such as POGO, IOC and the Scientific Committee on Oceanic Research (SCOR). Capacity building can be most effective through the participation of developing countries in research projects run in collaboration with developed countries. Ultimately, if capacity building is truly successful, developing nations will become more integrated and active in international networks, such as those named above.

International organisations and programmes such as IOC, SCOR, POGO and others work together to ensure that capacity building is carried out in an integrated manner, avoiding duplication of effort. For example, POGO and SCOR collaborate to deliver a Fellowship Programme, and the IOC's International Oceanographic Data and Information Exchange (IODE) provides training in data management at the Centre of Excellence in Observational Oceanography that is run by POGO in partnership with the Nippon Foundation. The three organisations meet regularly to discuss a common strategy, identify needs and plan new activities, such as, for example, the setting up of the Ocean Summer Schools web portal in 2011 (www.oceansummerschools.org).

The Group on Earth Observations (GEO) also has a strong mandate for capacity building with

particular emphasis on societal benefits. Examples include ChloroGIN and SAFARI that both came into being largely through GEO initiatives. ChloroGIN aims to promote in situ measurement of chlorophyll in combination with satellite-derived estimates and associated products to facilitate assessment of marine ecosystems for the benefit of society.

Specific activities will include:

- Short training courses (NF-POGO, IOC, IODE)
- Visiting-scientist fellowships (POGO-SCOR, AtlantOS)
- Visiting professorships (SCOR, SCAR)
- Cruise-participation fellowships (AWI/NF-POGO, SMART)
- A Centre of Excellence in Ocean Observations (currently located at the Alfred Wegener Institute in Germany) and associated Regional Training Programme
- A global network of Regional Training Centres (IODÉ)
- A global network of alumni conducting regional, collaborative research projects with a societal benefit focus
- An on-line platform for distance learning (Ocean Teacher Global Academy, IODE).

GEO is dedicated to demonstrating the societal benefits of Earth Observations. Blue Planet supports this ambition for the ocean observing realm. The Blue Planet Component on “Developing capacity and societal awareness” will help the community to improve its communication efforts, and to ensure that a coherent message is being sent out from the Blue Planet to the rest of the world. This will build on existing efforts in marine science communication, outreach and ocean literacy. Connections will be made with international and regional initiatives such as the National Marine Educators Association (NMEA) in the USA, the European Marine Science Educators’ Association (EMSEA), the newly formed Asian Marine Educators Association (AMEA), the Trans-Atlantic Ocean Literacy initiative and others. Much of this work in connecting marine science communicators and educators is being carried out through the umbrella initiative Ocean Communicators United, which is a community of practice for individuals from research institutions and international organisations who are involved in marine science communication and outreach.

Specific activities will include:

- Marine science communication conferences (EMSEA, NMEA, AMEA, GOSE, TOL, etc)
- Ocean Communicators United quarterly video-conferences
- Marine science communication webinars
- Outreach activities in developing countries (NANO-Outreach)
- Citizen science projects
- Production of videos and brochures on ocean observations.

C2. Sustained ocean observations

The overall goal of this component is to deliver a sustained ocean observing system meeting societal and scientific goals. Building on the basis of Member State and institutional contributions coordinated through the IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS), the Joint WMO-IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) Observations Programme Area, the IOC International Oceanographic Data and Information Exchange (IODÉ), the Committee on Earth Observation Satellites (CEOS), and using a Framework for Ocean Observing (doi:10.5270/OceanObs09-FOO), expected achievements are:

- Sustained availability of satellite and in situ data streams of Essential Ocean Variables focused on climate and weather
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- Definition of observing requirements for biogeochemical Essential Ocean Variables based on societal benefit for climate and understanding ocean health, and their better integration in a global observing system,
- In cooperation with GEO BON, definition of observing requirements for biological and ecosystems Essential Ocean Variables for sustaining a healthy and productive ocean, with focus on productivity, biodiversity, ecosystem services, and the human footprint on the ocean,
- Improved capacity to use and exploit ocean data for global, regional, and local decision-making.

The essential activity is coordination on behalf of and with the appropriate observing system stakeholders, working to build a common system. These stakeholders include IOC Member State governmental agencies, CEOS space agencies, leaders and representatives of the ocean research and observing community such as POGO, leaders of individual in situ observing networks, GOOS Regional Alliances, and representatives of primary output/user communities such as data management activities, ocean forecasters, and ocean assessments.

GOOS Regional Alliances exist in many regions to coordinate regionally-agreed activities that contribute to GOOS as well as regional and national goals. A number of them focus on coastal observations and promote the sharing of data regionally. Their activities are supported by secretariats based at IOC/UNESCO and other locations, which also work on: supporting fundraising efforts; supporting the building of institutional capacity related to GOOS; and overall outreach and communication on GOOS and related activities. The communication is largely aimed at Member States (government representatives) and the scientific community participating in and benefiting from GOOS.

C3. Data access and visualization

The aim of this component is to transform data from existing sources to information, products and services. This will leverage the data collection, collation and delivery of the various ocean observation and modelling activities with a view to the generation of information for societal benefit.

Significant investment has been made in a range of ocean data, modelling and analysis at regional, national and global scales. A key challenge remains, however, in the transformation of data to knowledge. This requires integration of data with social, economic and management data to deliver information to end users from various viewpoints and across a diversity of interests. This component will present data products, information and knowledge to users in ways that are relevant to their interests and to their needs. This will be achieved through the use of modern data interoperability, integration and visualisation methodologies and will leverage the various efforts that are being made in the semantic web and linked open data domains. Most importantly, this will not replace or duplicate existing efforts. This component will work with existing projects and initiatives to value add and integrate, allowing greater data discovery, access and reuse.

Specifically, this component will:

- Network existing regional and international efforts in improving data interoperability and access (e.g. ODIP, IODE)
 - Encourage and facilitate registration of databases within GEOSS
 - Provide a service (e.g. Web-GIS) on the Blue Planet website that summarises what long-term data are available in which locations and provide metadata and links to existing databases/portals
 - Coordinate various initiatives that are making available research cruise information to ensure that efforts are not being duplicated, and broaden the input to these efforts (e.g. POGO, ODIP,
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JCOMM)

- Create an on-line resource aimed at policy makers and the scientific community that illustrates and provides basic information on the network of organisations, research institutes, programmes and projects that are conducting and/or coordinating ocean observations and research, and how they are contributing to Blue Planet/GEO
- Improve the Blue Planet website in such a way that it guides users from their areas of interest (e.g. oil spills, HABs, fishing...) to sources of data/information that they might want to use.

C4. Ocean forecasting

The long-term objective of this component is to raise capability of ocean forecasting and analysis; in support of the safety of life and property at sea and in coastal areas, risk management for ocean-based economic / commercial / industrial activities, the prevention and control of marine pollution, sustaining healthy and productive oceans, and developing integrated coastal area management services. In a wider context, the pursuit of this component linked with that of C5.

Scientific and technical coordination for this component is managed by the GODAE OceanView Science Team (GOVST), whose objectives are to define, monitor, and promote actions aimed at co-ordinating and integrating research associated with multi-scale and multidisciplinary ocean analysis and forecasting systems, thus enhancing the value of these systems for research and applications. The science team provides international coordination and leadership in:

- Consolidation and improvement of global and regional analysis and forecasting systems (physics);
- Progressive development and scientific testing of the next generation of ocean analysis and forecasting systems, covering bio-geochemical and eco-systems as well as physical oceanography, and extending from the open ocean into the shelf sea and coastal waters;
- Exploitation of this capability in other applications (such as weather forecasting, seasonal and decadal prediction, climate change detection and its coastal impacts); and
- Assessment of the contribution of the various components of the observing system and scientific guidance for improved design and implementation of the ocean observing system.

Building on the success of GODAE and continuous development through GOV, operational ocean forecast capability has now been implemented in a number of countries. Such developments have allowed significant improvement of the oceanographic and meteocean services, to the point of reliable operational services, such as meteorological services. The Services and Forecasting Systems Programme Area (SFSPA) of JCOMM coordinate global efforts to implement operational ocean forecasting services, through; 1) developing technical guidance for modelling and data assimilation; 2) improved data flow between real time observations, new observations and forecasting and analysis systems; 3) enhanced coordination of review requirements as well as performance verification for operational forecasting systems and services; 4) coordination of the development of coupled ocean-atmosphere forecasting systems and climate coupled models as needed. The operational services are developed and provided by those national and regional operational centres that are capable of operating and maintaining ocean modelling and forecasting systems.

C5. Healthy ecosystems and food security

The overall goal of this component is to provide sustained, integrated and globally-complete observations and knowledge of the ocean ecosystem to assess and anticipate possible changes in its structure and function that may result from environmental perturbations such as climate change, or from human activities such as overfishing of wild-caught fisheries, aquaculture and/or land-based pollution.

Specific activities will include:

- Establish a global coastal network of observations and modeling that target sentinel and reference sites for rapid detection of changes in ecosystem states caused by land-based sources of pollution, fishing and climate change.
- Develop and sustain the Chlorophyll Global Integrated Network (ChloroGIN) project which coordinates in situ measurement of chlorophyll and related bio-optical properties of the ocean, in combination with satellite derived estimates of the same.
- Develop the Societal Applications in Fisheries and Aquaculture of Remotely-sensed Imagery (SAFARI) project, which aims to accelerate the assimilation of Earth Observation (EO) into fisheries and aquaculture research and ecosystem-based, sustainable fisheries and aquaculture management on a global scale. This will be accomplished by facilitating the application of rapidly evolving satellite technology to fisheries and aquaculture management questions.
- Develop and expand global plankton biodiversity monitoring, building upon 80 years of phytoplankton and zooplankton biodiversity data obtained in the North Atlantic by means of the “Continuous Plankton Recorder” survey and the development of the Global Alliance of CPR Surveys (GACS).
- Implement the Science Plan for the “International Quiet Ocean Experiment” to quantify global ocean sound (natural/anthropogenic) and measure the effects of changing sound exposure on marine life. Implement essential acoustical applications within existing ocean observing systems.
- Develop appropriate and consistent methods and implement a sustainable program for the monitoring of the extent and condition of mangrove forests and the quantification of societal benefits that they provide.
- Work with the Marine component of GEOBON to promote and establish a Marine Biodiversity Observation Network (MBON). This will involve support for a “Pole to Pole” MBON effort that envisions marine biodiversity observation transects from the Arctic to Antarctica. A pilot may be built by organizing various existing observing programs along both the Atlantic and the Pacific coasts of the Americas, as a model for other similar latitudinal transects of observing programs. The goal is to establish the infrastructure and partnerships needed to realize the benefits of an international MBON. The MBON Pole to Pole pilot requires strengthening the relationship between GEO MBON and Blue Planet (including GOOS-Biology, ChloroGIN and Antares).

C6. Services for the coastal zone

The goal of this component is to improve access to environmental intelligence for all stakeholders in the coastal zone, and to support deliberations on coastal zone management as well as decision making related to the sustainable development of the coastal zone. It will facilitate adaptive, ecosystem-based approaches (EBAs) to sustainable development, including marine spatial planning and management. Sustainable development depends on the continued provision of ecosystem goods and services valued by society. EBAs require the sustained provision of multidisciplinary data (biogeochemical and ecological as well as geophysical) and information on ecosystems states, especially in the coastal zone where goods and services are most in demand.

High and immediate priorities for GEOSS are services that inform about coastal hazards, including but not limited to improved forecasts of local coastal sea-level rise and associated increases in coastal inundation that may be exacerbated by increases in the frequency of extreme weather. Likewise, services focusing on the state and potential degradation of coastal ecosystems, including loss and

modification of crucial habitats such as mangroves, coral reefs and estuaries, as well as the state of other environmental conditions, including water quality (e.g., coastal eutrophication and hypoxia; human exposure to waterborne pathogens; harmful algal blooms), are key contributions needed to provide accurate and timely support for decision making for sustainable coasts.

Specific activities include:

Develop a global coastal zone information system:

- A global cyber-infrastructure that will provide access to available information on coastal zones and facilitate the collection of new information through crowd-sourcing and citizen-science
- Develop the concept for a comprehensive information system that links a living knowledge base with a virtual stakeholder table and that can enable informed, participatory governance and decision making. The outcome of this activity will be a community-vetted white paper describing a general concept for a future information system, with specific focus on governance and decision making in the coastal zone.
- Implement the information system and populate the system for selected test-beds in North America, Africa, and potentially other locations. As a result of this activity, a global cyberinfrastructure will provide a basis for communities in coastal zones to populate the system with their information and to use the system in their deliberations.
- Utilize the information system for deliberations on a few selected topics such as planning for sea level rise, disaster risk reduction for extreme weather events, and identification of emerging public health risks to demonstrate the usability and value-added of the information system in participatory governance. This activity will result in assessment reports that evaluate to what extent the information system enables informed participatory governance.

Assess the observational requirements for decadal forecasts of coastal local sea-level variation and develop a demonstrator forecasting service:

- Develop and implement a system-of-systems model for local sea level (SoSLSL) that can be used to study the predictability of local sea level (LSL) at intra-annual to multi-decadal time scales. The outcome of this activity will be an open-source modeling framework for LSL that initially will be fully detailed for a few study cases, but can easily be set up for any coastal zone.
- Use the SoSLSL to assess predictability of LSL depending on data availability. Identify Essential Sea Level Variables, particularly those that would serve the target to ensure early warnings in case of abrupt sea level rise, and define observation specifications for these variables. This activity will have two main outcomes: (1) an assessment of the predictability of interannual to multidecadal LSL and (2) Essential Sea Level Variables (ESLVs) and specification for their observations.
- Based on SoSLSL, implement a demonstrator that allows both, predictions of LSL within the range of predictability and queries for “What if?” questions to determine LSL trajectories under assumed scenarios for climate change and climate change impacts. The demonstrator will be available to decision makers and provide a novel way to assess the risk associated with LSL rise.

Assess user needs and observational requirements for coastal water quality:

- Using the GEOSS User Requirements Registry, identify indicators and best practices for coastal water quality, and implement a monitoring service pilot for coastal water quality; disseminate information particularly to under-served communities;
-

- Use the proposed Socio-Economic and Environmental Information Needs Knowledge Base (SEE IN KB) to capture water quality goals, targets, indicators and essential variables in deliberations with the relevant user communities. The main outcome of this activity will be a set of Essential Water Quality Variables (EWQVs) and observation specification for these variables with particular focus on the information needs in the coastal zone;
 - Develop a demonstrator for a coastal water quality service based on observations of the EWQVs with the specific goal to make the information available to underrepresented communities. The demonstrator will allow us to assess data gaps and it will help to assess to what extent the information is of value to societal users, including underrepresented groups.
- C7. Ocean climate and carbon

The goal of the Ocean Climate and Carbon component of Blue Planet is to advance the development and implementation of the marine component of the observation systems for both Climate and Carbon, and in particular to address the issues and synergies across the climate-carbon interface for the marine environment. There exist substantive and relevant programmes and coordinating mechanisms addressing climate and carbon observations for the oceans. The added-value of this Blue Planet component will be to:

- Provide additional exposure and visibility to these programmes, where possible making a concerted effort to link to relevant policies and policy frameworks;
- Identify additional synergies between the programmes; and
- Provide additional linkages with complementary activities both within Blue Planet as well as inside and outside of the GEO community.

For both climate and carbon there are concrete requirements on the basis of which the relevant activities will be developed and monitored, i.e.

- The ocean Essential Climate Variables of the Global Climate Observing System;
- The observing system recommendations of the GEO Carbon Strategy report, which makes specific recommendations for the ocean domain
- The ocean ECVs of the CEOS Working Group on Climate and definition of a Climate Monitoring Architecture (joint CEOS-CGMS-WMO activity)
- The response of the CEOS Carbon Task Force to the GEO Carbon Strategy in which the chapter on oceans evidences critical implementation requirements
- The in-situ requirements outlined for the Ocean domain in the GCOS Implementation Plan.
- The biogeochemical Essential Ocean Variables (EOVs) defined by the International Ocean Carbon Coordination Project (IOCCP).

Initial efforts on this component of Blue Planet will largely address the interfaces between many of the subject areas and communities described above, including:

- Addressing the interface between the relevant Climate and Carbon communities for ocean applications;
 - Addressing the interface between activities coordinating the space-based and in-situ observations for both climate and carbon;
 - Ensuring that the sustained observation capacity for both climate and carbon is continuously and appropriately motivated, to the appropriate funding bodies, and that this is done through a consistent framework such as that proposed for the Climate Monitoring Architecture;
 - Ensuring that adequate integration with the other relevant Blue Planet components is developed so that an observational basis is available for periodic multi-pressure assessments, to be performed for the global oceans; and
 - Developing an information system framework/portal comprising observational data for ocean climate and carbon from both satellite and in-situ observations.
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C8. Integrated maritime services

Our oceans have historically been instrumental in the transport of goods and people. Globalisation has led to a constant increase in the global merchant fleet, whereby nowadays approximately 90% of the global trade is carried by sea. Industrial activities related to the exploitation of ocean resources are also on the rise. In addition the melting of the Polar caps due to climate change has opened up several new routes to commercial shipping, sea transportation, off-shore operations, and fisheries, making the timely information on sea ice essential for all types of marine operations in Polar Regions. All of these factors call for the need to have a set of services for monitoring our oceans for environmental, safety and security purposes.

Integrated Maritime Services (IMS) provide reliable information on what happens at sea in real time from a large variety of data sources. Earth Observation remote sensing (plus in-situ and modelling) ocean data-sets can be brought together with vessel/ship position information and other user/domain specific datasets, to provide an all-inclusive, real-time and correlated awareness of the maritime domain.

There is an extended community of BPI IMS users, as the scope of the services to be provided is envisioned to include a number of different and varied domains. These comprise of: marine resource exploration (e.g. oil and gas), maritime commerce and transportation (e.g. monitoring of vessels and shipping routes), maritime operations (e.g. port and-offshore facilities), enforcement (e.g. anti-piracy and illegal ship traffic monitoring), siting and operation of energy facilities (e.g. renewable energy sources such as wind farms), environmental hazards (e.g. oil spills and storm damage assessment), safety (e.g. Search and Rescue operations) and fisheries (monitoring of fisheries activities, zones and campaigns and stocks).

The Earth Observation (EO) data to be provided under the auspices of GEOSS provides significant value to Integrated Maritime Services (IMS). Needed capabilities include: real-time monitoring (e.g. tides and water level), short-term forecasts (e.g. winds and currents), and climate predictions (e.g. sea level change, diminishing sea ice in the Arctic). Crucial EO data include - *inter-alia* - satellite measurements of wind fields (i.e. scatterometry, synthetic aperture radar), sea level and currents (i.e. HF radar, altimetry), and high resolution imagery of ships, spills et al. (e.g. synthetic aperture radar; high-resolution optical imagery). In addition Remotely Piloted Aircraft Systems (RPAS or Unmanned Aircraft Vehicles) are an emerging cost-effective technological platform, ideally suited to provide data and information on the large scale needed for the IMS.

Particular areas of interest include coastal zones, high density traffic area, Polar Regions (particularly in the Arctic and sub-Arctic), and other environmentally sensitive areas (e.g. coral reefs, fisheries habitats).

C9. User engagement

This is a cross-cutting component that will benefit the other components and the Blue Planet and GEO communities at large, by providing a forum for exchange of experience and best practices in user engagement.

8. Planning, milestones and deliverables

- A detailed Implementation Plan for Blue Planet to be delivered by the end of 2016.
 - A 3rd Blue Planet Symposium to be held in the USA in September 2016.
 - An improved Blue Planet website that guides users from their areas of interest (e.g. oil spills, HABs, fishing...) to sources of data/information that they might want to use.
-

- A framework mapping of the Global Ocean Observing System, with traceable links between societal drivers, the scientific context, Essential Ocean Variables, observing elements, data management
- Continuously updated quality-controlled data streams of ocean physical, chemical, and biological Essential Ocean Variables contributed to the GEOSS portal, many under GEOSS Data CORE conditions:
 - o Volunteer Observing Ship VOS marine meteorology through iCOADS (JCOMM)
 - o Ship of Opportunity Programme SOOP XBT network temperature profiles through GTSP (JCOMM)
 - o GLOSS tide gauge network - monthly and annual sea level data through the PSMSL (JCOMM)
 - o Data Buoy Cooperation Panel DBCP data from ocean surface drifters and the tropical moored buoy networks
 - o Argo profiling floats measuring temperature, salinity, and a growing number of biogeochemical and bio-optical variables
 - o GO-SHIP repeat hydrographic measurements of the ocean interior: physics and carbon variables
 - o OceanSITES moored buoys and transport time series: physics and biogeochemistry variables
 - o biological taxa from the Ocean Biogeographic Information System (OBIS)
 - o indicators for marine assessment produced under the EC FP7 GEOWOW and GEF Transboundary Waters Assessment Programme
- Publication of guidelines for best practices and standards in oceanographic observations;
- Technical guidance for modelling and data assimilation;
- Improved data flow between real time observations, new observations and forecasting and analysis systems;
- Increased number of marine databases registered within GEOSS;
- Coordinated databases providing research cruise information and a greater number of entries within these;
 - A Coastal Zone Information System;
 - A demonstrator forecasting service for coastal local sea-level variation
 - A monitoring service pilot for coastal water quality, disseminating information particularly to under-served communities;
- Continue and expand the ChloroGIN suite of observing stations;
- Monographs of the International Ocean Colour Coordinating Group.

Capacity Building

- Course material on access to available ocean data and forecast products and the development of locally-relevant services
 - Catalogue of GOOS Regional Alliance observing and modeling capabilities
 - Fifth In-Region Western Indian Ocean Capacity Building Workshop (2014)
 - African summer school on Application of Ocean and Coastal Data and Modelling Products (2014)
 - Surveys leading to GOOS Regional Alliance inventory of observing and modeling capabilities (2014)
 - Train up to 50 scholars in ocean observations at the NF-POGO Centre of Excellence
 - Train up to 50 scholars in the POGO-SCOR Fellowship programme
-

- Establish Phase 2 of the NF-POGO Centre of Excellence in Ocean Observations

Links with other Initiatives within the GEO Work Programme:

GEOBON:

Marine biodiversity is a key indicator of ocean health and is a critical factor to sustain the well-being of humanity. An integrated picture of what is happening to marine biodiversity will provide marine resource managers and policymakers with tools to address threats ranging from invasive species to climate change. A Marine Biodiversity Observation Network, or MBON, is being formulated to address these needs. MBON is a cross-cutting concept that links Blue Planet and GEO BON. It may be envisioned as one of the pillars of GEO BON which requires the observing infrastructure and human capacity developed under Blue Planet.

Blue Planet exercises the link between the various marine initiatives within GEO and develops synergies between them, and the MBON effort does the same for marine biodiversity. The GEOBON WG5 is developing an overarching MBON concept that links the Blue Planet mission of raising public awareness of the role of the oceans in the Earth system, of their impacts on humankind, and of the societal benefits of ocean observations, with the GEO BON goal of presenting a full picture of what is happening to biological diversity. The MBON concept is proposed to address the needs for monitoring marine biodiversity of countries in different regions over the next decade or longer. Blue Planet supports a “Pole to Pole” MBON effort that envisions marine biodiversity observation transects from the Arctic to Antarctica. A pilot may be built by organizing various existing observing programs along both the Atlantic and the Pacific coasts of the Americas, as a model for other similar latitudinal transects of observing programs. The goal is to establish the infrastructure and partnerships needed to realize the benefits of an international MBON. The MBON Pole to Pole pilot requires strengthening the relationship between GEO MBON and Blue Planet (including GOOS-Biology, ChloroGIN and Antares).

Others:

- Carbon Flagship: Blue Planet, and in particular its Component on Ocean carbon and Climate, will work closely with the new GEO Carbon Flagship;
- Water Quality: Blue Planet, and in particular its Component on Services for the Coastal Zone, will work closely with the GEO Water Quality Community Activity.
- Foundational Tasks: in addition, Blue Planet will contribute to a number of Foundational Tasks, including Knowledge Base development (GD-07), Capacity Building coordination (CD-01) and Systematic determination of user needs and observational gaps (GD-06).

10. Data policy (sharing and management)

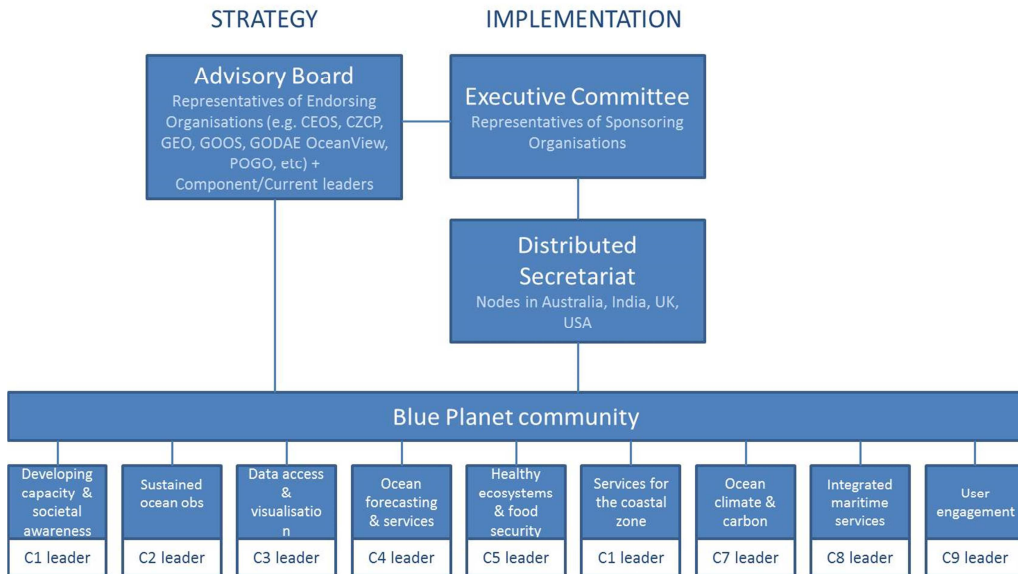
- Recommendations for improving oceanographic and meteorological institution data management systems
- Marine assessment data portal with access to indicators and analysis code on ocean state and threats to sustainability
- JCOMM assessment of observing networks data architecture and future Task Team on improving the data architecture
- IODE and OBIS meetings and capacity development activities including through OceanTeacher
- GEOSS Interoperability for Weather Ocean and Water (GEOWOW) EC FP7 project: developing data infrastructure for marine assessment indicators

Datasets contributed to the GEOSS Data CORE:

- GTSP
- a subset of data from PSMSL
- data from all surface drifters
- Argo temperature and salinity
- OBIS
- the majority of GEOWOW/TWAP indicators

10. Management arrangements

The proposed governance structure is depicted in Figure 2.



Roles and responsibilities:

- **Executive Committee**: Coordinate activities of the 3 nodes and report to GEO (and other relevant bodies); coordinate input to GEO Plenaries and other events; oversee Blue Planet Symposia, publications, etc; represent Blue Planet in international fora when opportunities arise.
- **Advisory Board**: provide guidance on strategic issues and input from/liaison with major Endorsing organisations.
- **Components**: (6 existing + 3 possible new ones); the leaders of these will serve on the Advisory Board and work closely with the Secretariat and Executive Committee to deliver on the Blue Planet Implementation Plan.

Proposed procedures:

- The Sponsoring Organisations will be able to nominate one representative to the Executive Committee.
- The Endorsing Organisations will be able to nominate one representative to the Advisory Board.

- The Components will be inclusive and open to community contributions; leaders will be points of contact for reporting to the Advisory Board and ExCom, who will report to GEO.
- The members of the different committees should rotate every 2-3 years.
- The leadership of the Components should rotate between individuals and/or between organisations
- Need to ensure regional balance.

11. Monitoring and evaluation approach and reporting

Monitoring and evaluation will be coordinated through the Blue Planet distributed Secretariats, in cooperation with the GEO Secretariat liaison.

12. Committed Resources and annual budget(s)

Project

- GMES marine services (MyOcean II)
- Deep Ocean Observing Strategy
- Tropical Pacific Observing System 2020 Project
- AtlantOS
- International Quiet Ocean Experiment
- The NSF-Funded RCN on Ocean Observations

In-kind (human resources)

- For overall coordination:
 - Blue Planet Secretariats hosted by NOAA and CSIRO
 - POGO Secretariat
- CEOS Secretariat(s) - CEOS Blue Planet Expert
- CEOS Working Groups
- Secretariat of the GOOS Project Office hosted by IOC (Paris, France)
- OOPC Secretariat (GCOS, Geneva, Switzerland)
- IOCCP Secretariat (IO PAS, Sopot, Poland)
- JCOMMOPS (Toulouse and Brest, France)
- IODE/OBIS Secretariat (Oostende, Belgium)
- In kind support by USA (NASA) and Australia for GOOS
- IOC field offices: Nairobi, Bangkok, Perth, Kingston
- Human resources made available by IEEE.

Financial

- IOC regular annual budget support for GOOS, IODE, JCOMM
- Extra-budgetary voluntary financial contributions from many Member States
- Investment in Capacity Building by POGO, approx \$500K per annum, courtesy of the Nippon Foundation
- Investment in Capacity Building by IODE, courtesy of the Government of Flanders.

Other

- An estimated USD 1-2 billion in direct support to ocean observations, data management and analysis activities, including contributions from space and in situ observations, from a broad variety of countries (national and institutional funding).
- CEOS Virtual Constellations.

13. Transition to operational phase

Many of the observing systems described above are already “operational”, but more work and investment is needed to achieve a system that is truly global and fit-for-purpose.

DRAFT

GI-09	Global Wildfire Information System	- Detailed description

Group on Earth Observations (GEO) Initiative for the establishment of a
Global Wildfire Information System (GWIS)
Summary Implementation Plan
August 20, 2015

Coordinator: Jesús San-Miguel-Ayanz
European Commission Joint Research Centre
Institute for Environment and Sustainability
Ispra, Italy

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1. EXECUTIVE SUMMARY (2 PAGES)

Wildfires represent a major risk in many countries, contributing to deforestation and land degradation. Currently, there is an increasing amount of spatially explicit data and information on wildfires being collected at the national and global levels on different aspects of the fire cycle. Additionally, a number of wildfire-related information systems have been developed and disseminate wildfire information from satellite and in-situ observations at different scales and resolutions. Often, due to the differences in definitions, data collection methods and terminology, the information among different systems is not harmonized and therefore not comparable. The Global Wildfire Information System initiative of GEO aims at linking various national, global and regional systems to make complementary spatial Earth Observation data more readily available, through a harmonized global wildfire information system of systems. The task will build on the ongoing activities of the GTOS GOFC-GOLD Fire Implementation Team, the associated Regional Networks, complementing existing, related activities that are on-going around the world, with respect to wildfire information gathering.

2. INTRODUCTION

Earth observations (Eos) and information, derived both from space and surface networks, have demonstrated not only their maturity, but their critical role in supporting first responders and risk managers by providing effective tools to rapidly map natural hazards and assess impacts. GEO through its 160-plus partners comprised of 90 Governments, UN Organizations including UNISDR, and international scientific organizations, is working to expand the use of satellite imagery and surface data for managing risks posed by fires, floods, earthquakes and other hazards.

The purpose of GEO is to achieve comprehensive, coordinated and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system. GEO will meet the need for timely, quality long-term global information as a basis for sound decision-making, and will enhance delivery of benefits to society. Crisis management faced by governments due to high-frequency natural and human-induced extreme events requires EO capacities that generally cannot be provided by one country alone; effective response requires regional/international collaboration and coordination.

GEOS's signature initiative, the Global Earth Observation System of Systems (GEOSS) represents the collective effort of hundreds of governments and organizations, and thousands of individuals, to monitor the Earth system, share and exchange Earth system data, and deliver useful information to society. GEOSS has enabled many countries to access information and thereby provide essential services to address challenges which otherwise would not have been met.

The ensemble of multisource data for deriving new data and information is specifically true in the case wildfires, in which a series of spatially explicit information from space and ground sources is integrated to provide information, supporting fire managers.

Wildfires continue to present a major risk in many countries. It is estimated that nearly 400 Million ha of natural areas are burnt every year causing large environmental and economic damages and contributing to the increase of carbon emissions worldwide. Wildfires have seasonal and regional patterns, which are reflected in different fire regimes across the globe. National and supranational organizations have established systems aiming at providing early warning for large fire events to minimize the effects of catastrophic fires. With the policies of fire exclusion in many areas of the world and the expansion of urban settlements in natural areas fire regimes have been modified and the number of critical events has increased in the

last decades. Although fire information exists at national and often at regional level, comprehensive and harmonized information at the global level is still lacking.

3. NEED FOR ACTION

There is an increasing amount of spatially explicit data and information on Wildfires being collected at the national and global levels. A number of wildfire-related information systems have been developed and disseminate wildfire information from satellite and in-situ observations. Currently, the plethora of satellite imagery of multiple spatial resolution and frequency in acquisition would permit having accurate information on wildfires at the global level in near real time. However, the lack of an international initiative to pull resources and information together did not exist.

GEO provides a unique platform for international cooperation. In the area of wildfires, the Global Wildfire Information System initiative aims at bringing together existing information sources at regional and national level in order to have a comprehensive view and evaluation of fire regimes and fire effects at global level.

This GEO Initiative is aimed at linking various national, global and regional systems to make complementary spatial Earth Observation data more readily available, through a harmonized global wildfire information system of systems. The task will build on the ongoing activities of the European Forest Fire Information System (EFFIS), the GTOS GOFC-GOLD Fire Implementation Team, the associated Regional Networks, complementing existing, related activities that are on going around the world, with respect to wildfire information gathering.

4. USER ENGAGEMENT

The Global Wildfire Information System initiative builds on two major global and regional initiatives. At the global level GWIS builds on the ongoing activities of the GTOS GOFC-GOLD Fire Implementation Team, which includes a set of associated Regional Networks aiming at improving fire management at regional and local levels. At the regional level, GWIS builds on the European Commission activities around the European Wildfire Information System, which currently provides information for the pan-European territory, Middle East and North Africa, and its associated network of 43 countries in that region.

GWIS will provide reliable and up to date information on wildfires increasing prevention and preparedness in the region/countries and enhancing international collaboration at regional and global levels. In countries that currently do not have a wildfire information system, GWIS will fill this gap and help countries engage in international collaboration. For countries and regions where wildfire information systems exist, GWIS will provide a complementary and independent source of harmonized information adding to the national/regional information sources. The system will thus provide a useful tool for developing countries supporting activities of wildfire prevention, increasing preparedness and supporting national and local authorities in their task related fire management and fire fighting.

5. PREVIOUS DEVELOPMENT AND RESULTS

The proposed GWIS follows from the work on Task DI-01-C4, which proposed to enter the GEO Work Program 2012-2015 in January 2015 and was approved in March 2015. Since then a number of actions have regarding the development of GWIS have taken place: Workshops/Meetings organized in: The Netherlands - March 2015 and in Germany (Berlin) –

May 2015. Contacts were established with regional data providers and networks, including fire network south and Central America (CONABIO), USA, Europe (Spain, Netherlands, and UK), and Russia.

A prototype system for the Global Wildfire Information System is currently under development and initially available within the EFFIS web services at: <http://forest.jrc.ec.europa.eu/effis/applications/global-viewer/>

6. PARTNERS

GEO Partners from the previous Task DI-01-C4

The main partners, in addition to the regional networks of national/local fire managers, are those organizations that are currently developing and providing information on wildfires at regional/national level.

As mentioned above, the GWIS builds on existing global and regional initiatives of GTOS and the European Commission, regarding GOFC-GOLD Fire Implementation Team and EFFIS, respectively. Additional key partners in the process are regional/national data providers of wildfire information such as the USA (USFS WFAS), South Africa (AFIS), Canada (CWFIS) and other countries/regions of the world where information is available but not easily accessible like China and Russia. The system builds also on wildfire initiatives that deal with sectorial aspects of wildfire effects, such as the fire emissions community, which provides information through GFED and MACC systems.

7. ACTIVITIES DESCRIPTION

1. Establish and further develop a prototype Global Wildfire Information System (GWIS) providing harmonized fire information (e.g. fire danger) – building on initial activities of the European Commission in the European Forest Fire Information System and the Global Observation of Forest Cover – Global Observation of Land Dynamics Fire Implementation Team (GOFC-GOLD Fire IT).
 2. Promote the networking of major national and regional fire information providers by organizing an annual workshop convening key international organizations and initiatives (e.g. GOFC-GOLD Fire IT) and national and regional providers, e.g. Australia, Canada, China, Central and South America and South Africa.
 3. Establish operational links and, if possible, arrangement with other wildfire communities dealing with wildfire aspects at global scale (e.g. burnt area assessment, emission estimation).
 4. Further develop the GWIS by integrating and harmonizing as much as possible regional data wildfire information sources.
 5. Develop, implement and promote the establishment of mechanisms for interoperability and communication among national, regional and global wildfire information systems following OGC standards and guidelines, and the GEOSS Data Sharing Principles.
 6. Coordinate and promote capacity building and training activities in close cooperation with the GOFC-GOLD Fire Implementation Team regional networks and the EFFIS network.
-

8. PLANNING, MILESTONES AND DELIVERABLES

M1 Workshop of GWIS partners – Q4 2016

M2 Consolidated prototype of the GWIS – Q4 2016

9. DATA POLICY (SHARING AND MANAGEMENT)

As mentioned above, GWIS will promote the establishment of mechanisms for interoperability and communication among national, regional and global wildfire information systems following OGC standards and guidelines, and the GEOSS Data Sharing Principles.

10. MANAGEMENT ARRANGEMENTS

No management arrangements are foreseen in the establishment of the GWIS.

11. MONITORING AND EVALUATION APPROACH AND REPORTING

Monitoring and evaluation on the achievements of GWIS will be done at the annual workshop organized with the partners of this Initiative. Reporting will be done by the Coordinator of the Initiative following the GEO guidelines.

12. COMMITTED RESOURCES AND ANNUAL BUDGET(S)

GWIS is supported by the European Commission Joint Research Centre activities on forest fire monitoring in the context of the extension of the European Forest Fire Information System to the global scale. The contribution of the EC Joint Research Centre includes the development and maintenance of a prototype Global Wildfire Information System

The participants in the GWIS initiative will provide in kind contribution through their participation in the meetings and teleconferences. Contributors to GWIS will provide support for the editing of documents and reports during the life span of the Initiative. The list of participants and their contribution will be updated along the duration of the project will be updated regularly.

The participants will support the link of their fire information systems to the centralized page of the Global Wildfire Information System. The integration of those systems into GWIS will vary according to the level of interoperability of the individual systems.

The European Commission Joint Research Centre, in the context of its activities within the Copernicus program, foresees the provision of financial resources for the organization of annual workshop. No other specific financial support is provided by any of the Institutions participating in the task.

13. TRANSITION TO OPERATIONAL PHASE

The operational implementation of a global initiative such as the GWIS will require the establishment of some arrangements among the participating organizations, keeping the administrative task to a minimum. The transition to an operational phase will be discussed with the partners in the project in the annual workshops.

The prototype developed in the GEO DI-01-C4 will provide access to global wildfire information in an nearly-operational way throughout the development of the GWIS Initiative.

DRAFT

GI-16	GEO-DARMA = Data Access for Risk Management (new-CEOS)	- Draft Implementation Plan
GI-17a	Global Urban Observation and Information	- Detailed description
GI-17b	Global Human Settlement indicators for post-2015 international frameworks	- Detailed description
GI-19	AmeriGEOSS (new)	- Draft Implementation Plan

GEO-DARMA Preliminary Implementation Plan

Issue v3, 11 August 2015

1 EXECUTIVE SUMMARY

GEO-DARMA aims at addressing priorities of the *Sendai Framework for Disaster Risk Reduction 2015-2030* using Earth observations (EO). GEO-DARMA will facilitate the sustained provision of accurate EO-based risk information products and services to national and local decision-makers in political and socio-economic sectors, to implement disaster risk reduction and resilience measures, during all disaster risk management phases, whenever those products and services require satellite EO combined with other sources of data (in-situ ground observations, socio-economic, model outputs). The ultimate goal is to establish an inclusive, comprehensive process to address local DRR requirements by using EO technologies efficiently. Long-term outcomes of GEO-DARMA are to foster the use of EO data and EO-based risk information by end users and to increase awareness within donor agencies of the promise of EO solutions. EO-related capacity building is a key challenge in many developing countries. GEO-DARMA includes a capacity building component both at the outset, from the project initiators towards early pilot countries, and throughout the project, as knowledge gained in the early phases is transferred between pilot countries and the GEO-DARMA effort is extended from early adopters to other countries in region.

The Partners sought for GEO-DARMA include:

- Representatives from national end user communities, national institutions and agencies
- International and regional stakeholders knowledgeable about regional issues related to disaster risk management, such as relevant UN agencies, GFDRR¹⁰, Development banks...
- EO and non-EO data providers (e.g. Satellite data providers such as CEOS¹¹ Agencies (incl. major space agencies in the world) and commercial satellite operators when possible)
- Providers of risk and other relevant information derived from EO data (e.g. Practitioners such as value added information providers), scientists and researchers

Three phases are foreseen:

	<u>PHASE</u>	<u>DURATION</u>
1	Concept phase	Start at KO, end at KO+18 months at the latest. Might vary from one region to another.
2	Prototyping phase	Start at KO+12 months, end at KO+60 months at the latest. Prototyping might start at different time depending on the project. It is not envisaged to continue the prototyping activities including its operation beyond a period of 4 years. Go/no go decision to determine sustainability and

¹⁰ Global Facility for Disaster Reduction and Recovery (GFDRR)

¹¹ Committee on Earth Observation Satellites - www.ceos.org

implementation of operations.

3 **Operational phase**

On a case by case, might start for a given project at KO+48 months depending on the funding and opportunity to transition the activities from a prototype to an operational system.

2 **INTRODUCTION**

Impacts of disaster events on economic and human lives are increasing every year due to growing urbanization and an increase in the number and severity of weather-extreme events; by 2050, the number of people exposed to storms and earthquakes in large cities could double and by 2100, damages from weather-related hazards may triple. Nine of the ten fastest growing urban mega-cities in the world are in Asia, and most of these are in vulnerable coastal areas.¹²

Until recently, stakeholders involved in disaster risk management (DRM), including space agencies, have focused their efforts mainly on the response phase, immediately after the crisis. The International Charter Space and Major Disasters is one of the most successful initiatives resulting from the coordination among space agencies but it is restricted to the response phase. Independent studies from organisations including the World Bank and the European Commission have indicated that for every \$1 invested in disaster prevention, \$4 to \$7 are saved in disaster response..

Progress in every aspect of Disaster Risk Reduction (DRR) requires strong international collaboration given limited capacities and resources. No single group or organisation can address every aspect of DRR. Disasters are complex problems demanding a collective response. GEO-DARMA¹³ aims at supporting the practical implementation of some critical elements of the *Sendai Framework for Disaster Risk Reduction 2015-2030* adopted at the 3rd United Nations World Conference on Disaster Risk Reduction (WCDRR, Sendai, Japan, 14-18 March 2015). While many initiatives are going forward with this objective, GEO-DARMA is an open initiative that aims to group the broadest possible partnership to implement operational use of EO products for risk reduction according to user defined priorities.

Several studies and R&D activities demonstrate that Earth observations (EO) could play an increasingly important role in making societies more resilient to natural hazards and more adaptive to climate change, and could contribute significantly to DRR. Today, EO data is largely unexploited except during the response phase. Large-scale use of EO data for DRM, particularly from satellites, is hindered by a lack of user awareness of possible applications and the complexity of both acquiring data from a wide range of providers and delivering ready-to-use risk information products to the end user.

Ensuring high-quality risk-related information to support national and local decision makers requires the combined use of multiple sources and tools, including satellite, airborne and in-situ EO measurements; socio-economic data; computer models; and higher order information products derived

¹² *Demographia World Urban Areas (2013)*: <http://demographia.com/db-worldua.pdf>

¹³ **DARMA = Data Access for Risk Management.**

The Japanese **Daruma** or **Darma**, a traditional handmade Japanese wishing doll (referred to as a "GOAL DOLL") that keeps people focused on achieving their goals.

from EO data. Synergistic use is possible only through international cooperation efforts. The GEO-DARMA initiative will bring together relevant stakeholders from governments, intergovernmental organizations, the UN system and civil society. For its success, GEO-DARMA requires strong involvement of the end user community with identified needs and vetted for local application by

relevant regional institutions (see section 4, “**User engagement**”).

The broad goal is to define and implement end-to-end solutions that respond to the real needs of the user community. A balance must be achieved between, on the one hand, focus on technical capabilities and new data products or data services, and on the other, meeting pressing and urgent and currently unaddressed needs. Space EO technology presents new opportunities in this area of work; the challenge is matching such capabilities to those end users most urgently in need. GEO-DARMA will facilitate the sustained provision of accurate EO-based risk information products and services to national and local decision-makers in political and socio-economic sectors, to implement disaster risk reduction and resilience measures, during all disaster risk management phases, whenever those products and services require satellite EO combined with other sources of data (in-situ ground observations, socio-economic, model outputs). The ultimate goal is to establish an inclusive, comprehensive process to address local DRR requirements by using EO technologies efficiently. Long-term outcomes of GEO-DARMA are to foster the use of EO data and EO-based risk information by end-users (e.g. Civil protection agencies, and other agencies and ministries at the national level) and to increase awareness within Donor agencies of the promise of space solutions.

3 NEED FOR ACTION

GEO-DARMA aims at addressing priorities of the *Sendai Framework for Disaster Risk Reduction 2015-2030* that are relevant for satellite EO but not limited to satellite data only. The series of projects to be defined might include use of other EO sources (airborne, in-situ, socio-economic, models outputs, ..), in association with partner providers. With an expected increase in human and economic losses in the coming decades, traditional tools and methods used by the disaster risk management community might not be sufficient and will have to be complemented by other means.

It is clear from the challenges in addressing the Hyogo Framework for Action that a comprehensive, objective means of informing risk reduction is required at an international level. EO has the potential to provide such information. Through a series of connected projects, GEO-DARMA will demonstrate that coordinated Earth observations from multi-sources can provide reliable, accurate, consistent and continuous information, which is the foundation for the development and operation of national DRM systems. More specifically, the overall goal is to develop a common approach for the use of various observations, models, tools and methodologies in order to provide advice and guidelines to countries willing to strengthen their DRM systems.

Since the mid-1970s, satellite observations have for example gathered an exceptionally valuable but still largely un-harvested record of flood inundation worldwide. Commencing in late 1999, two NASA MODIS sensors also obtained daily information on all of the Earth’s flood waters; this archival record is now supplemented by frequent-repeat, wide-swath ground-imaging sensors aboard the National Polar-orbiting Partnership (NPP) Suomi and the European Sentinel-2¹⁴. Such combined EO data can be likened to the record of earthquake seismicity provided by seismographic stations in that they provide the only objective characterization of many extreme, damaging flood events. This globally consistent information of past events could be deployed to its maximum utility in defining areas of flood risk, and be used as well during new floods to assist with their characterization. The remote sensing record of flood inundation and damage can also be used to identify defended floodplains where levees have failed, sometimes even repeatedly, during relatively common floods. This is just one example of the need for and utility of EO data from many sources to be combined, processed, and analysed to assist with DRM and DRR.

¹⁴ Sentinel-2 is an EO mission developed by the European Space Agency (ESA) as part of the Copernicus Programme

4 USER ENGAGEMENT

How user communities join the initiative

EO data providers are seeking input from user communities on priorities in term of disaster risk reduction at the regional and national levels. National needs will be collated and vetted at a regional level by authoritative regional partners who are already working with local and national stakeholders on risk reduction initiatives. These institutions have well established relationships with end users (e.g. national civil protection, national and local decision makers, national resource management agencies, ..). Regional Institutions may be regional offices of international organizations or regional coordination bodies. Their first task will be the identification of hazards and DRR-related issues that should be addressed as top priorities at the regional level, in line with the priorities from the *Sendai Framework for Disaster Risk Reduction 2015-2030*, as well as to identify the principal obstacles to implementing effective DRR in each region, and the countries where pilot implementation should be started. The next step will be the definition and implementation of a series of projects aiming at responding to some of the top priorities & recommendations coming from the Regional institutions. Projects will also include capacity building activities.

How the activity would benefit stakeholders (in particular developing countries)

The development and subsequent improvement of prototype solutions for a smaller set of initial target countries will also benefit to the neighbouring countries with marginal additional efforts through capacity building activities. EO-related capacity building is a key challenge in many developing countries. GEO-DARMA includes a capacity building component both at the outset, from the project initiators towards early pilot countries, and throughout the project, as knowledge gained in the early phases is transferred between pilot countries and the GEO-DARMA effort is extended from early adopters to other countries in region.

How it feeds into decision-making processes

Currently, risk reduction decisions are taken without fully understanding the consequences of risk reduction measures. GEO-DARMA aims to increase the availability and accuracy of risk related information to allow decision makers to simulate the impact of risk reduction measures and make informed decisions about risk reduction investment. In the long term, national and local users will benefit from a more accurate risk-information in complement to their other tools, helping to take appropriate DRR and resilience measures.

5 PREVIOUS DEVELOPMENT AND RESULTS

The initiative will leverage on-going projects and initiatives as much as possible through improved coordination. For instance, relevant outcomes and experience from the CEOS Flood, Volcano and Seismic Hazard Pilots and the Recovery Observatory will be included and improved on; GEO-DARMA may become a mechanism to ensure successful elements of early pilots find a path towards sustainability. In each region, the GEO-DARMA team will examine past experience and identify elements that can be built on.

6 PARTNERS

The accomplishment of the task will require the active support of major stakeholders in the field of DRM at global, regional and national level in order to implement a series of pilot projects.

The partnership will be constructed progressively according to the implementation needs and phases.

The Partners sought for GEO-DARMA will be typically from the following groups:

- International and regional stakeholders knowledgeable about regional issues related to disaster risk management such as relevant UN agencies, GFDRR¹⁵, Development banks, etc ...
- National institutions and agencies
- Representatives from the end user communities
- EO and non-EO data providers:
 - Satellite data providers such as CEOS¹⁶ Agencies (incl. major space agencies in the world) and commercial satellite operators when possible.
 - Other EO data and information providers
- Providers of risk and other relevant information derived from EO data
 - Practitioners – Value added information providers including private sector
 - Scientists

Respecting the voluntary nature of GEO, the Partners' engagement in GEO-DARMA will be based on voluntary contributions and the Partners' participation will be legally non-binding.

The activities to be undertaken by the various categories of Partners during each phase, are described in section 7.

7 ACTIVITIES DESCRIPTION

7.1 Task definition and overall logic and phasing

In order to coordinate their actions, immediately following the kick-off of the GEO-DARMA initiative, the partners will identify and assess the critical needs of the participating disaster management communities and establish priorities. The identification of user needs takes place at a local level, but establishing priorities requires the active involvement of regional entities and organizations with a stake in DRR and/or in EO and remote sensing, as encouraged by the Sendai Framework. Given the limited resources available, GEO-DARMA will begin by selecting a few priority themes, building on strong elements from existing initiatives and choosing those elements most likely to be scalable at a regional and global level. Once the usefulness of the implemented prototypes has been demonstrated in a few countries, the extension to neighbouring areas could be envisaged whenever applicable.

Given that a growing number of countries are expected to be involved in the use of EO in the coming years, GEO-DARMA adopts an incremental approach with three main stages. A **Concept phase** and a subsequent **Prototyping phase** will first be developed to focus on strengthening the initiative and its capacity to address the critical needs of national and regional users. The partnership will be built progressively. One of the major tasks during the early Concept phase will be to select projects and related user needs to be implemented as a priority. Then the initiative will focus on the implementation of prototype solutions to provide specific risk information products and services and capacity building elements through the active cooperation of partners. A limited number of early adopter countries from different regions may serve as National Demonstrators. These demonstration initiatives will serve to develop and test approaches and methodologies and may involve some or all of the partners and attract additional regional and local partners. Proposed activities and related timeframe towards the development of a GEO global initiative on the use of EO for DRR are presented below.

The Prototyping phase will be limited in time. Before the end of the Prototyping phase, each project will be assessed according to a list of criteria (to be defined later) to determine whether the project should stop or on the contrary, transition to the **Operational Phase**. The explicit and strong request from the user community to ensure in the long run, the sustained provision of risk-information and

¹⁵ Global Facility for Disaster Reduction and Recovery (GFDRR)

¹⁶ www.ceos.org

risk-related services demonstrated for a given project during the Prototyping phase, would be a necessary condition to transition to operations. The availability of sustained funding would be another necessary condition.

7.2 Tasks description (for each of them: description, planning, partners responsibilities, resources)

PHASE	PARTNER CATEGORY	TASK DESCRIPTION
Concept phase	International and regional stakeholders	• Consolidate GEO-DARMA proposal together with other GEO-DARMA initial partners. Includes the identification of the regions considered in GEO-DARMA; will depend on the availability of International and regional stakeholders for each region foreseen. • Compile on national user needs in collaboration with national and regional actors • Identify hazards in each selected region. • Identify most critical DRR measures to be implemented at regional level, and that could benefit from EO data and EO-based risk information. • Identify hurdles in the establishment of high priority DRR and resilience measures • Identify countries in the region that would be willing to participate in the initial definition implementation of solutions in the GEO-DARMA framework. • Discuss implementation with National institutions and agencies and with Representative of end user communities. • Establish a prioritized list of recommendations to the GEO-DARMA partners that combine the identified hazards, most critical DRR measures, hurdles in DRR and initial countries • Select together with all other Partners of the activities to be started in the next Prototyping phase , in the form of pilot projects.
	National institutions and agencies	• Cooperate with International and regional stakeholders whenever needed • Confirm willingness to participate in the definition and implementation of pilot projects during the next Prototyping phase.
	Representative of end user communities.	• Cooperate with International and regional stakeholders whenever needed • Confirm willingness to participate in the definition and implementation of pilot projects during the next Prototyping phase.
	EO & non-EO data Providers and risk	• Consolidate GEO-DARMA proposal together with users and other GEO-DARMA initial partners.

PHASE	PARTNER CATEGORY	TASK DESCRIPTION
	information Providers	- Assess recommendations from International and regional stakeholders - Select together with all other Partners of the activities to be started in the next Prototyping phase, in the form of pilot projects. - Articulate end user commitment for implementation
Prototyping phase	International and regional stakeholders	- Ensure interface between national authorities, projects implementers (e.g. EO & non-EO data Providers and risk information Providers, National institutions and agencies) and the user communities - Define with all other Partners of the series of pilot projects to be implemented in the voluntary countries within each region - Within each region / country, support the implementation of the pilot project(s) to be implemented in the country - Continuously assess the pilot projects being implemented. In case of satisfactory pilot projects, propose to the Partners the next countries that could benefit of the geographical and gradual extension of the pilot projects from the initial countries in the region to the neighboring countries. - For the successful pilot projects, assess the resources at regional level necessary to transition from prototype to operations; and work with potential financial and donor institutions to define the sources of funds to support both the transition and the sustained operations in several countries in the same region.
	National institutions and agencies	- Within each country, together with all other relevant Partners, define the pilot project(s) to be implemented in the country. - Within each country, support the implementation of the pilot project(s) to be implemented in the country. - Continuously assess of the pilot projects being implemented - For the successful pilot projects, assess the national resources necessary to transition from prototype to operations
	Representative of end user communities	- Within each country, together with all other relevant Partners, define the pilot project(s) to be implemented in the country in particular by providing detailed user needs. - Within each country, support the implementation of the pilot project(s) in particular by a continuous assessment of the pilot projects implementation. - For the successful pilot projects (i.e. projects of great importance for the national and local end user community), assess the resources necessary to transition from prototype to operations.

PHASE	PARTNER CATEGORY	TASK DESCRIPTION
	EO and non-EO data Providers and risk information Providers	- Define with all other Partners of the series of pilot projects to be implemented in the voluntary countries within each region - Within each region / country, support the implementation of the pilot project(s) to be implemented in the country. - Continuously assess the pilot projects being implemented - For the successful pilot projects, assess the resources necessary to transition from prototype to operations to ensure a sustained provision of EO data, non-data and EO-based risk information.

Note: Operational phase planning to be completed during Concept phase.

8 PLANNING, MILESTONES AND DELIVERABLES

Three phases are foreseen; the following durations are indicative and shall be confirmed at the kick-off (KO):

	<u>PHASE</u>	<u>DURATION</u>
1	Concept phase	Start at KO, end at KO+12 months at the latest. Might vary from one region to another.
2	Prototyping phase	Start at KO+12 months (or earlier if the Concept phase is completed in less than 12 months for a particular region), end at KO+60 months at the latest. Prototyping might start at different time depending on the project. It is not envisaged to continue the prototyping activities including its operation beyond a period of 4 years. Go/no go decision to determine sustainability and implementation of operations (transition to Operational phase)
3	Operational phase	On a case-by-case basis, might start for a given project at KO+48 months depending on the funding and opportunity to transition the activities from a prototype to an operational system.

An overlap of the phases can be envisaged as GEO-DARMA will consist in a series of projects that could be implemented at different paces.

9 DATA MANAGEMENT & POLICY

GEO –DARMA will be implemented in the GEO framework and will apply the GEO Data Sharing principles. A large volume of EO instrument data from CEOS agencies is already accessible for free through the Internet. In the case of commercial satellite missions, EO data can sometimes be obtained through space agencies or directly from commercial satellite operators—for instance, every year a limited volume of commercial data is provided at no cost to the CEOS Pilot projects.

10 MANAGEMENT ARRANGEMENTS

The GEO-DARMA initiative will be managed as a project with an effective dedicated Steering Board that oversees implementation of the Initiative. Members of the Steering Board should be representatives of those partners providing significant resources to the implementation and representing the various types of communities involved including representatives of user communities as appropriate.

A Project Coordinator will be identified. She/he will typically be resourced by a contributing GEO Member or GEO Participating Organisation. The Coordinator is responsible for coordinating the implementation of the agreed implementation plan and reporting to GEO on progress and other related issues. A sufficiently resourced Initiative coordinator is an important criterion for accepting a new GEO Initiative and plays a critical role in success of new initiatives.

11 MONITORING AND EVALUATION APPROACH AND REPORTING

The monitoring of GEO-DARMA will be first performed internally (i.e. by the Steering Board) against the list of milestones & deliverables. The status of each GEO-DARMA activity will be regularly monitored in particular during the monthly teleconferences and made visible on the GEO-DARMA web site (TBC – to be developed).

The Project Coordinator will report the progress to GEO as requested providing in particular:

- Progress reports reviewed by the GEO Programme Board in contribution to the annual GEO Progress Report.
- Presentations to Plenary, the Executive Committee or the GEO Programme Board, as necessary.

12 COMMITTED RESOURCES AND ANNUAL BUDGET(S)

Each stakeholder engaged in the GEO-DARMA initiative will be requested to actively contribute to the various phases on a voluntary basis with contributions in kind.

Concept phase: this initial phase is a study phase that will require each actor to allocate enough time to generate and review documents, participate in monthly (TBC) teleconferences, and participate in a final GEO-DARMA workshop. During this workshop, all the recommended projects will be analysed and decisions will be made regarding which of them to start.

Prototyping phase: the number and nature of projects to be started will depend on the recommendations made by the Regional Institutions, on their assessment by the GEO-DARMA contributors and on the resources that can be allocated by the potential implementers. The series of projects will be defined at the end of the Concept phase and only at that time will it be possible to evaluate what specific resources will be needed for each project.

Operational phase: for each project, around the end of the Prototyping phase, the need to transition from a prototype to a sustainable solution will be assessed depending on the success of the prototype, on the request from the user community and on the availability of the necessary funding (transition and long term operations).

13 TRANSITION TO OPERATIONAL PHASE

International financial institutions and donor agencies will play a critical role to ensure a smooth transition from prototyping to operations, and their support of capacity building activities will be essential to ensure sustainability.

See also “Operational phase” paragraph in section 12

GI-17a	Global Urban Observation and Information	- Detailed description

Global Urban Observation and Information Implementation Plan Proposal

1. Executive Summary (2 pages)

We support the GEO's proposal that a single GEO Initiative on urban issues will be created in the new Work Programme. This initiative may include a special component of Global Urban Data Layers (GUrDL), with the contributions from the NOAA light imaging products, DLR Global Urban Footprint, JRC Global Human Settlement Layer, Sweden/Italy global urban extent extracted from "Urban Extractor", Japan ASTER Global Urban Area Map, and the United States Geological Survey NLCD. The structure and mechanism of functioning of this component shall be in accordance with pertinent GEO requirements and be approved by all participant groups.

2. Introduction

Improve the coordination of urban observations, monitoring, forecasting, and assessment initiatives worldwide. Support the development of a global urban observation and analysis system. Produce up-to-date information on the status and development of the urban system – from local to global scale. Fill existing gaps in the integration of global urban land observations with (i) data that characterize urban ecosystems, built environment, thermal conditions, geohazards, air quality and carbon emission; (ii) indicators of population density, environmental quality, quality of life; and (iii) patterns of human environmental and infectious diseases. Develop innovative concepts and techniques in support of effective and sustainable urban development.

3. Need for action

- Connect national/international urban activities to GI-13;
- Dedicate national/regional funds to urban product generation and technological development;
- Identify/initiate international project calls and funding options for joint GEO urban activities through national funding agencies;
- Support the organization of GEO Urban International Summer School;
- Help develop and expand ties with existing and new users.

4. User engagement

- **how established user communities link to the initiative**
- **how the activity would benefit stakeholders (in particular developing countries)**
- **how it feeds into decision-making processes**

Five groups have generated Global Human Settlement Layers using satellite data:

- The US (NOAA National Geophysical Data Center) has produced global radiance calibrated VIIRS low light imaging products: 1) nightly, 2) monthly, and 3) annually. NGDC is still developing algorithms for producing research quality night-time lights, with background noise, fires, and aurora removed. The World Bank (Sustainable Development Unit) is using the radiance VIIRS products to rate the success and longevity of electrification projects in India, Vietnam and Indonesia;
- The European Commission (JRC) has contributed its whole image repository for information extraction (Global Human Settlement Layer (GHSL) project). This data (derived from fine scale optical images) cover 100's of millions of km² with resolution ranging from 0.5 to 100 m;
- The Global Urban Footprint (GUF), the Global Urban Area Map (AGURAM), and the Global Urban Extent, generated by Germany Space Agency (DLR), include user groups of the World Bank Group, the European Environment Agency (EEA), DG Regio of the European Commission, the International Society of City and Regional Planners (ISOCARP) etc.

Moreover, DLR has produced a time-series analysis (1975-2010) describing the spatiotemporal development of 26 mega-cities, also setting up a global data base of binary settlements masks (Global Urban Footprint) derived from SAR data of the TanDEM-X mission (grid cell size: ~50x50 m);

- Sweden (KTH) and Italy (University of Pavia) have developed an “Urban Extractor” to map global urban extent at 30m resolution using ENVISAT or Sentinel-1 SAR data;
- Japan (GEO Grid/AIST, University of Tokyo) has developed the ASTER Global Urban Area Map (AGURAM). 3734 cities of more than 0.1 million people urban area have been mapped using ASTER (15m). Gaps will be filled using PALSAR data.
- In addition, the U.S. Geological Survey has recently released the National Land Cover Database (NLCD) 2011 products, including impervious surface changes between 2001-2006, and 2006-2011. The NLCD urban land product has been widely used by many scientific studies including land cover change and climate change impact in the United States and around the world. Many GEO participants are the users of NLCD products.
- Several civil protection authorities are following the works of Thermal Risk rEDuction Actions and tools for SecURE cities (TREASURE) including a system for operational nowcasting of urban thermal temperatures. The project is funded by the European Humanitarian Aid and Civil Protection Directorate General (DG-ECO).

These data sets are used widely by decision-makers to better understand of environments, resources, and ecosystems worldwide and the scientific community for studies of urban environments and impacts of urbanization.

5. Previous development and results

- Global Urban Supersites Initiative: To estimate urban extent, change detection, and assess risks associated with natural disasters, air/water qualities, and health hazards; 8 megacities selected (Los Angeles, Atlanta, Mexico City, Athens, Istanbul, Sao Paulo, Beijing, Hong Kong); Website incl. data repository launched (www.indstate.edu/cuec/UrbanSupersites/home.html). Global Urban Supersites have recently been funded through two international projects:
 - €199,968, “Earth Observation for Urbanization” (EO4U), PI, Mattia Marconcini, DLR, Co-Is, Q. Weng et al., ESA Invitation To Tender (ITT) AO/1-7829/14/I-NB DUE – Innovators III, 1/1/2015 – 12/31/2016.
 - HK\$955,400, “Improving the Estimation of Impervious Surfaces Using Optical and Polarimetric SAR Data in Humid Subtropical Urban Areas”, PI, Hongsheng Zhang, Chinese University of Hong Kong, Co-PIs, Q. Weng et al., Hong Kong Research Grants Council, 1/1/2016-12/31/2017.
- A Global Urban Remote Sensing Laboratory (GURSLab), aiming at developing a tool for online processing, visualizing, and sharing of urban data sets. This project has been recently funded with €999,870, titled “Thematic Urban Observation Hub (TUrbO-Hub) - Platform for the Mapping, Analysis, Monitoring and Assessment of Urban Development,” PI, Thomas Esch, DLR, with participation of several co-Leads of SB-04, through ESA Invitation To Tender/1-7870/14/I-NB Thematic Exploitation Platforms (TEP) program, 1/1/2015 – 12/31/2016.
- Five groups have generated Global Human Settlement Layers using satellite data (see the previous section).
- Reference/Text book “*Global Urban Monitoring and Assessment through Earth Observation*” (www.crcpress.com/product/isbn/9781466564497), published in 2014 with contributions from mainly SB-04 participants, has been sold very well.
- Seven (7) workshops/symposia focusing on GEO SB-04 activities and outcomes:
 - 1st Urban Task Symposium in conjunction with EORSA 2012 in Shanghai, China, June 9-11, 2012;
 - 2nd Urban Task Symposium in conjunction with JURSE 2013 in Sao Paulo, Brazil, April 21-23, 2013;

- 3rd Urban Task Symposium organized in conjunction with EORSA 2014, Changsha, China, June 11-14, 2014;
- International Workshop on Global Urban Observation and Monitoring from Space, Athens, Greece, March 31-April 1, 2014;
- 1st Global Human Settlement Workshop, Ispra, Italy, October 21-23, 2014;
- GEO Urban Session in JURSE 2015 in Lausanne, Switzerland, March 30-April 1, 2015;
- GEO Urban Symposium (five sessions) in AAG annual conference in Chicago, Illinois, U.S.A., April 21-25, 2015.
- The alpha version of the Global Human Settlement Layer (GHSL) produced by Landsat data 1975-2014 has been released. The user list includes circa 30 research groups inside World Bank, UN agencies, European Commission, several national space agencies and other governmental and academic entities.
- A real-time, operational, quarter-hourly monitoring system of Land Surface Temperatures for 5 European Cities (Athens, Istanbul, Paris, Madrid, Rome) for summer 2014. Real-time, operational, 5-min monitoring of Land and Air Surface Temperature and humidity for 15 Cities for summer 2015 is nearly finished with validation. Real-time, operational, quarter-hourly monitoring of Land Surface Temperatures for 5 European Cities (Athens, Istanbul, Paris, Madrid, Rome) for summer 2014. Real-time, operational, 5-min monitoring of Land and Air Surface Temperature and humidity for 15 Cities for summer 2015 is undergoing validation.
- Students and young researchers worldwide attracted to GEO Urban Symposia and various activities through the GEO Trust Fund.
- The International Program on Global Urban Observation and Public Health (IPUP) was initiated in Changsha, China, in June 2014, aiming at monitoring global urban environment and public health concerns from space and with *in situ* measurements. This initiative has recently been funded (PI, Q. Weng) through Global Institute of Sustainable Cities (GISC), Fujian Normal University, China.

6. Partners

Co-Leads:

- Weng, Q. Indiana State University, USA (Coordinator; Point of Contact)
- Ding, X. Hong Kong Polytechnic University, CHINA
- Esch, T. German Aerospace Center, GERMANY
- Elvidge, C. National Oceanic and Atmospheric Administration, USA
- Gamba, P. University of Pavia, ITALY
- Keramitsoglou, I. National Observatory of Athens, GREECE
- Pesaresi, M. European Commission, Joint Research Centre
- Quattrochi, D.A. Marshall Space Flight Center, NASA, USA
- Xian, G.Z. United States Geological Survey; USA
- Xu, B. Tsinghua University, China

GEO MEMBER INSTITUTIONS/ GEO POs/ OTHERS

- International Society for Photogrammetry and Remote Sensing (Dr. Jun Chen, President);
- IEEE Geoscience and Remote Sensing Society (Dr. Jon A. Benediktsson, President).

GEO Members/ INSTITUTIONS who initiated SB-04

- US GEO;
- Germany GEO;
- China GEO;
- IEEE Geoscience and Remote Sensing Society.

Major User Groups:

- The World Bank;
- UN Habitat and several agencies;
- European Commission;
- European Environment Agency;
- International Society of City and Regional Planners;

- National Agencies;
- Chinese Academy of Sciences;
- Civil Protection, Energy suppliers and Health Authorities;
- Decision-makers of environments, resources, and ecosystems worldwide;
- Scientific community;
- Graduate and undergraduate students.

7. Activities description

To include Capacity Building/Training activities

- i. **Tasks definition and overall logic and phasing**
 - ii. **Tasks description (for each of them: description, planning, partners responsibilities, resources)**
- Global Urban Supersites Initiative (Expanded to **Megacities Observation and Monitoring – MOM program**: Currently supported by ESA Invitation To Tender (ITT) AO/1-7829/14/I-NB DUE – Innovators III (1/1/2015 – 12/31/2016) and Hong Kong Research Council (1/1/2016 – 12/31/2017), with partners from DLR, Chinese University of Hong Kong, Indiana State University, and National Observatory of Athens, Greece. A new partner is Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences, which has a funded project by National Natural Science Foundation of China (Grant No. 41201357). These projects all focus on impervious surface data generation and providing the data sets for municipalities for megacities in the world.
 - Continued generation of **Global Human Settlement Layers** at various international and national levels and seek synergies among them. Dr. Weng has recently discussed potential for collaboration with the National Administration of Surveying, Mapping and Geo-information (Prof. Chen Jun, ISPRS President) of China, which has developed a global land cover dataset at 30 m resolution for 2000 and 2010. A special joint session will be held at 2016 ISPRS Congress to discuss about the collaboration.
 - Implementing **Global Urban Remote Sensing Laboratory** through joint projects: This activity has one funded project with €999,870, titled “Thematic Urban Observation Hub (TUrbO-Hub) - Platform for the Mapping, Analysis, Monitoring and Assessment of Urban Development,” through ESA Invitation To Tender/1-7870/14/I-NB Thematic Exploitation Platforms (TEP) program, 1/1/2015 – 12/31/2016, with Thomas Esch, DLR, as the PI with several co-Leads of SB-04 from Indiana State University, National Observatory of Athens Greece, University of Pavia, Italy, and KTH Royal Institute of Technology, Sweden. A new project has recently been awarded €200,000 through ESA DUE INNOVATOR III on Global Urban Services using Sentinel-1/-2 data (3/1/2015-2/28/2017) to University of Pavia, Italy, and KTH Royal Institute of Technology, Sweden.
 - Initiate a joint project of Impervious Surface Mapping in Tropical and Subtropical Cities - **ISMiTSC** (Asia, Africa, and South America): This initiative focuses on urban mapping and providing datasets and EO technology services to developing countries. A preliminary research has been conducted in selected cities in South America, Africa, South and East Asia with data support from DLR and research collaboration between Chinese University of Hong Kong, Indiana State University, DLR and university of Pavia. Preliminary result will be published via a book (<https://www.crcpress.com/Remote-Sensing-of-Impervious-Surfaces-in-Tropical-and-Subtropical-Areas/Zhang-Lin-Zhang-Weng/9781482254839>).
 - Establish a Global Institute of Sustainable Cities (**GISC**) - Explore EO as a enable technology for development of sustainable cities and for supporting GEO’s objective on urban resilience and coastal resilience by supplying objective information on the footprint of global urbanization and assisting in the development of indicators for sustainable cities to support the UN’s sustainable development goals. This initiative has recently been funded at 5 million RMB Yuan by Fujian Normal University, China, 2015-2020.
 - The International Program on Global Urban Observation and Public Health (**IPUP**) - linking global urban environment monitoring with public health from space and in situ measurements: This initiative was initiated in Changsha, China, in June 2014, and has obtained support from Global Institute of Sustainable Cities (GISC), Fujian Normal University, China (PI, Q. Weng). An
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international workshop was organized by Prof. Bing Xu and was held in Wuhan, China, June 17-18, 2015, to discuss about this initiative (<http://www.lmars.whu.edu.cn/IGGHRC/>).

- Create an annual **International Summer School** to train and educate students and young researchers worldwide in conjunction with GEO Urban annual symposium/workshop: This initiative will be discussed further during conference of the Mapping Urban Areas from Space – MUAS 2015 at ESA – ESRIN (Frascati - Italy), November 4-5, 2015 (<http://due.esrin.esa.int/muas2015/>).
- Organize **Annual GEO SI-13 Symposium** (maybe in conjunction with a conference, e.g., JURSE, EORSA, or a designated workshop from a project) to showcase results, to promote GEO/GI-13 goals, to engage users, and to foster synergies among international contributors. Each symposium has a specific theme serving the GI-13 goals. Sponsor an urban public health workshop that will assess the integration of our data and products into public health decision makers.
- **Collaboration with ISPRS and IEEE GRSS:** There will be a special session (**SpS18: Earth Observation from Global Land to Urban Systems**) at ISPRS Congress (<http://www.isprs2016-prague.com/>), July 12-19, 2016, Prague, Czech, and another special session (focus on Sensors and Sensing Techniques for Urban Areas) at 2016 IEEE International Geoscience and Remote Sensing Symposium, Beijing, July 10-15, 2016.
- Facilitate **publications** and disseminate the results through collaboration with Elsevier and Taylor & Francis: A new Elsevier journal “*Remote Sensing Applications: Society and Environment*” has a focused section on urban observation and applications (G. Xian; X.L. Ding, Associate Editors); A theme issue on Earth observation from global land to urban systems is planned to be published at *ISPRS Journal of Photogrammetry and Remote Sensing* in 2016/2017; CRC Press/Taylor & Francis Group will publish a book titled “*Remote Sensing for Sustainability*” in 2016/2017 (<http://www.tandf.net/books/details/9781498700719/>).
- Seek synergies with other GEO tasks/initiatives, such as Global Land-cover and Land-cover Change, Global Ecosystem Classification, Mapping and Inventory, Extension and Improvement of the Climate Record, and Air-borne Diseases, Air Quality and Aeroallergens; Investigation of the relationship between the thermal urban environment and heat-related morbidity and mortality.

8. Planning, milestones and deliverables

Deliverables:

- Urban footprint/urban extent, urban land cover change, human settlement datasets at global, regional, and national scales generated by several groups;
 - Models and algorithms: (1) Spatio-temporal Adaptive Data Fusion Algorithm for Temperature mapping (SADFAT) – Merge coarse resolution and medium resolution satellite image data to generate daily medium resulting data; (2) DELTA algorithm to reconstruct consistent, daily land surface temperature data at Landsat resolution based solely on Landsat imagery; and (3) the NOAA System of real-time, operational, 5 minute monitoring of land and air surface temperature and humidity for cities;
 - Information about existing data gaps in integration of global urban observations with (i) data characterizing urban ecosystems, thermal environment, geohazards, air quality, and carbon emission; (ii) indicators of population density, environmental quality, and quality of life; (iii) social and economic data; and (iv) patterns of human, environmental and infectious diseases;
 - A set of "indicators" that quantify the status and trends of cities and human settlements and support the urban sustainable development goal that is being planned for at the UN.
 - Systems and tools: (1) Thematic Urban Observation Hub (TUrbO-Hub) - Platform for the Mapping, Analysis, Monitoring and Assessment of Urban Development; (2) SAR4Urban: Provide data sets of selected cities from ESA radar imagery to the users of the cities; and (3) Urban Extractor: to map global urban extent at 30m resolution using ENVISAT or Sentinel-1 SAR data;
 - The ISPRS Journal of Photogrammetry and Remote Sensing theme issue, and book “Remote sensing for Sustainability”;
 - Assessment of the developed tools, systems, and models by decision makers and user partners;
 - Annual International Summer School and annual GEO SI-13 symposium.
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Delivery Schedules:

Year: Milestones: Month:	2015				2016				2017				2018			
	3	6	9	12	3	6	9	12	3	6	9	12	3	6	9	12
Objective 1: Datasets on urban areas and human settlements																
NOAA light imaging products																
DLR Global Urban Footprint																
JRC Global Human Settlement Layer																
Global urban extent from “Urban Extractor”																
Japan ASTER Global Urban Area Map																
USGS NLCD																
Objective 2: Models and algorithms																
SADFAT																
DELTA																
NOA System																
Objective 3: Systems and tools																
TUrbO-Hub																
SAR4Urban																
Urban Extractor																
Objective 4: Knowledge Base																
Information about existing data gaps																
Sustainable cities indicators																
Objective 5: Publications																
ISPRS Journal theme issue																
Book “Remote sensing for Sustainability”																
Objective 6: Capacity building and user engagement																
User assessment of tools and datasets																
International Summer School																
GEO SI-13 symposia																

9. Data management & policy

Data and information produced from this project will be incorporated into a web interface compatible with common mapping applications. The datasets will be geocoded allowing user queries and downloading. A graphical interface will be developed as a JavaScript API to function as a Google Earth plug-in. Then this application will be embedded into our website, designed and dedicated to facilitating dissemination of the results and engaging users. Furthermore, the use of data, information, algorithms, and tools to be produced by GI-13 must acknowledge specific developer and the support from GEO and this team's contribution.

10. Management arrangements

To ensure the project making progress in a timely manner, we plan to have a monthly tele-conference. Physical meetings of leads and contributors would be scheduled at annual GI-13 symposia. During a physical meeting, a draft annual Progress Report would be discussed, so that progress towards the corresponding targets of the previous year would be assessed, and planning for next year's activities would be made.

We will send at least one representative to annual GEO Work Programme Symposium and if feasible, to each GEO Plenary.

11. Monitoring and evaluation approach and reporting

An annual Progress Report will be compiled to serve as a discussion point for assessing the performance/progress towards the corresponding targets of the previous year and for guiding next year's activities. A final version of the report would then be sent to the GEO Secretariat.

12. Committed Resources and annual budget(s)

Projects:

- German Remote Sensing Data Center (DFD) and German Aerospace Center (DLR) in support of global urban footprint production.
 - US Geological Survey (USGS) Earth Resource Observation and Science Center (EROS) in support of national land cover datasets generation.
 - "Thematic Urban Observation Hub (TUrbO-Hub) - Platform for the Mapping, Analysis, Monitoring and Assessment of Urban Development" supported by ESA Invitation To Tender/1-7870/14/I-NB Thematic Exploitation Platforms (TEP) program, 1/1/2015 – 12/31/2016, led by DLR.
 - "Earth Observation for Urbanization" (EO4U)" supported by the ESA Invitation To Tender (ITT) AO/1-7829/14/I-NB DUE – Innovators III program, 1/1/2015 – 12/31/2016, led by DLR.
 - ESA DUE INNOVATOR III on Global Urban Services using Sentinel-1/-2 data (3/1/2015-2/28/2017) awarded to University of Pavia, Italy, and KTH Royal Institute of Technology, Sweden.
 - "Improving the Estimation of Impervious Surfaces Using Optical and Polarimetric SAR Data in Humid Subtropical Urban Areas" supported by Hong Kong Research Grants Council led by Chinese University of Hong Kong, 1/1/2016-12/31/2017.
 - TREASURE: Thermal Risk rEDuction Actions and tools for SecURE cities, supported by a European Civil Protection project for heat waves using satellite data, led by National Observatory of Athens, Greece (<http://treasure.eu-project-sites.com/> , ECHO/SUB/2014/695561).
 - "Continuous Monitoring of the Distribution of Urban Temperatures in 5 Greek Cities' in Excellence Research Programs General Secretariat for Research and Technology (Greece)-SIEMENS awarded to National Observatory of Athens, Greece, 2014-2016.
 - DRAGON 3 (KTH, UNIPV, DLR) - "Urbanization project": Use of European and Chinese EO data to monitor the urban expansion and environmental conditions in selected areas of P.R. China.
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- NASA Goddard Space Flight Center/Marshall Space Flight Center Interdisciplinary Science Project, “Combining satellite data and models to assess the impacts of urbanization on the continental United States surface climate”.
- ABCC (CEODE, CAS & JRC): National Science Foundation of China (NSFC) project of “Comparative Study on Global Environmental Change Using Remote Sensing Technology”.
- NOAA’s National Geophysical Data Center has a long standing program to generate and provide open access to global nighttime lights from satellite data. They are now working on VIIRS DNB products.
- Global Talents Program of Fujian Normal University, China, in support of creation of Global Institute of Sustainable Cities.
- Funding for projects related to the NASA National Climate Assessment program.
- The European Commission, Joint Research Center project: “Global Human Settlement Analysis for Disaster Risk Reduction” (GLOB-HS).
- The European Commission, Joint Research Center project “European Urban Development and Territorial Cohesion” (E-URBAN).

In-kind (human resources)

- Global Institute of Sustainable Cities, Fujian Normal University, China;
- Data, models, and related resources associated with US NASA Earth Science research and Earth observing remote sensing platforms such as Terra and Aqua, and the 40-year availability of continuous Landsat data;
- Additional in-kind contributions from the USA (Indiana State University, NASA) and China (Tsinghua University, National Satellite Meteorological Center), Italy (University of Pavia), IEEE Geoscience and Remote Sensing Society.

13. Transition to operational phase

All activities are continuous in nature or extensions of the SB-04 activities, which make it easy for the transition from SB-04 to GI-13.

GI-17b	Global Human Settlement indicators for post-2015 international frameworks	- Detailed description

Draft GEO initiative: **“Global Human Settlement indicators for post-2015 international frameworks”**

Introduction

The GHS initiative builds upon the positive experience of the new Global Human Settlement Working Group (GHS WG) that was launched at the first Global Human Settlement Workshop hosted by the European Commission, Joint Research Centre, on 21-22 October 2014. A *Manifesto for a Global Human Settlement Partnership*¹⁷ was agreed among the partners and made the first nucleus of the group still under evolution. At the date of the last census (June 2015), the group included ~40 registered research teams (accounting >120 individual researchers) working in governmental and international organization, NGO, academic, and private firms. The GHSL applications (so far) include: damage and reconstruction assessment, impact assessment, disaster early warning and alerting, losses estimates, exposure and risk mapping and post-disaster need assessment (PDNA), population spatial modeling, census planning, regional development and planning, transport planning, urban and global climate modeling, spatial epidemics analysis, ecological studies, environmental protection, agricultural fragmentation studies, and historical landscape protection.

The GHS WG was originally initialized in support the GEO task SB-04-C1: “Global Urban Observation and Information” as contribution to the task (1) *Conduct global urban analyses, including time-series for assessing mega-cities development (e.g. urban sprawl) and a world-wide inventory of human settlements based on satellite data*. In the subsequent months, the GHS group evolved far from the original setup of the GEO-SB-04 task, which was made by remote sensing specialists engaged in extracting primary information products from remotely sensed data. The new community is mostly made by policy makers and political communities involved in the post-2015 frameworks, and scientists already providing support to the international negotiation processes in the specific domains: consequently the technical focus has moved from accuracy of the *remote-sensing information extraction* and inventory to *fitness-for-purpose of various-spatial-sources information integration* in support to specific policy goals. In the new perspective remote sensing is only one of the various relevant sources used for designing the indicators¹⁸, the “urban” category (belonging to urban/rural dichotomy) as goal of the remote sensing data analysis is abandoned in favor of a continuous human settlement conceptualization, and the information extracted from remote sensing and integrated in the indicators goes beyond the classical boundaries of “urban” remote sensing applications.

In the above frame, it is considered the option to create a specific GEO initiative in the draft GEO Transitional Work Programme 2016¹⁹, making visible the activities of the GHS group and facilitating the evolution toward operational services that may be set up by some of the partners (tbd). In particular, the EC will support with specific programs the pre-operational phase of the GHS baseline production and yearly update using Sentinel 10m-resolution satellite data input in the perspective of a new operational Copernicus service activated in 2018+.

Scope

¹⁷ <http://www.earthobservations.org/ghs.php>

¹⁸ The indicators under development include various land use and land cover information and physical measurements derived from remote sensing data, combined with statistical counts, crowd sourcing (as OSM and GeoWiki), and social sensing

¹⁹ http://earthobservations.org/documents/excom/ec34/ExCom34_06_GEO%20Transitional%20Work%20Programme%202016.pdf

The scope of the GHS initiative is to develop and assess the fitness-for-purpose of a new generation of measurements and spatial statistics products in support to post-2015 international processes on sustainable and urban development, climate change and disaster risk reduction. Sustainable Development Goals are accompanied by targets and will be further elaborated through indicators focused on measurable outcomes. These indicators are action oriented, global in nature and universally applicable. Moreover, in order to monitor the implementation of the SDGs, it will be important to improve the availability and access to data and statistics to ensure that no one is left behind in the information gaps. The GHS initiative uses a globally -consistent and universally applicable methodology, making the GHS the right platform for testing of alternative options in operationalization of the SDG indicators, particularly those related to Goal 11 on cities. Furthermore, the free and open data policy access of the GHSL information will greatly contribute to fill the information gaps at local national and international levels

In particular, the GHS initiative shall test the production and the use of new global human settlement information products derived by the integration of multi-disciplinary data, namely global remote sensing, environmental, population and socio-economic. The scope is global and multi-disciplinary, with a particular emphasis on the generation of new global fine-scale information products made available through advances in remote sensing technology and open public data access policies. In the frame of the initiative, are considered strategic global and multi-temporal thematic information (land cover) products with a spatial resolution ≤ 50 meters and open and free data access policy. The free and open data access will ensure that GHS derived indicators will be produced also in low-income countries where no census data is available.

In principle, Global Human Settlement information can support all the spatial metrics and indicators related to population and settlements: consequently modelling access (to services, market, industrial infrastructure, food, water, land), exposure (to natural disaster), or impact (ecosystem, water, land degradation). Access, exposure and impact spatial measurements are embedded in several goals and targets under discussion in the post-2015 frameworks. The new GHS initiative is committed in developing a new generation of measurements and information products that provide new scientific evidence and a comprehensive understanding and that can support global policy processes with agreed, actionable and goal-driven metrics. In particular, the GHS initiative is committed to support the following processes: the UN Third Conference on Housing and Sustainable Urban Development (Habitat III, 2016)²⁰, the post-2015 framework on sustainable development goals (SDGs)²¹, the UN Framework Convention on Climate Change²², and the Hyogo framework for disaster risk reduction²³.

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Internal organization

The GHS initiative is based on in-kind support of the participating organizations interested in the development or early testing of the indicators and integration in their modeling and analytical platforms. The participating organizations are already financed by their specific programs. The EC Joint Research Center, is chairing the GHS GEO initiative in the initial phase. A specific budget is foreseen in support of the GHS GEO initiative and the support of the Sentinel GHS baseline production and update in the pre-operational phase 2016-2018. After the initial phase (~ 2 years), the chairing of the GHS initiative will be rotated among the partners with a mechanism tbd.

The work will be organized in thematic working groups – they will make visible the results and the assessments done by the partners in their specific areas, facilitate sharing of techniques and data, and facilitate convergence to agreed technical solutions. A yearly conference is foreseen aggregating the results in proceedings and in new data packages made available for free and public access, downloadable from platforms made available by the partners.

²⁰ <http://unhabitat.org/habitat-iii/>

²¹ <http://sustainabledevelopment.un.org/post2015>

²² <http://newsroom.unfccc.int/> <http://www.un.org/climatechange/>

²³ <http://www.wcdrr.org/preparatory/post2015>

The thematic working groups will be chaired with a rotation mechanism by the interested partners, the yearly conference as well.

The very initial (open) list of working groups includes the items below

- Built-up environment baseline
- Population baseline
- Settlement classification baseline
- Population spatial dynamics
- Social sensing
- Urbanization processes
- Exposure, risk, early warning
- Accessibility and infrastructures
- Poverty and vulnerability
- Diseases and epidemics
- Environmental sustainability and ecological footprints
- Agriculture, land, desertification
- ...

Activity Plan

As GHS working group

- Oct 2014 - GHSL workshop, Landsat GHS baseline (epochs 1975-1990-2000-2014) , alpha pre-release among the partners
- March 2015 – GHS data seminar at the World Bank, Washington DC
- March 2015 – GHS data seminar at the UN Habitat III secretariat offices, New York
- April 2015 – *New Remote Sensing of the Global Human Settlement*²⁴ - GHS side event at the Habitat III prepcom2 Nairobi (co-organized by JRC, UNECE, GORA)
- April 2015 – GHS contribution to the PennIUR Workshop on "Global Mapping and Remote Sensing for Sustainable Urbanization". University of Pennsylvania, US.
- June 2015 – GHS contribution to the Urban Sustainability for Human Development Indicators, Geospatial Technology Disaggregation for SDG11 and its Linkages with other SDGs. Technical Seminar in support of the UN IAEG-SDGs
- July 2015 – Landsat GHS baseline, beta pre-release among the partners
- Nov 2015 - Side event GEO ministerial Mexico (submitted), optionally including GHSL workshop preparatory for the working plan 2016 of the new GEO initiative

As new GEO initiative

- Oct 2016 - Side event UN Habitat III Quito, including public release of the Landsat GHS baseline (epochs 1975-1990-2000-2014) integrated with other available (open and free) satellite derived products and spatial baseline data in an initial set of SDG indicators proposal database. EC will announce the commitment to sustain the GHS baseline production and updates with Sentinel data. Coordinated with a GHS workshop
- Nov 2017 - GHS workshop, launch of the Sentinel GHS baseline prototype and updated set of indicators
- Nov 2018 - GHS workshop public release of the Sentinel GHS baseline operational service and updated set of indicators

Specifically, during 2016 the following products are planned in collaboration with the partners

- Public release of the GHS baseline on population and settlements. Built-up areas are extracted from Landsat satellite data collections in the epochs 1975-1990-2000-2014 integrated with

²⁴ <https://ec.europa.eu/jrc/en/event/workshop/new-remote-sensing-global-human-settlement>

various other open and free available spatial sources. Totals resident population grids at corresponding epochs are estimated from the Gridded Population of the World (GPW)²⁵ and other data in collaboration with CIESIN.

- First public release of the population and settlements statistics and derived spatial indicators aggregated at national and sub-national administrative levels.
- A prototype of web platform for testing of alternative options in operationalization of the derived indicators and dissemination of information - processing on demand specific spatial indicators and aggregating them on user-defined spatial units.

Linkages with other GEO initiatives

The GHS GEO initiative will make strong linkages with the following activities included in the draft GEO Transitional Work Programme 2016²⁶

- CA-01 Global Land Cover
- CA-12 Soil mapping at regional and global level
- GI-09 Integrated Information Systems for Health (Cholera, Heat waves)
- GI-12 Use of Earth observations to support the implementation of the Sendai framework 2016-2030
- GI-13 Global Urban Observation and Information
- GI-15 GEO and SDGs. EOs role in providing support to countries in achieving SDGs and in defining and monitoring the associated indicators.
- GD-01 Data Sharing and Data Management
- GD 7 GEO Knowledge Base development
- CD 02 Promote the role of EOs and GEO in the post-2015 development agenda and in the UN Conventions
- CD-03 Reinforcing engagement at national and regional level (includes EO uptake for decision making)

In particular, regarding the linkages with the GI-13 “Global Urban Observation and Information” and CA-01 “Global Land Cover” they are concretized in two ways: i) active scoping of available information layers produced or improved by the GI-13 and CA-01 initiatives and suitable for the GHS objectives; ii) active sharing of the fitness-for-purpose assessments made by the GHS initiative and technical specifications for satellite-derived information production if relevant.

²⁵ <http://sedac.ciesin.columbia.edu/data/collection/gpw-v3>

²⁶ http://earthobservations.org/documents/excom/ec34/ExCom34_06_GEO%20Transitional%20Work%20Programme%202016.pdf

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AmeriGEOSS: A GEO initiative
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1. Executive summary

The Americas Caucus members (Argentina, Bahamas, Belize, Brazil, Canada, Chile, Colombia, Costa Rica, Ecuador, Honduras, Mexico, Panama, Paraguay, Peru, and the United States) have recognized the value of working together as one region to meet GEO objectives. In October 2014, the AmeriGEOSS initiative was born as a way to continue the progress made at that meeting in identifying regional needs GEO can address. Priority thematic areas identified form the technical basis of this initiative. The management arrangements that create organized thematic and coordination-working groups provide the sustained coordination framework to ensure the success of this initiative over the next decade.

With this initiative, the American Caucus assumes greater responsibility in short- and long-term planning for the development of activities through regional cooperation that reflect the local, national, and regional interest; this responsibility will be entrenched in the technical capabilities of its country members and in the resources of other global initiatives that may be available for the benefit of the region.

2. Introduction

The Americas Caucus members have recognized the value of working together as one region to meet GEO objectives: improve and coordinate observation systems; advance broad open data policies/practices; foster increased use of Earth Observation (EO) data and information; and build capacity across the GEO societal benefit areas (SBA's). Great progress and great relationships have been formed between Caucus principals and their staff during Caucus teleconferences and meetings. Three GEOSS in the Americas Symposia in Brazil in 2007, Panama in 2008, and Chile in 2011 have encouraged dialogue across thematic areas of importance to the region. While these Symposia provided valuable interchange, the ability to continue interactions have been hampered by lack of consistent regional coordination and communication other than preparation for and at Caucus-level meetings each year in association with GEO Plenary and Ministerial meetings.

Efforts to encourage further engagement have included offering general GEO overview webinars to GEO member countries in Fall 2013, reaching out to Americas Embassy representatives in Washington DC in August 2014, and the first ever GEO Americas Caucus 2-day workshop hosted by Americas Caucus Chair Colombia in October 2014.

On October 2014, delegates from Argentina, Canada, Chile, Colombia, Costa Rica, Honduras, Mexico, Panama, and United States, met in Bogotá, Colombia with the objective of sharing the experiences and activities of members of the Caucus of the Americas in the framework of the Group of Earth Observation (GEO). The members also explored how the regional perspective could be included within the GEO implementation Plan 2016-2025. Presentations from Argentina, Canada, Costa Rica, Brazil, USA and Colombia among others, were included as well as discussions on the Regional initiative to be proposed in the future of the GEO Implementation Plan for the 2016-2025 GEO decade. The discussions led to the identification of four areas of common interest to the countries of the Americas Caucus, along with a continued emphasis on capacity building:

1. *Agriculture, associated with climate variability, climate change, and food security*
 2. *Disaster risk reduction, particularly for data exchange associated with early warnings, and for the generation of regional products of early warnings*
 3. *Water, associated with the management approach of water resources and data management*
 4. *Biodiversity and Ecosystem Monitoring, in the context of capacity building for better monitoring, management, and maintenance of ecosystems and biodiversity they support; and to predict future changes*
-

The resulting Declaration from the October 2014 meeting was presented at the GEO-XI Plenary. This Declaration was discussed, and it was emphasized that these four areas of emphasis are in addition to those activities that are already working well, e.g. GEOI and SilvaCarbon.

Since the GEO XI Plenary, a small writing team from the GEO Co-chairs Colombia and Mexico, as well as members of the USGEO, have been developing this initiative. Following the path forged by the AfriGEOSS initiative, the AmeriGEOSS seeks to regionalize participation in the areas of Water, Agriculture, Disaster, Biodiversity and Ecosystems. This participation seeks to increase the efficiency and interoperability of Earth observations for better decision-making and to foster regional cooperation and capacity building among GEO members under the GEO principles.

3. Need for action

The Group on Earth Observations (GEO) was established as a voluntary partnership in February 2005 and in response to calls for action by the 2002 World Summit on Sustainable Development and the Group of Eight (G8) leading industrialized countries. These high-level meetings recognized that international collaboration is essential for exploiting the growing potential of Earth observations to support decision making in an increasingly complex and environmentally stressed world.

As of November of 2015, 15 countries in the American continent have joined this partnership to pursue the vision of GEO: “a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information.” Efforts on GEO’s SBAs have been taking place in the region and are in various stages of development; however, progress and engagement has not been uniform due to challenges of different nature, in particular the lack of a framework to harness opportunities for regional progress.

GEO’s regional caucus structures play an important role in the overall governance of GEO. Additional engagement across SBAs focused on regional, national or local level requirements has been shown to be beneficial by efforts such as SERVIR (<https://www.servirglobal.net/>), the EGIDA project (<http://www.egida-project.eu/>), the Asia-Pacific Symposia (<http://www.earthobservations.org/afrigeoss.php>) and AfriGEOSS (<http://www.earthobservations.org/afrigeoss.php>). This initiative defines regional coordination mechanisms to strengthen consistent engagement in the Americas, with the hopes to engage all countries in the Americas in the next decade.

4. User engagement

- a. *How established user communities link to the initiative*
- b. *How the activity would benefit stakeholders (in particular developing countries)*
- c. *How it feeds into decision-making processes*

Some GEO flagships are already addressing the AmeriGEOSS priority areas. The first step will be to engage with the GEO flagships and their end user communities from Americas member countries. From there, we will strengthen the engagement of other Americas countries, and work with the flagships to tailor their work to address regional needs. Regional needs will be brought to this initiative through coordination in the AmeriGEOSS initiative. In particular, unaddressed needs from developing countries will be prioritized. In each case, the data, information or tools being developed by the flagships will be tailored to meet the needs of the decision-makers in each of the Americas nations.

5. Previous development and results

Americas member countries have been working to contribute to the development of GEO. For example, within the Water SBA Information System Development and Capacity Building Task (WA-01-C5), led by Angelica Gutierrez from the United States, an excellent technical network has been established through the Centre of Hydrologic and Spatial Information for Latin America and the Caribbean (CIEHLYC). This group of water and remote sensing experts from governments and academia has created an international non-profit network that coordinates the activities of GEO for capacity building and development of water-related projects in Latin America and the Caribbean.

The United States, co-directs the network's activities of capacity building and project development with Mexico, Chile, and Argentina. These countries have initially taken the lead in their areas of expertise, but welcome others to participate and lead with activities related to water. Specific expertise includes:

- Mexico leads in oceanographic activities, with the management of the Antares marine monitoring network with stations in 10 countries in Latin America (<http://www.antares.ws>). The objective of this network of marine monitoring data is to generate high quality in situ data that enables the ability to discern between natural and anthropogenic variability. This network is a pioneer in this type of monitoring and currently represents the Latin American branch of the global network Chloro-GIN. <http://www.antares.ws>.
- Chile is leading capacity building for high school students, with its pilot program "GEO for the millennial generation," and promoting the use of the GEONETCast system not only for training, but also for decision making in the areas of agriculture and disasters.
- Colombia leads the campaign for the implementation of CNG-A system at national and local level, operating the first pilot project of mercury contamination in the region.
- Argentina leads the training in operational oceanography, including in numerical modeling of water quality, ecological, sediments, etc.
- The United States has the overall coordination of the group and leads activities in the area of hydrology and marine biodiversity. The U.S. has initiated a Marine Biodiversity Observation Network (MarineBON) demonstration project, with stations in Florida (Florida Keys coral reefs), California (Monterey Bay and Santa Barbara Channel), and Alaska (Chukchi Sea, oil exploration areas). These pilots are funded under a partnership of U.S. Federal agencies that include National Aeronautics and Space Administration (NASA), National Oceanic and Atmospheric Administration (NOAA), Bureau of Ocean Energy Management (BOEM) and private industry (Shell Oil). The Smithsonian Institute has also initiated a large international marine biodiversity experimental effort, the Tennenbaum Observatory. This larger MarineBON is a contribution by the U.S. to GEO BON.

AmeriGEOSS proposes to link some of these efforts to form groups of networks, and to provide pathfinder activities to foster regional collaboration. For example, there is significant potential benefit in collaborations between the agencies and scientists working on the Antares Network, the U.S. MarineBON pilot projects, and the Smithsonian Tennenbaum Observatory. They could be linked through AmeriGEOSS to both GEOBON and GEO Blue Planet to form a cross-cutting activity that links ecological observations to the socio-economic well-being of communities that depend on marine and coastal resources.

6. Partners

In addition to member countries, there are many participating organizations from the Americas countries. There are non-Americas countries contributing to the development in the Americas that also can serve as partners.

For example, the OAS Pan-American Institute of Geography and History (PAIGH) has members from 20 countries in the region, but limited participation in GEO, under the GSDI Specialized Organization entities. The Institute of Electrical and Electronics Engineers (IEEE) Geoscience & Remote Sensing

Society (GRSS) has chapters in the Americas and while IEEE is a participating member of GEO, IEEE GRSS could be more engaged. Also, in many Americas countries, there are embassy representatives that are active in bilateral and regional relationships and activities. We will continue to engage the embassies as a way to increase communication, identify representatives in countries which are already members of GEO, and as a means of inviting new countries to join GEO.. They also may be able to provide additional services during project execution, e.g. translation services.

7. Activities description

The specific goals of the AmeriGEOSS initiative are to address coverage gaps, develop actionable tools and services, build capacity in GEO-member countries by leveraging existing expertise, technology, and efforts in-country and across the region, and apply the knowledge and capabilities of partner members to address gaps and challenges. Over the next ten years, the partnership will:

- Enable countries to benefit from improved environmental understanding, to better address societal needs in the following areas: Agriculture, Disaster risk reduction, Water, and Ecosystems including Biodiversity monitoring.
- Leverage technical resources, and scale up existing capabilities throughout the region.
- Strengthen institutional and personal capacity, through sustained and targeted training in the use of EO.
- Promote open community-developed data standards and data sharing. The term “data” refers not only to the observations obtained through in situ or satellite monitoring, but also to information obtained through modeling.
- Promote the integration of data products that bring together in situ and satellite observations in the relevant areas of cooperation
- Promote the implementation and strengthening of regional Earth observing systems

To accomplish these ambitious goals AmeriGEOSS will:

- Assist in the coordination of pilot projects,
- Facilitate interoperability of data resources for reuse at global, regional and/or national scales
- Promote learning and mentoring of water data tools, standards, conventions and best practices for improved environmental understanding at the local level
- Engage stakeholders to address global and regional challenges
- Foster regional cooperation to build institutional and personal capacity
- Assist in activities that will lead to the strengthening of regional observing GEO networks.
- Deliver regional data and information
- Use and promote, where appropriate, foundational activities of GEO

AmeriGEOSS also seeks to increase institutional and personal capacity through the acquisition and sharing of technology and training, and engage experts, stakeholders, and decision makers in the process of decision making through cooperation.

4.15 Areas relevant for coordinated projects that focus on societal benefits

Proposed areas are:

- Agriculture, associated with climate variability, climate change, and food security;
-

- Disaster risk reduction, particularly for data exchange associated with early warnings and for the generation of regional products of early warnings.
- Water, associated with the management approach of water resources and data management.
- Biodiversity and Ecosystem Monitoring in marine, freshwater, and land habitats, in the context of capacity building for better monitoring, management, and maintenance of ecosystems and biodiversity they support; also to predict future changes.
- Several thematic areas have longstanding engagement in the Americas, and will continue to engage and be strengthened, e.g. in the areas of biodiversity and forest management.
- Specific activities that will help to improve information systems and the exchange of experiences, e.g. communities of practice; strengthening national capacities through a comprehensive program with vision, resources, and its own life; and webinars and technical seminars.

▪ **Agriculture and Food Security Activities**

Agriculture, associated with climate variability, climate change, and food security, is another focus of this initiative. The socio-economic and environmental characteristics of the region call for a unique vision when implementing agricultural monitoring initiatives. Food security is integrally linked with water availability for natural systems, for agriculture, and for the built environment (cities, towns, industrial parks, ports, etc.). Food security is also intimately linked with land use, land cover, and coastal management practices that sustain optimal biodiversity states and ecosystem productivity for healthy ecosystem services. Contrasts in the level of development of agricultural productivity, as well as the climatic and topographic diversity among regions and countries of the Caucasus demand new approaches to the application of Earth observations for the collection and processing of information from the agricultural sector. While the GEOGLAM initiative has advanced information for the global monitoring of crops and markets, its application in countries of tropical agriculture with more complex dynamics requires new methodological and conceptual approaches. The concept of implementing AmeriGEOSS in agriculture and in coastal and marine biodiversity monitoring is a valuable opportunity to strengthen the actions of GEO globally by responding to the needs of the regional level in the Americas. The decisions in agriculture, aquaculture, and coastal resource use by AmeriGEOSS countries will collectively spur further actions for capacity building and information exchange among countries of the Caucasus.

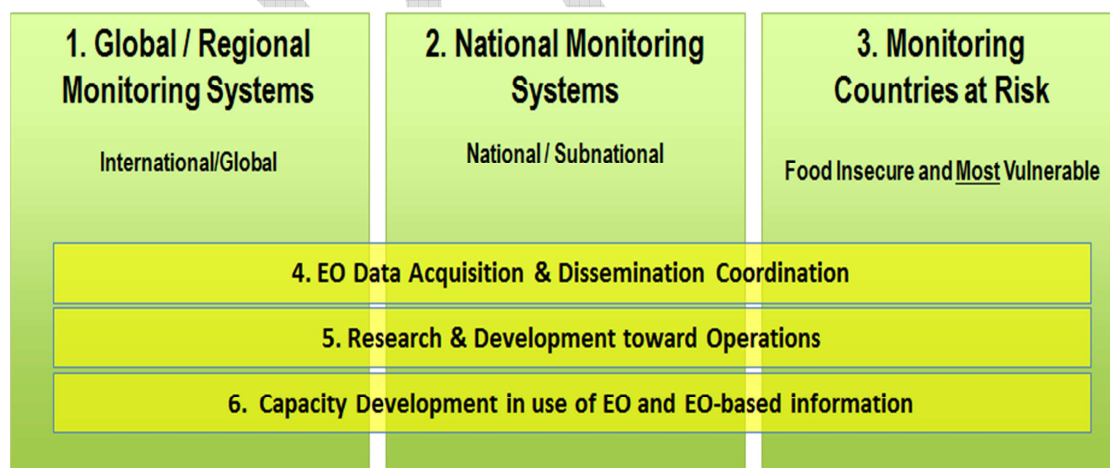
The world's population has increased by 130% during the last 50 years, from an estimated 3.0 billion in 1960 to 6.9 billion in 2010. The United Nations projects that it will increase by 0.8% per year to reach 9.2 billion people in 2050. Food demand is driven by population size and consumption habits, which in turn are influenced by culture and standards of living, with average food consumption varying greatly across the globe. In addition to providing food and feed (animal), agriculture, aquaculture and fisheries also generates products for the energy (biofuels), materials (wood, fibres, textiles) and chemicals industries, with an increasing competition among these sectors (4F: Food, Feed, Fuel, and Fiber). Properly managed ecosystems with a desired biodiversity offer significant economic opportunity beyond food security, including tourism and recreation, adequate clean water supply, and emerging opportunities in other chemical harvesting, such as for pharmaceuticals.

The agriculture, aquaculture, and fisheries sectors faces new and emerging challenges to meet the demands of growing populations for an ever-broader spectrum of agricultural products, fish migrations, and invasive species. One of the challenges is particularly in the context of a

changing climate. At the global levels, agricultural and fisheries production are marked by high temporal and geographical variability. Furthermore, over the past decade, agricultural markets have become increasingly volatile, threatening food security and human livelihoods. Fisheries and coastal living marine resources have been stressed everywhere around the globe for many years. The diverse socio-economic and environmental characteristics of the Americas call for creative approaches in implementing agricultural and marine living resource monitoring initiatives. Contrasts in the level of development of agricultural productivity and marine industries, as well as the climatic and topographic diversity, among regions and countries of the Americas Caucus demand new approaches to the application of EO for the collection and processing of information about the agricultural and marine living resources use sectors.

To this end, in 2011 the G20 Agricultural Ministers mandated the creation of a GEO Global Agricultural Monitoring Initiative (GEOGLAM), toward improving the use of EO-based information about crop condition and production at earlier periods in the agricultural growing season. GEOGLAM also provides an opportunity to develop management paradigms that consider linkages between water quality, land use, coastal and marine resource health, and sustainable use. GEOGLAM's primary objective is to reinforce the international community's capacity to produce and disseminate timely and accurate information on agricultural production at national, regional, and global levels through the use of satellite and *in situ* EO. The tools underpinning remote sensing-based agricultural monitoring have developed or multiplied, but the adoption of these tools, as well as the access to the space-based data required for monitoring, remain heterogeneous across the globe, including the Americas. Similar tools are being developed for marine resource observation. Through the coordination of satellite and *in situ* observations, and through the transparent sharing of methods and information, GEOGLAM aims to improve regional-to-global scale agricultural information.

GEOGLAM has 6 components, including 3 core components and 3 cross-cutting components:



Component 1 deals with the creation of global and regional monitoring systems, and has been quite active with the creation of its Crop Monitor for AMIS (Agricultural Market Information System; www.amis-outlook.org; www.geoglam-crop-monitor.org) and in Asia through the Asia-RiCE (www.asia-rice.org) activity. However, there is a strong need to create more regional networks around the world, including in the Americas. The current Crop Monitor for AMIS focuses only on maize, soybean, wheat, and rice, and focuses only on the G20+7 countries responsible for 80% of their global production,, leaving important subsistence areas and crops outside of the formal reporting procedure. To this end, GEOGLAM is developing

an Early Warning Crop Monitor, targeting areas vulnerable to food insecurity, with special attention to the relevant crops and threats to crop production not accounted for in the current Crop Monitor for AMIS. Also, acknowledging that rangelands and pasture lands are a crucial component of food security and markets both in the Americas and beyond, GEOGLAM is also developing its Rangeland and Pasture Productivity (RAPP; www.geo-rapp.org) monitoring activity, which has its own efforts to develop national capacity, build a network of test sites for best-practices development, and is in the process of prototyping a RAPP Monitor as well.

Supporting the growth national monitoring systems which utilize EO data for analyses and the production of national statistics is a crucial component of GEOGLAM (Components 2 & 6). In the Americas, several investments have been made in the strengthening of national capacity to utilize remote sensing-based methodologies in Mexico, Brazil, and Argentina. These efforts include training workshops, sharing of best practices, and the transfer and installation of various EO-based monitoring systems to national monitoring agencies. The University of Maryland and NASA have partnered with SAGARPA (Mexico), CONAB (Brazil), and INTA (Argentina) to customize and install the Global Agricultural Monitoring [GLAM] system (e.g. <http://pekko.geog.umd.edu/glam/brazil/zoom2.php>). The GLAM system utilizes time series of MODIS data and ancillary information to aid near-real time monitoring of crop conditions and decision support. Meanwhile, research activities have been undertaken in the Americas to refine methodologies and develop best practices via the Joint Experiment on Crop Assessment and Monitoring (www.jecam.org), a network of agricultural test sites distributed across diverse agricultural landscapes, and led by Agriculture and AgriFood Canada.

At present, there are generally poor statistics on regional marine biodiversity and living marine resource exploitation. GEOGLAM provides an opportunity for countries to better manage these national resources.

Crucially, there remain many opportunities to engage additional Central and South American countries in the GEOGLAM initiative, but institutional and financial support are needed in order to progress in this domain. This would be greatly facilitated by the creation of an Americas GEOGLAM with a strong coordination body, to maximize knowledge, experience, and data transfer north, south, east, and west. The concept of implementing AmeriGEOSS in agriculture and living marine resource use is a valuable opportunity to strengthen the actions of GEO globally by responding to the needs of the regional level in the Americas. The decisions in agriculture and marine resource by AmeriGEOSS countries will collectively germinate further actions for capacity development and information exchange among countries of the Caucus.

Contributors:

- AAFC (Agriculture & Agri-Food) Canada
 - INTA (Instituto Nacional de Tecnología Agropecuaria) – Argentina
 - SAGARPA (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación Secretary of Agriculture) - Mexico
 - CONAB (Companhia Nacional de Abastecimento) -Brazil
 - INEGI (Instituto Nacional de Estadística y Geografía) – Mexico
 - USDA (U.S. Department of Agriculture) - USA
 - USGS (U.S. Geological Survey) – USA
 - NASA (National Aeronautics and Space Administration) – USA
 - University of Maryland - USA
-

- **Disaster Activities**

The vulnerability of members of the Americas Caucus to the effects of climate change and increasing variability requires the adoption of appropriate approaches for the region to enable integrated management of the disaster cycle, particularly with the implementation of mechanisms for exchanging information that will generate national and regional early warning products. It is necessary for the region to develop a plan for capacity building on the use of geospatial information and to work towards disaster risk reduction, particularly for data exchange associated with early warnings and for the generation of regional products of early warnings. Current initiatives and projects, such as different architectures and platforms, can help fill the gaps between countries for effective risk management of disasters at the regional level, which in turn can contribute to overall risk management in the framework of GEO.

7.1.1.1.Data broadcast through GEONETCast-Americas (GNC-A)

GEONETCast Americas is a service that is well-suited to disaster preparedness and response. GNC-A receive stations can, in many if not most cases, operate with a 1.8-meter or smaller antenna in emergency situations. They do not rely on the Internet or a utility provided power source. Since the receiver powers the antenna, a mobile power source, such as a generator, is all that is needed to power the station. These factors allow GNC-A stations to be portable. The International Charter on Space and Major Disasters recognizes GEONETCast Americas as an alternative dissemination system. GNC-A users have sent a petition letter to the Disaster Charter so that once the Charter is activated, the information (including high-resolution imagery related to the disaster area) be transmitted through the GNC-A system.

7.1.1.2.DEWETRA

DEWETRA is an open source platform capable of ingesting multiple data formats, combining dynamic and static layers to build disaster risk scenarios in near real time,. It is an excellent prospect platform for integration, visualization, and data management of the early warning systems. DEWETRA is the Italian Government's contribution to the Group of Earth Observations (GEOSS)

DEWETRA has been implemented by the hydro-met services in Ecuador (INAMHI) and Bolivia (SENAMHI). In Bolivia the DEWETRA platform was installed a few years ago, as part of a project on early warning with a meteorological approach. A new phase is about to start to strengthen flood forecasting. Various ministries and institutions such as the hydrometeorological National Service (SENAMHI) and the Vice Ministry of Civil Defense (VIDECI) use the DEWETRA platform.

Dr. Lauro Rossi (lauro.rossi@cimafoundation.org), DEWETRA coordinator in Italy, provided information to the Hydro-met services in Colombia (IDEAM). IDEAM in association with the Climate Change Adaptation Fund and the Spaniard Meteorological Agency (AEMET), is developing an Early Warning System for Colombia which includes four weather radars, the integration of the four existing radars in the country, and the integration of 410 semiautomatic hydrometeorological stations within the system. Such infrastructure must be articulated through a software architecture that allows modeling risk scenarios in near-real time as well as an interface for alert products, reports, etc.

DEWETRA, is an excellent prospect platform for integration, visualization, and data management of the early warning system of Colombia. The implementation of the platform

will be sought within the framework of GEO actions, to strengthen the prognosis, monitoring, and risk prevention in the areas of hydrometeorology and forestry wildfires.

Contributors:

- CIMA (Centro Internazionale in Monitoraggio Ambientale) – Italy
- USGS (United States Geological Survey) – United States
- NOAA (National Oceanic and Atmospheric Administration) – United States

▪ **Water activities**

The growing impact of weather phenomena and land use changes (e.g., loss of forest) in the region significantly influences the variability of the hydrological cycle, which leads to greater difficulty in determining not only the amount of available water, but the amount of resources required to manage and mitigate water-related disasters creating economic and social instability in the region. Activities in inland areas can have large impacts on coastal zones and the living marine resources and human communities living in these areas. Caucus member countries of the Americas must evolve in the area of water-resources data management in order to have the necessary tools and observations for better management decisions. This management focused on water resources needs a Water Strategic Framework that provides a well-supported “regional” water implementing mechanism to leverage regional and local resources and that allows for the implementation of programs that address regional development of observing systems, interoperable data infrastructure, capacity building and institutional strengthening. The philosophy to design and implement these systems needs to consider the geography of the region from mountaintops to the ocean.

This framework is provided by the **GEO Global Water Sustainability (GEOGLoWS)** initiative, **a user driven initiative** with a “community centric dynamic implementation” plan, which provides a common context and community of practice to support implementation of different projects, programs, and activities as they move at their own pace. This initiative is intimately linked with GEO BON efforts to establish a scientifically robust framework for observations to detect biodiversity change (e.g. in to migratory, endemic, invasive or other species). Together these efforts provide information to characterize and understand regional ecosystems and to develop improved and sustainable resource use practices.

Acting within the framework of the GEOGLoWS, AmeriGEOSS will facilitate the interaction mechanisms within the member countries of the Americas Caucus that includes a national, regional, and local perspective to support the development of sustainable EO-based terrestrial water information systems. As the adoption of EO-based methodologies will be heterogeneous across different administrative, political, and hydrologic divisions, implementation of GEOGLoWS will need to be user-driven and user-defined.

The GEOGLoWS initiative provides a framework for effectively mobilizing EO assets to contribute to mitigating water challenges on various scales and across different climates and landscapes. GEOGLoWS seeks to use EO and associated tools and assets to decrease regional tensions and the risk of instability and state failure by ensuring that water is available to all, even as the proportion of people living in high water stress is increasing due to climate change, population growth and economic growth; and inequities exist in nations’ access to data for decision making.

GEO, through its unique value proposition of convening communities and through its broad membership, provides the right environment for a regional collaboration. Under the GEO

principles, we will pursue the implementation of coordinated actions that will assist in developing water initiatives that recognize the services that ecosystems provide to freshwater and coastal and marine systems. With this broad perspective, we recognize the need and importance to develop a strategy for collaboration that is inclusive in nature and that reinforces the role that national and regional government organizations play in the success of this regional effort. AmeriGEOSS will assist in the evaluation of existing observation frameworks that in many cases need to be shored up and in some cases rescued, and will assist in the evaluation of innovative and low-cost technology within new observation frameworks needed to fill critical gaps. The goal of this initiative is to work towards improved quality, timeliness, range, availability, interoperability, and use of EO through data-sharing principles and mechanisms of cooperation.

Freshwater, marine, and land systems are linked. They are affected by the quality of water that runs off the land surface and meteorological conditions that link them through the hydrologic cycle. Local ecosystem services are affected by phenomena that operate at regional to global scales. Observations are needed to fully understand the linkages and feedbacks between water availability and quality and biodiversity, ecosystem productivity, and ecosystem services. GEOGLoWS supports the GEO BON goals of supporting marine and freshwater resource management tools for conserving existing biodiversity and enhancing biosecurity against threats such as invasive species and infectious agents. To achieve this goal, marine biodiversity, the biodiversity of freshwater aquatic systems, and the biodiversity of land ecosystems, including the various uses given to these by people, must be monitored at scales ranging from microbes to whales and from the benthos to treetops in different environments.

Many major and critical water observing systems have been declining in recent years. Water-related observations (i.e. not just observations of water specifically, but of myriad Earth parameters that are relevant to hydrologic processes) are equally important and have similar issues. In many cases, observation data important to water prediction are declining, difficult to discover and access, use legacy formats, and have not improved significantly in many years. Moreover, there are very significant data gaps where innovation would be welcome. Technologies such as *sensor webs* and others could be part of the next generation of water monitoring to form massive observation networks that could be readily consumed by water prediction and related services.

The activities proposed for the water area and within the AmeriGEOSS initiative, will aim to provide a regional response to the challenging issue of water services as well as the management perspective of the resource. We will seek the support of development partners in the region.

The following activities are identified as relevant for coordinated infrastructure projects:

Linkages between land use characterization and management coordination efforts and biodiversity monitoring efforts to improve ecosystem-based management.
Develop the MarineBON Pole to Pole activity (7.1.1.7 below) in a manner that establishes linkages with watershed, water availability and coastal and estuarine water quality initiatives.

7.1.1.3. GEOSS Water Services

The interactions between human communities and the natural environment should be managed to enhance the availability of water, optimum biodiversity and production of food, while sustaining other uses of relevant terrestrial and marine ecosystems to stimulate economic and social health. The primary goal of the GEOSS Water Services is to encourage

and help government data providers and research centers to publish water resource time series data, including observed and modeled variables such as stream flow, stream depth, precipitation, soil moisture, runoff, water quality, and others. These data are important to our understanding of the frequency, variability, and consequences of extreme weather events (storms, floods, drought), as well as for supporting consistent, on-demand pictures of regional and national water availability. An important aspect is to understand the value of biodiversity and other ecosystem services in maintaining water resources. For the past three years, the GEOSS Water Services team has worked with participants from developed and developing countries to help them publish water resource data, using the GEOSS Architecture Implementation Pilot (AIP) as a convening venue. GEO-CIEHLYC, a working group of GEOSS in the Americas is participating in the outreach activities of the GEOSS Water Services by promoting the benefits of this application to the regional and local communities, and water management organizations, and by providing capacity building activities that foster the use of the application.

7.1.1.4. HydroServer

HydroServer Lite developed by The Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) provides an open source solution to water observation data management that can fulfill the needs of a variety of organizations charged with the collection, management, and dissemination of this vital information to the larger public, private, and academic scientific community. It is built on accepted standards such as the CUAHSI Object Data Model (ODM) and the WaterML web services. As part of previous AIP's we have made contributions to these tools such as translations to Spanish and other languages, and conducted pilot implementations in local and national hydrometeorological agencies. We will continue to make the HydroServer tool available and provide training as well as work towards the development of a regional catalog where individual entities that stand up and operate data sharing tools like HydroServer can register their data and services and make them more easily discoverable. Part of this registration will include connectivity to GEOSS. The primary purpose of the development of the HydroServer water information management and dissemination tools along with the ECMWF-RAPID stream forecasting model is to lower the barrier for national hydro meteorological services and other academic, government and non-government institutions charged with collecting, managing, and providing water information to end-users to be able to stand on their own technologically. The open source platform on which the tools have been developed allows adopting organizations to become participants in the process and stand shoulder to shoulder with other users and the developers according to their current capacity, even while elevating what they know through adaptation and customization to their specific needs. The idea that we are developing local and international networks of support is fundamental to the objectives of this and the overarching GEO capacity building effort.

7.1.1.5. ECMWF-RAPID Stream Flow Prediction

As part of an ongoing effort to transform the US National capacity for streamflow prediction a National Flood Interoperability Experiment (NFIE) was undertaken. In conjunction with the AIP work a new cloud-based streamflow prediction application based on the global meteorological and land surface runoff forecasts produced by the European Center for Medium-Range Weather Forecasts (ECMWF). This system forms the basis of the Global Flood Awareness System or GloFAS (<http://www.globalfloods.eu/>) and provides a valuable resource for monitoring severe events over large basins globally. In order to be useful to regional and local water data managers it is important to provide this information on smaller watersheds as it currently only works for watersheds on the order of 10,000 sq. km and larger. As part of the NFIE/AIP work, a methodology to downscale the ECWMF forecasts has been

developed to stand up watersheds of any size and provide valuable streamflow prediction using a cloud-based computational and data discovery tools. This work, as demonstrated in the NFIE where the nearly three million river reaches of the National Hydrography Dataset (NHD-Plus), have been made operational, can be extended to any other region of the world. In developing areas where information and tools are limited, this represents a major step forward in developing the capacity to have critical forecasted flows for river networks. Using this tool it is possible to extend NFIE to a global scale, or Global Flood Interoperability Experiment (GFIE).

7.1.1.6.Meteorological Products through GEONETCast

Water activities from a regional perspective include water products from the hydro-met services nations in America, which are users of the GNC-A system. These products add new capabilities for activities related to resources management and to other objectives of GEO.

The main contributions in terms of regional products come from the following nations:

- El Salvador and Costa Rica, contributes with WRF model output and the .5 KM NCEP model data broken out for Central America, the Caribbean, and South America, this contribution continues in 2016.
- Brazil will implement 23 new GNC-A receiving stations in each of their regional hydrometeorological services.
- Colombia's hydro-met service (IDEAM) has offered to contribute with hydro-met and GEOBON products in 2016.

Contributors:

- IMN (Instituto Meteorológico Nacional) – Costa Rica
- IDEAM (Instituto de Desarrollo del Ambiente) – Colombia
- MARN (Ministerio de Medio Ambiente y Recursos Naturales) – El Salvador
- JRC (Directorate-General Joint Research Centre) - European Commission
- INPE (Instituto Nacional de Pesquisas Espaciais) - Brasil
- UBY (University of Brigham Young) – USA
- NASA (National Aeronautics and Space Administration) – USA
- USGS (United States Geological Survey) – USA
- NOAA (National Oceanic and Atmospheric Administration) – USA

▪ Ecosystem and Biodiversity monitoring activities

The Americas region is one of the most biodiverse regions in the world, containing 6 of the world's 17 megadiverse countries. While current GEO initiatives like GEO BON (GEO's Biodiversity Observation Network) and the GEO Ecosystem Mapping effort have a global focus, their implementation in member countries of the Americas Caucus is in a relatively early stage. Monitoring programs that provide information to establish the impact of changing ecosystems and ecosystem services on the economic and social development of the region are almost non-existent.

There are very few terrestrial, freshwater, and marine biodiversity and ecosystems programs in the Americas, which promote the development and use of science for the sustainable management of these resources. Those that exist are hindered by a general lack of finances to sustain program activities. There is also a lack of coordinated networks of collaborating institutions seeking to understand regional shifts in the status and trends of ecosystems at a time when terrestrial and marine ecosystems are under increasing natural and human-generated pressures.

The AmeriGEOSS initiative will promote the development of biodiversity and ecosystems monitoring (including ecosystem services) networks, with the aim to develop a regional system for monitoring changes to biodiversity and ecosystems in the region. These monitoring systems will promote GEO BON's (see Section 7.1.4.3 below for more information on GEO BON) conceptual framework for standardized biodiversity observations (i.e. the Essential Biodiversity Variables, or EBVs – Section 7.1.4.6), allowing for scaling of ecosystem and biodiversity observations from national to regional to global levels.

7.1.1.7. Regional Ecosystem and Biodiversity Information Networks

AmeriGEOSS will endorse and where possible support the development of regional ecosystem and biodiversity information development and networks. A pole-to-pole Marine Biodiversity and Ecosystems Observation Network for the Americas is currently in discussion as a foundational element of MBON (Marine Biodiversity Observation Network), a thematic BON associated with GEO BON. This pole-to-pole distribution of monitoring sites could provide for the collection of information from a variety of different marine ecosystem types. The Marine Working Group of GEO BON is actively developing the MBON concept, and is planning its initial deployment in the Americas as an AmeriGEOSS priority. In a related activity, the U.S. Geological Survey, in collaboration with Esri, is implementing a standardized, data-derived, 3D mapping of global marine ecosystems. The Americas subset of these global marine ecosystems could be incorporated as a stratification mechanism for selecting monitoring sites, thereby addressing the representativeness criteria in the site selection process. Once mapped, these marine ecosystems of the Americas could be assessed for vulnerability and the provisioning of ecosystem services. One of the objectives of the Pole to Pole MBON (Section 7.1.4.4) is to provide the dynamic, ongoing observations needed to update the state of these initial ecosystem maps.

Other regional ecosystem information networks exist or are in development and could be integrated under AmeriGEOSS. For example, a marine environmental observation network using satellite remote sensing has been developed by the Comisión Nacional para el Conocimiento y Uso de la Biodiversidad (CONABIO) for Mexico. This network, the Automatic Ocean Monitoring Satellite System (SATMO), has been developed to provide near real time, continuous monitoring of the daytime sea surface temperature (SST) nighttime sea surface temperature (NSST and SST4) and other biophysical parameters such as ocean color, the concentration of chlorophyll a (Chl_OC3 or CHLO), chlorophyll fluorescence (FLH), the diffuse attenuation coefficient (K₄₉₀ or K490) the concentration of total suspended material (TSM_{Clark} or TSM), and the remotely sensed reflectance (R_{rs} λ). This system collects marine environmental data as important contextual information for understanding biodiversity distributions in Mexican waters and adjacent ocean regions. These georeferenced products are obtained daily from 1 km MODIS (Moderate Resolution Imaging Spectroradiometer) satellite imagery received at CONABIO's ground receiving station after each pass of the Aqua and Terra satellites. The system automatically provides composite images for several weekly and monthly ocean products as well as weekly and monthly compound anomalies in the concentration of chlorophyll a and the sea surface temperature based on weather compounds 9 year (July 2002 - June 2011) generated from MODIS-Aqua. Similar satellite products are needed to cover the rest of the Exclusive Economic Zones of countries of the Americas.

Groups presently engaged in the U.S. MBON projects are developing a series of satellite-based products that represent dynamic 'seascapes'. These use the satellite products mentioned above to derive a 'thematic classification' based on historical and current ocean conditions

that informs users on changes in marine ecosystems and how these may be affecting the functional biodiversity of an ecosystem. AmeriGEOSS will work with these groups to make such products widely available.

7.1.1.8. Ecosystem Services

Terrestrial, freshwater, and marine ecosystems provide many goods and services which benefit humankind. These ecosystem goods and services are generally thought of as provisioning services (food, water, fiber, etc.) regulating services (climate, water quality, flood control, etc.), supporting services (nutrient cycling, pollination, etc.) and cultural services (spiritual benefits, recreation, etc.). Under AmeriGEOSS, ecosystem services valuation and accounting will be promoted. Best practice approaches for national ecosystem accounting (e.g. the United Nations System of Economic and Environmental Accounting (SEEA), and the World Bank's Wealth Accounting and the valuation of Ecosystem Services (WAVES) program) will be investigated for application in national ecosystem accounting efforts.

Ecosystem services are an important part of many important economic activities in the region: industry, tourism/recreation, transportation, water supply and purification, coastal protection, carbon sequestration, and resource extraction by fisheries and aquaculture. Certain ecosystems provide many ecosystem services at the same time, as "bundled" benefits from nature. Coral reefs are an example of such complex ecosystems, providing ecosystem services related to fisheries management, tourism, and construction materials. In general, coastal and continental margins account for over 90% of world fish production. In coastal areas of developing countries, more than 20% of the protein is derived from fishing activities. In Latin America, many of the national gross domestic products (GDPs) are strongly related to ecosystem services associated with the coastal areas. However the indirect benefits from these ecosystems are rarely accounted for in a manner proportional to their importance. An AmeriGEOSS focus on promotion of best practice approaches to incorporate ecosystem services values, both economic and non-economic, will address the current lack of attention in this area.

7.1.1.9. GEO BON in AmeriGEOSS

GEO's Biodiversity Observation Network (GEO BON), is a flagship program of GEOSS with a global scope. GEO BON's mission is to improve the provision, coordination, and delivery of biodiversity information and services to users, particularly decision-makers. AmeriGEOSS envisions a regional implementation of GEO BON activities to support ecosystems and biodiversity conservation and management in the Americas. The 2025 vision for GEO BON under AmeriGEOSS is the existence of a robust, extensive and interoperable biodiversity and ecosystems observation network covering the major biomes of the Americas. AmeriGEOSS will promote the development of a regional monitoring capacity for biodiversity and ecosystems through the establishment of interoperable national and regional observation networks that can be integrated with global biodiversity and ecosystem monitoring systems. Regional observation networks will focus on the collection, management, sharing and analysis of ecosystems and biodiversity observations. In turn, that information should facilitate decision-making in support of sustainable management of natural resources. This information should contribute to effective and timely conservation, sustainable use, and mitigation and adaptation decisions regarding the America's ecosystems, the biodiversity they support, and the services provided.

7.1.1.10. Marine Biodiversity Observation Network (MBON)

GEO BON recognizes two different kinds of biodiversity observation networks, regional BONs and thematic BONs. A new thematic BON called the Marine Biodiversity Observation Network (MBON, mentioned above in Section 7.1.4.2), is emerging for the purpose of dedicating attention and resources to marine ecosystems and biodiversity. The MBON will be piloted in Latin America and the Caribbean, in essence creating both a regional and a topical BON in one key AmeriGEOSS activity. The MBON will prioritize the development of an Americas-wide marine ecosystems and biodiversity observation network. In addition to national priorities, a pole-to-pole marine ecosystems map under development between USGS and Esri will inform site selection decisions for the construction of the MBON. A variety of information is planned to be collected at the MBON network locations. Program development and information collection priorities at MBON sites will reflect national marine biodiversity and ecosystem priorities as well as the EBV framework. MBON site selection and program development will be a key focus in the initial MBON implementation phase. Sites like Parque Nacional Natural Corales de Profundidad in Colombia (see below), the Antares network (<http://antares.ws/>), and the SARCE network (<http://sarce.cbm.usb.ve/>) which are already contributing significantly to the documentation of marine biodiversity change, will be identified as model examples of candidate MBON sites.

7.1.1.11. Parque Nacional Natural (PNN) Corales de Profundidad (Colombia)

MBON will seek to identify changes occurring to the coastal and marine biodiversity and ecosystems of the Americas. In Colombia, the research and monitoring efforts at the Deep Corals Natural National Park, are already documenting change in biodiversity variables in this deep-sea corals ecosystem. These coral reefs, especially the mesophytic reefs (30 – 15 m deep) and cold-water corals (> 200 m deep), are known to be closely interrelated to shallow coral reefs (<30m depth). Colombia has made great efforts to protect these resilient marine ecosystems which contain 60% of the deep-sea ecosystems in the Colombian part of the Caribbean. However, the study of biodiversity associated with these deep systems is difficult due to high monitoring costs, poor technological infrastructure, lack of trained personnel, and other reasons. As a contribution to MBON and AmeriGEOSS, a biodiversity monitoring program, particularly for planktonic communities (phytoplankton and zooplankton) is proposed, as changes in these communities could be useful indicators of potentially harmful environmental change like continental runoff, global warming, and ocean acidification.

In 2016, the PNN Corales de Profundidad deep coral group expects to have full biological characterization of deep coral formations, which will provide the baseline for the study of the biodiversity of these cold waters located between 150 and 400 m deep. This type of rigorous characterization of these formations could be useful for contemplation elsewhere in the MBON network. The current monitoring at the site could also be potentially expanded to include other biological and environmental variables, consistent with the Essential Biodiversity Variables (EBV) framework described as follows below.

7.1.1.12. Essential Biodiversity Variables

One of the global priorities of GEO BON is the adoption and implementation of the Essential Biodiversity Variables (EBVs) as an over-arching framework for biodiversity observation

systems. GEO BON under AmeriGEOSS will promote the use of EBVs as a consistent and rigorous set of concepts that frame a comprehensive biodiversity and ecosystems observation strategy. The EBVs will be presented to scientists, natural resource managers, and policy makers in an Americas-wide education and capacity building effort. This outreach will include guidance on the development of biodiversity observation networks, and provision of modeling and analysis tools, and interoperable data management systems. GEO BON has initiated targeted capacity building and technology transfer efforts at the national and regional level (e.g. development of a “BON in a Box” toolkit) focusing on enhanced observations to facilitate improved policy and decision-making. These approaches reflect the need to provide a top-down design for a global observation system (e.g. EBV’s, monitoring guidelines, interoperable data systems) with the pragmatism of a bottom-up construction process (e.g. through national and regional capacity building). In addition to promoting the uptake and use of EBVs in the region, a consolidation of information on EBVs could be used as the basis for assessing the status and trends of biodiversity and ecosystems in the Americas. Specific EBV objectives include 1) further definition of EBVs and assessment process for determining biodiversity status and trends, 2) management of technical and administrative mechanisms for the generation and collection of EBV information, 3) management of mechanisms for strengthening capacity building related to EBVs, 4) integration and analysis of information across national and regional biodiversity and ecosystem monitoring initiatives, 5) product generation for EBV information synthesis, and 6) promotion of efficiency emphasizing synergies and collaborations among and between regional biodiversity observation programs.

7.1.1.13. Established Biodiversity Activities

7.1.1.13.1. BON in a Box: Latin America

BON in a Box (Biodiversity Observation Network in a Box) is a regionally customizable and continually updated online toolkit for lowering the threshold for the start-up or enhancement of biodiversity observation systems. With a particular focus on national and regional systems, BON in a Box will facilitate discovery and access to state-of-the-art tools. Tool classification and filtering will allow for guidance on the appropriate use of the tool. It is through this process that we will see greater harmonization of observation design and data collection, management, analysis and reporting amongst and between nations.

The development of BON in a Box is being piloted in Latin America led by the Alexander von Humboldt Institute of Colombia on behalf of GEO BON. To date, a survey has been sent to over 1000 people in the Latin American region (15% response rate) in an effort to better understand needs regarding the generation and use of biodiversity data and a workshop in Colombia with over 50 participants from 8 Latin American countries (Mexico, Costa Rica, Panama, Colombia, Ecuador, Peru, Bolivia and Brazil) was held in April 2015. The workshop was focused on specifically designing the structure, content and functionality of the Latin American pilot (see Figure 2 as an example of the potential look and feel). The first version (beta version) of BON in a Box: Latin America will be released this fall (launched at the CBD SBSTTA19 and GEO Plenary meetings in November) and will be in Spanish, Portuguese and English. The full version will be ready in late 2016. The toolkit is comprised of two major elements – a web-based, searchable and customizable user interface and a database of tools that are characterized based on a series of tags (e.g. EBV class, observation component, scale of use, etc.). To date, the look and feel has been partially designed, the database of tools is in development with close to 100 tools identified and a number of partnerships have been established or are being negotiated for specific tool development (e.g. EarthWatch Institute to develop citizen science tools; iNaturalist to produce a template for

national versions; Map of Life to produce a national and regionally customizable version for tropical Latin America). The toolkit will be continually updated to ensure that the information contained within remains relevant and allows access to the newest tools available.

7.1.1.13.2. Global Forest Observation Initiative (GFOI) and SilvaCarbon in the Americas

GEO's Global Forest Observation Initiative (GFOI), like GEO BON, is another flagship program of GEOSS. GFOI seeks to build global capacity in inventory, monitoring, and evaluation of global forest resources, and includes a forest carbon accounting dimension as well. The fundamental objective of GFOI is to help nations develop a capacity to utilize earth observation data in a credible national forest monitoring system that can provide input to national monitoring, reporting, and validation systems for greenhouse gas emissions and removals. From the beginning, GFOI has had a strong regional focus in Latin America, with foundational support from three Americas Caucus member nations: Colombia, Mexico, and the United States. Many of the GFOI concepts and documents have originated from GFOI program implementation in the Americas. GFOI seeks to further institutionalize and increase the regional implementation of its program in the Americas region through incorporation in the AmeriGEOSS agenda as a high priority. SilvaCarbon, the capacity building arm of GFOI, has had several workshops in the Americas, and seeks to develop new workshops and other capacity building activities for future implementation in the region.

Contributors

- IDEAM (Instituto de Desarrollo del Ambiente) – Colombia
- CONABIO (Comision Nacional de Biodiversidad) – Mexico
- USGS (United States Geological Survey) – United States
- NOAA (National Oceanic and Atmospheric Administration) – United States
- U.S. MBON projects
- Smithsonian Tennenbaum Observatory
- Parques Nacionales (Colombia)

4.16 Relevant areas for coordinated foundational projects, e.g. in infrastructure, data, and capacity building.

The October 2014 meeting in Bogota identified the need to include specific activities that will help to improve information systems and the exchange of experiences: e.g. communities of practice; strengthening national capacities through a comprehensive program with vision, resources, and its own life; and webinars and technical seminars. Many of these activities will be included in each thematic area above, with overall coordination by the AmeriGEOSS foundational activities working group. Specific regional activities that cut across the thematic priorities are identified below.

▪ GEONETCast-Americas (GNC-A)

GEONETCast Americas (GNC-A) is the Western Hemisphere component of GEONETCast, a near real time, global network of satellite-based data dissemination systems designed to distribute space-based, airborne and *in situ* data, metadata and products to diverse communities. GEONETCast Americas is the United States Government contribution to GEOSS. The primary goals for GEONETCast Americas in the short term are to 1) develop a

user-friendly interface to facilitate the visualization of product, 2) continue collaboration with WMO Virtual Laboratory for Training and Education in Satellite Meteorology (VLab), INPE and other partners and providers to develop tutorial and tools, 3) increase outreach to better determine user needs, continue outreach to Partners and Users to participate as providers and in governance via the GEONETCast Americas Coordination Group, 4) increase the ability to use GNC-A in disaster response including carrying relevant Disaster Charter products, 5) work to add WMO Region III/IV Requirements while leaving room to support other SBAs, 6) and work toward at least one installation in each country (e.g. Hydro/Met, Disaster Response, Universities, Utilities, Other agencies serving SBAs).

GNC-A's goal is to enable enhanced dissemination, application, and exploitation of environmental data and products for the diverse societal benefits defined by GEO, including agriculture, energy, health, climate, weather, disaster mitigation, biodiversity, water resources, and ecosystems. Accessing and sharing such a range of vital data will yield societal benefits through improved human health, well-being environment management, and economic growth. GEONETCast receiving technology is based on using widespread and off-the-shelf components allowing for widespread adoption of the service at low cost. NOAA and the Instituto Nacional de Pesquisas Espaciais (INPE - Brazil) are collaborating to expand the broadband capacity of the system, to develop a user-friendly platform for data access, and to include INPES' information into the list of transmitted products in the Americas. NOAA has used two sizes of antennas for GNC-A; a 2.4 and a 1.8 meter dish. The 2.4 m dish will work almost anywhere while the 1.8 requires some investigation and is somewhat more difficult to point correctly.

The software used to access the information is Kencast FAZZT Professional Client and it comes with a mandatory 1-year of support. Further support is available but optional. There is no yearly license fee. The broadcast specification is:

PID 4201 **

Satellite IS-21

Transponder 7C

Polarity Vertical

Frequency 3840 MHz

Symbol Rate 27.69 Msym

FEC 7/8

Contributors

- NOAA (National Oceanic and Atmospheric Administration) – United States
- INPE (Instituto Nacional de Pesquisas Espaciais) - Brasil

8. Planning, milestones and deliverables

Each working group described below in section 10 will manage their own planning, milestones, and deliverables. Expected planning includes monthly working group teleconferences, participation in relevant GEO meetings, and at least annual meetings of the AmeriGEOSS community. Deliverables includes teleconference notes to be shared with the other working groups and periodic status briefings. Deliverables specific to each thematic area will be defined and coordinated with the related global GEO activities.

9. Data policy (sharing and management)

(use of GCI, data sharing & data mgmt for the initiative/flagship)

The AmeriGEOSS initiative will strive to advocate that all participants follow GEO's data principles. Nations without needed infrastructure and/or data policies will be provided examples of what is working in other Americas member nations.

10. Management arrangements

AmeriGEOSS has developed a proposed management arrangement based on a review of the approaches being used by UNGGIM-Americas, GEO BON, and AfriGEOSS. This proposed arrangement will be piloted in 2016, and adjusted as needed to achieve the best regional coordination with the least resources. The management arrangements that create organized thematic and coordination-working groups provide the sustained coordination framework to ensure the success of this initiative over the next decade.

The proposed arrangement includes several working groups, each with a Chair and Vice Chair and at least one participant from each country, and preferably two, to ensure that one member can always be present at working group teleconferences and meetings. Regional participating organizations are welcome to participate as well. The following AmeriGEOSS working groups are proposed:

1. Regional coordination working group responsible for the overall regional coordination between Americas Caucus nations, coordination with resource contributors, political coordination including engagement with other potential member nations, and coordination and reporting to Americas Caucus principles. This single coordination group will bring together the individual thematic working group contributions to form a comprehensive “view” and work to ensure/facilitate any necessary cross-communication and coordination among the individual working groups.

The regional coordinating group will report to the Americas Caucus in two ways. First, each national member(s) will report through their nation's GEO leadership and reporting structure to keep them apprised of AmeriGEOSS activities. Second, the regional coordinating group's chair, vice-chair, and/or their designated representatives will provide an overall summary of AmeriGEOSS activities to the Americas Caucus. At a minimum, this report will be provided to the Americas Caucus prior to Caucus meetings held in conjunction with GEO Plenaries and Ministerial meetings. Other reports can be made as needed, e.g. in advance of Executive Committee meetings.

2. Agriculture and food security working group responsible for the coordination with, and participation in, GEOGLAM from a regional perspective, engagement and contribution from Americas nations that add new capabilities to the overall GEOGLAM system and objectives, and linking existing nations' agricultural initiatives that are of benefit to or could benefit from GEO EO assets.
 3. Disasters working group responsible for the coordination with, and participation in, other GEO disasters activities, e.g. hazards supersites and flood monitoring systems from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO disasters activities and objectives, and linking existing nations' disasters initiatives that are of benefit to, or could benefit from, GEO Earth observation assets.
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4. Water working group – the functions of this group include coordination with, and participation in, other GEO water activities, e.g. global water cycle activities, from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO water activities and objectives, and linking existing nations' water initiatives that are of benefit to, or could benefit, from GEO EO assets.
5. Ecosystems and biodiversity working group responsible for the coordination with, and participation in, other GEO ecosystems and biodiversity activities, e.g. GEO BON from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO ecosystems activities and objectives, and linking in existing nations' ecosystems and biodiversity initiatives that are of benefit to, or could benefit from, GEO EO assets.
6. Foundational activities working group responsible for the coordination with and participation in other GEO foundational activities, e.g. infrastructure and capacity building activities from a regional perspective, engagement and contribution from Americas nations that add new capabilities to other GEO foundational activities and objectives, and linking existing nations' foundational initiatives that are of benefit to or could benefit from GEO Earth observation assets.

With this initiative, the Americas Caucus assumes greater responsibility for short- and long-term planning for the development of activities through regional cooperation that reflects the local, national, and regional interest. This responsibility will be entrenched in the technical capabilities of its country members and in the resources of other global initiatives that may be available for the benefit of the region.

2016 Activities

In 2016, the regional coordination framework will be piloted and improved. Each working group will manage their own planning, milestones, and deliverables. Coordination activities include monthly working group teleconferences, participation in relevant GEO meetings, and at least annual meetings of the AmeriGEOSS community. Deliverables includes teleconference notes to be shared with the other working groups and periodic status briefings.

In 2016, deliverables specific to each thematic area will be defined and coordinated with the related global GEO activities.

In 2016, the national and regional needs will be assessed in each of thematic working group areas. The GEO global initiatives needs, e.g. GEO BON's needs for greater regional engagement, will also be assessed. These combined sets of needs will form the basis of longer-term AmeriGEOSS plans.

11. Monitoring and evaluation approach and reporting

AmeriGEOSS is an initiative to improve the coordination and participation in GEO from a regional perspective. The basic theory of change is that if each nation in the Americas is engaged thematically and through regional coordination, Americas participation in GEO will be strengthened. If participation is strengthened, then additional use of GEO's EO assets will occur, open data policies will be promulgated, and capacity will be strengthened in decision-makers to use EO across the GEO SBAs.

AmeriGEOSS is open and interested in tracking GEO's global indicators at the regional level. Members of the regional coordination-working group will coordinate with GEO's monitoring and evaluation group to determine the approaches being taken that could be adapted and used by AmeriGEOSS at the regional level.

12. Committed Resources and annual budget(s)

Resource commitments include the national human resources needed to participate in the management arrangements described above. Additional resources to participate more fully in each of the thematic areas will be coordinated as the specific activity is proposed by that nation and included.

2016 Resources

Contributions from the national governments of the Americas Caucus nations have included human resources from Caucus co-chairs Colombia and Mexico, as well as other Americas member countries. These contributions will continue through 2016 to establish the working groups and to assess national, regional, and GEO global initiatives' needs. In 2016, additional resources will be targeted to support a sustained coordination framework.

Additional Activities for 2016

If additional resources are made available, the AmeriGEOSS working group members will participate more deeply in GEO global initiative meetings and activities. GEO foundational activities will be more fully engaged to address infrastructure and data access gaps, e.g. in nations' spatial data infrastructure.

APPENDIX 3

List of Major Changes from Version v2.0 and Complete List of Activities

2016 Work Programme version v 3.0
List of major changes from version v 2.0
And
Complete list of the activities

Change Record

GEO Work Programme 2016 version v3

List of changes (referred to the list contained in the Work Programme v2 submitted to ExCom in July)

CD	Only 3 tasks. Old CD-03 deleted. Content split between SO-03 and GI-18	
CD-03	It is now the old CD-04 renamed	
SO	List of SO tasks partially renumbered	
CA	Added a number of new activities.	
CA-25	Changed title	Was the old CA-12
GI	All previous Flagships now list as Initiatives, with specific mention Added new Initiatives. Former GI-06, GI-07 and GI-12 have been moved to the CA list to CA-10, 11 and 16 respectively. List of GI tasks partially renumbered.	
GD	List of GD tasks partially renumbered	
GD-01	Dedicated to Data Sharing principles only (continuing the DSWG, with GEOSec support)	Data Management transferred to task GD-08, GCI development
GD-03	New task on Global Observing and Information Systems	
GD-10	Dedicated to RF Frequency only	
GD-11	New task for communication networks	
GF	Following the recommendation of the Executive Committee, the draft Work Programme doesn't include a specific section for the five activities identified as Flagships in the previous version v2. They are now included at the beginning of the section on Initiatives, with the indication that the proposing teams identified them as Flagships.	

Activities list

COMMUNITY ACTIVITIES

	Description	Remarks	WPRD material
CA-01	Global Land Cover		
CA-02	Land Cover for Africa		
CA-03	Access to model data in GEOSS		
CA-04	Strengthen collaboration between GEO and GFCS	Preliminary draft (from initial consultation with GFCS Office)	
CA-05	TIGGE (Thorpex Interactive Grand global Ensemble) evolution into a Global Interactive Forecast System (GIFS)		
CA-06	EO data and mineral resources (Includes also the, Impact Monitoring System for Geo-Resource Exploration and Exploitation)		
CA-07	Integrated Water-cycle Products and Services - Overall coordination	It provides coordination of the following tasks: CA-08 Water Vapor and Clouds (and Aerosol and Precipitation) CA-09 Precipitation CA-10. Evapotranspiration (and Evaporation) CA-11 Soil Moisture CA-12 River Discharge CA-13 Groundwater	
CA-08	Water Vapor and Clouds (and Aerosol and Precipitation)		
CA-09	Precipitation		
CA-10	Evapotranspiration (and Evaporation)		
CA-11	Soil Moisture		
CA-12	River Discharge		
CA-13	Groundwater		
CA-14	GEO Water Quality		
CA-15	Water Cycle Capacity Building		
CA-16	Global Drought Information System (GDIS)		
CA-17	GEO Great Lakes Activity		
CA-18	Water Cycle Integrator (WCI)		
CA-19	E2E Water Indicators		

CA-20	Earth2Observe		
CA-21	Total Water Prediction: Observations Infrastructure (new-US)	Similar objectives (in US) with the CA-13 activity (in Europe and few developing countries)	
CA-22	Linking water tasks with wider societal benefit areas and the post-2015 global development framework		
CA-23	Space and Security		
CA-24	Earth Observation in Cultural Heritage documentation		
CA-25	Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity-building phase		YES
CA-26	Towards Chinese tsunami mitigation system under GEO framework		
CA-27	Foster Utilization of Earth Observation Remote Sensing and In Situ Data for All Phases of Disaster Risk Management (new-CEOS)		
CA.28	Global Flood Risk Monitoring (new-US)		
CA.29	Using Geospatial Data to Identify and Monitor Ecosystem Service and Track in a Natural Capital – Ecosystems Accounts Framework (new-US)		
CA-30	Harmful Algal Bloom (HAB) Early Warning System (new-US)		
CA-31	For Global Mangrove Monitoring (new-US)		
CA-32	Research Data Science Summer Schools (new-CODATA/RDA)		YES
CA-33	Building capacity for Forest Biodiversity in Asia and the Pacific Region (new-Indian Institutions)		

CANDIDATE GEO INITIATIVES

	Description	Remarks	WPRD Material
GI-01	GEOGLAM-Global Agricultural Monitoring and Early Warning	Proposed as Flagship	YES
GI-02	GEOBON-Global Biodiversity Observation (GEO BON)	Proposed as Flagship	YES
GI-03	GFOI Global Forest Observation Initiative	Proposed as Flagship	YES
GI-04	Global Observing System for Mercury and Persistent Pollutants	Proposed as Flagship	YES
GI-05	Global Carbon Observation and Analysis System	Proposed as Flagship	YES
GI-06	Reinforcing engagement at regional level: AfriGEOSS for Africa		YES
GI-07	Ocean and society - Blue Planet		
GI-08	GEO Geohazard Supersites and Natural Laboratories (GSNL)		
GI-09	Global Wildfire Information System		YES
GI-10	EO data and renewable energies	Complete information with next draft	
GI-11	Information Services for Cold Regions		
GI-12	Integrated Information Systems for Health (Cholera, Heat waves)		
GI-13	Integration of Methods for Air Quality and Health Data, Remote Sensed and In-Situ with Disease Estimate Techniques (new US)		
GI-14	GECCO: the GEO Global Ecosystem Initiative	US contribution added	
GI-15	GEO-GNOME Initiative: GEO Global Network for Observation and information in Mountain Environments		
GI-16	GEO-DARMA = Data Access for Risk Management (new-CEOS) <i>(to support the implementation of the Sendai framework 2016-2030).</i>		YES
GI-17a	Global Urban Observation and Information	Consultations on going to merge the two different proposals	YES
GI-17b	Global Human Settlement indicators for post-2015 international frameworks		YES
GI-18	GEO and SDGs. EOs role in providing support to countries in achieving SDGs and in defining and monitoring the associated indicators.		
GI-19	AmeriGEOSS (new)		YES
GI-20	GEO Global Water Sustainability (GEOGLOWS) new-US		

PROPOSED FOUNDATIONAL TASKS

	Description	Remarks
GD	GEOSS Development and GCI Operations	
GD-01	Advancing GEOSS Data Sharing principles	
GD-02	GCI Operations (<i>including access to Knowledge</i>)	
GD-03	Global Observing and Information Systems (new) (<i>includes systems like WIGOS. GCOS; And reference datasets</i>)	
GD-04	GEONETCast Development and Operations	
GD-05	GEOSS satellite Earth Observation Resources (<i>includes advocacy for continuity</i>)	
GD-06	GEOSS in situ Earth Observation Resources (<i>includes inclusion of citizens' observatories</i>) (<i>includes advocacy for continuity</i>)	
GD-07	GCI Development (<i>includes development of Data Management guidelines</i>)	
GD-08	SBA processes: Systematic determination of user needs / observational gaps	
GD-09	Knowledge Base development	
GD-10	Radio-frequency protection	
GD-11	Utilization of Communication Networks	
CD	Community Development	
CD-01	Capacity Building coordination	
CD-02	Reinforcing engagement at national and regional level (<i>includes EO uptake for decision making</i>)	
CD-03	Assess the benefits from EOs and of their socio-economic value	
SO	Secretariat Operations	
SO-01	Management and Support	
SO-02	Communication and Engagement	
SO-03	Monitoring and Evaluation	
SO-04	Resources Mobilization	

APPENDIX 4

List of Points of Contact for Community Activities, GEO Initiatives and Foundational Tasks

GEO Work Programme 2016 version v3 List of Points of Contact

CA	Description	Point of Contact	email	GEOSEC
CA-01	Global Land Cover	Brice Mora, GOFD-GOLD Chen Jun (NSDI, China) Chris Steenmans, EEA	brice.mora@wur.nl chenjun@nsdi.gov.cn chris.steenmans@eea.europa.eu	André Obregon aobregon@geosec.org Gary Geller ggeller@geosec.org
CA-02	Land Cover for Africa	Farah Hussein, RCMRD Jean Parcher, USA	farah@rcmrd.org jean_parcher@ios.doi.gov	André Obregon aobregon@geosec.org Gary Geller ggeller@geosec.org
CA-03	Access to model data in GEOSS	Glenn Rutledge, NOAA Michel Rixen, WCRP Eleanor O'Rourke, SMHI	glenn.rutledge@noaa.gov mrixen@wmo.int eleanor.orourke@smhi.se	André Obregon aobregon@geosec.org
CA-04	Strengthen collaboration between GEO and GFCS	Meredith Muth, NOAA, USA Stefan Rösner, DWD, Germany	meredith.f.muth@noaa.gov stefan.roesner@dwd.de	André Obregon aobregon@geosec.org
CA-05	TIGGE (Thorpex Interactive Grand global Ensemble) evolution into a Global Interactive Forecast System (GIFS)	Jean-Noel Thepaut, ECMWF	jean-noel.thepaut@ecmwf.int	André Obregon aobregon@geosec.org
CA-06	EO data and mineral resources (Includes also the, Impact Monitoring System for Geo-Resource Exploration and Exploitation)	Stephane Chevrel, BRGM, France	s.chevrel@brgm.fr	André Obregon aobregon@geosec.org

CA-07	Integrated Water-cycle Products and Services - Overall coordination	Richard Lawford, Morgan State University, USA	rlawford@gmail.com	Dominique Berod dberod@geosec.org
CA-08	Water Vapor and Clouds (and Aerosol and Precipitation)	Ralph Ferraro, NOAA/NESDIS USA	Ralph.R.Ferraro@noaa.gov	Dominique Berod dberod@geosec.org
CA-09	Precipitation	George Huffman: GFSC, NASA, USA	george.j.huffman@nasa.gov ,	Dominique Berod dberod@geosec.org
CA-10	Evapotranspiration (and Evaporation)	Forrest Melton NASA USA	forrest.s.melton@nasa.gov	Dominique Berod dberod@geosec.org
CA-11	Soil Moisture	Forrest Melton NASA USA	forrest.s.melton@nasa.gov	Dominique Berod dberod@geosec.org
CA-12	River Discharge	Julius Whellens-Mensah WMO	jwellens-mensah@wmo.int	Dominique Berod dberod@geosec.org
CA-13	Groundwater	Neno Kukuric IGRAC	Neno.Kukuric@un-igrac.org ;	Dominique Berod dberod@geosec.org
CA-14	GEO Water Quality	Steven Greb, WDNR USA	steven.greb@wisconsin.gov	Dominique Berod dberod@geosec.org
CA-15	Water Cycle Capacity Building	Angelica Gutierrez-Magness, CIEHLYC	Angelica.Gutierrez@noaa.gov	Dominique Berod dberod@geosec.org
CA-16	Global Drought Information System (GDIS)	Will Pozzi USA	will.pozzi@gmail.com	Dominique Berod dberod@geosec.org
CA-17	GEO Great Lakes Activity	Gail Faveri Canada Norman Granneman USA	Gail.Faveri@ec.gc.ca nggranne@usgs.gov	Dominique Berod dberod@geosec.org
CA-18	Water Cycle Integrator (WCI)	Toshio Koike Japan	tkoike@hydra.t.u-tokyo.ac.jp	Dominique Berod dberod@geosec.org
CA-19	E2E Water Indicators	Charles J. Vörösmarty, CUNY Environmental CrossRoads Initiative, City University of New York USA	cvorosmarty@ccny.cuny.edu	Dominique Berod dberod@geosec.org

CA-20	Earth2Observe	J. Schellekens, The Netherlands	jaap.schellekens@deltares.nl	Dominique Berod dberod@geosec.org
CA-21	Total Water Prediction: Observations Infrastructure (new-US)	Angelica Gutierrez, NOAA, USA	angelica.gutierrez@noaa.gov	Dominique Berod dberod@geosec.org
CA-22	Linking water tasks with wider societal benefit areas and the post-2015 global development framework	Richard Lawford, Morgan State University, USA and Adrian Strauch, University of Bonn, Germany.	rlawford@gmail.com ; adrian.strauch@uni-bonn.de	Dominique Berod dberod@geosec.org
CA-23	Space and Security	Sergio Albani, European Union Satellite Centre (EU SatCen)	Sergio.Albani@satcen.europa.eu	Osamu Ochiai oochiai@geosec.org
CA-24	Earth Observation in Cultural Heritage documentation	Petros Patias, the Aristotle University, Greece	patias@auth.gr	Wenbo Chu wchu@geosec.org Chao Xing cxing@geosec.org
CA-25	Africa Global-scale Geochemical Baselines for mineral resource and environmental management: Capacity-building phase	Claudia Delfini, Eurogeosurveys	claudia.delfini@eurogeosurveys.org	Gary Geller ggeller@geosec.org
CA-26	Towards Chinese tsunami mitigation system under GEO framework	WEN Ruizhi, Institute of Engineering Mechanics, China Earthquake Administration, China	ruizhi@iem.ac.cn	Dominique Berod dberod@geosec.org Chao Xing cxing@geosec.org
CA-27	Foster Utilization of Earth Observation Remote Sensing and In Situ Data for All Phases of Disaster Risk Management (new-CEOS)	Ivan Petiteville (CEOS) Kerry Sawyer (CEOS)	Ivan.Petiteville@esa.int	Dominique Berod dberod@geosec.org
CA.28	Global Flood Risk Monitoring (new-US)	NASA, USA David Green	david.s.green@nasa.gov	Dominique Berod dberod@geosec.org

CA-29	Using Geospatial Data to Identify and Monitor Ecosystem Service and Track in a Natural Capital – Ecosystems Accounts Framework (new-US)	State Department USA John Matuszak	MatuszakJM@state.gov	Gary Geller ggeller@geosec.org
CA-30	Harmful Algal Bloom (HAB) Early Warning System (new-US)	NOAA USA, Juli Trtanj	juli.trtanj@noaa.gov	Gary Geller ggeller@geosec.org
CA-31	For Global Mangrove Monitoring (new-US)	USGS USA Chandra Giri	cgiri@usgs.gov	Gary Geller ggeller@geosec.org
CA-32	Research Data Science Summer Schools (new-CODATA/RDA)	CODATA and RDA Simon Hodson	simon@codata.org	Andiswa Mlisa amlisa@geosec.org
CA-33	Building capacity for Forest Biodiversity in Asia and the Pacific Region (new-Indian Institutions)	K. D. Singh Academy of Forest and Environmental Sciences, FRI Campus, Dehradun, India	karndeo_singh@hotmail.com	Andiswa Mlisa amlisa@geosec.org

GI	Description	Point of Contact	email	GEOSEC
GI-01	GEOGLAM-Global Agricultural Monitoring and Early Warning	Michel Deshayes	mdeshayes@geosec.org	Michel Deshayes mdeshayes@geosec.org
GI-02	GEOBON-Global Biodiversity Observation (GEO BON)	Jörg Freyhof GEO BON Executive Director Germany	joerg.freyhof@idiv.de	Gary Geller ggeller@geosec.org
GI-03	GFOI Global Forest Observation Initiative	Stephen Ward, GFOI Office Coordinator, Australia	mail@stephenward.net	Gary Geller ggeller@geosec.org
GI-04	Global Observing System for Mercury and Persistent Pollutants	Nicola Pirrone, CNR Italy	pirrone@iia.cnr.it	Douglas Cripe dcripe@geosec.org
GI-05	Global Carbon Observation and Analysis System	Antonio Bombelli, CMCC-Italy Werner Kutsch ICOS Headoffice-Finland	antonio.bombelli@cmcc.it werner.kutsch@icos-ri.eu	André Obregon aobregon@geosec.org
GI-06	Reinforcing engagement at regional level: AfriGEOSS for Africa	Andiswa Mlisa	amlisa@geosec.org	Andiswa Mlisa amlisa@geosec.org
GI-07	Ocean and society - Blue Planet	Sophie Seeyave and Trevor Platt, POGO	ssve@pml.ac.uk tplatt@dal.ca	Douglas Cripe dcripe@geosec.org
GI-08	GEO Geohazard Supersites and Natural Laboratories (GSNL)	Andrea Taramelli, Stefano Salvi, INGV Italy	stefano.salvi@ingv.it	Dominique Berod dberod@geosec.org
GI-09	Global Wildfire Information System	Jesus San Miguel, EC/JRC	jesus.san-miguel@jrc.ec.europa.eu	Dominique Berod dberod@geosec.org

GI-10	EO data and renewable energies	Thierry Ranchin MINES ParisTech/ ARMINES . PSL - Research University, France	thierry.ranchin@mines-paristech.fr	André Obregon aobregon@geosec.org
GI-11	Information Services for Cold Regions	Yubao Qiu Institute of Remote Sensing and Digital Earth (RADI) under the <i>Chinese</i> Academy of Sciences (CAS), China	qiuyb@radi.ac.cn	Dominique Berod dberod@geosec.org
GI-12	Integrated Information Systems for Health (Cholera, Heat waves)	NOAA USA Juli Trtanj	juli.trtanj@noaa.gov	Douglas Cripe dcripe@geosec.org
GI-13	Integration of Methods for Air Quality and Health Data, Remote Sensed and In-Situ with Disease Estimate Techniques (new US)	EPA USA Phil Dickerson	Dickerson.Phil@epa.gov	Douglas Cripe dcripe@geosec.org
GI-14	GECO: the GEO Global Ecosystem Initiative	A. Provenzale, CNR Italy	antonello.provenzale@cnr.it	Gary Geller ggeller@geosec.org
GI-15	GEO-GNOME Initiative: GEO Global Network for Observation and information in Mountain Environments	A. Provenzale, CNR Italy	antonello.provenzale@cnr.it	Gary Geller ggeller@geosec.org
GI-16	GEO-DARMA = Data Access for Risk Management (new-CEOS) <i>(to support the implementation of Sendai framework 2016-30).</i>	Ivan Petiteville (CEOS)	Ivan.Petiteville@esa.int	Dominique Berod dberod@geosec.org
GI-17a	Global Urban Observation and Information	Qihao Weng, Indiana State University - USA	qweng@indstate.edu	André Obregon aobregon@geosec.org Wenbo Chu wchu@geosec.org

GI-17b	Global Human Settlement indicators for post-2015 international frameworks	Martino Pesaresi, JRC/EC	martino.pesaresi@jrc.ec.europa.eu	André Obregon aobregon@geosec.org Wenbo Chu wchu@geosec.org
GI-18	GEO and SDGs. EOs role in providing support to countries in achieving SDGs and in defining and monitoring the associated indicators.	TBD		Robert Samors rsamors@geosec.org Giovanni Rum grum@geosec.org
GI-19	AmeriGEOSS (new)	Angelica Gutierrez, NOAA, USA	angelica.gutierrez@noaa.gov	Giovanni Rum grum@geosec.org
GI-20	GEO Global Water Security (GEOGLOWS) new-US	Bradley Doorn, NASA, Jerad Bales, USGS, USA	bradley.doorn@nasa.gov ; jdbales@usgs.gov	Dominique Berod dberod@geosec.org

PROPOSED FOUNDATIONAL TASKS

	Description	Point of Contact	email	GEOSEC
GD	GEOSS Development and GCI Operations			
GD-01	Advancing GEOSS Data Sharing principles	Data Sharing WG Co-chairs Robert Chen (ICSU) Catherine Doldirina (EC/JRC) Michel Schouppe (EC) Lerato Senoko (RSA) Paul Uhler (ICSU) Greg Withee (US)	bchen@CIESIN.COLUMBIA.EDU catherine.doldirina@JRC.EC.EUROPA.EU michel.schouppe@ec.europa.eu lerato.senoko@DST.GOV.ZA puhler@NAS.EDU gwithee@MSN.COM	Wenbo Chu wchu@geosec.org
GD-02	GCI Operations (<i>including access to Knowledge</i>)	Guido Colangeli ESA	guido.colangeli@esa.int	Osamu Ochiai oochiai@geosec.org
GD-03	Global Observing and Information Systems (new) (<i>includes systems like WIGOS, GCOS; And reference datasets</i>)	Osamu Ochiai	Osamu Ochiai oochiai@geosec.org	Osamu Ochiai oochiai@geosec.org
GD-04	GEONETCast Development and Operations	Vincent Gabaglio EUMETSAT	Vincent.Gabaglio@eumetsat.int	Osamu Ochiai oochiai@geosec.org
GD-05	GEOSS satellite Earth Observation Resources (<i>includes advocacy for continuity</i>)	Brian Killough CEOS	brian.d.killough@nasa.gov	Osamu Ochiai oochiai@geosec.org
GD-06	GEOSS in situ Earth Observation Resources (<i>includes inclusion of citizens'</i>	Chris Steenmans, EEA Brian Killough, CEOS	Chris.Steenmans@eea.europa.eu brian.d.killough@nasa.gov	Osamu Ochiai oochiai@geosec.org

	<i>observatories) (includes advocacy for continuity)</i>			
GD-07	GCI Development <i>(includes development of Data Management guidelines)</i>	Ivan B. DeLoatch, USGS	ideloatch@usgs.gov	Osamu Ochiai oochiai@geosec.org
GD-08	SBA processes: Systematic determination of user needs / observational gaps	Secretariat Experts		Giovanni Rum grum@geosec.org
GD-09	Knowledge Base development	Hans Peter Plag, IEEE	hpplag@odu.edu	Douglas Cripe dcripe@geosec.org
GD-10	Radio-frequency protection	Jose Arimatea de Sousa Brito, WMO	josearimateabrito@gmail.com	Osamu Ochiai oochiai@geosec.org
GD-11	Utilization of Communication Networks		TBD	Osamu Ochiai oochiai@geosec.org
CD	Community Development			
CD-01	Capacity Building coordination	Gregory Giuliani, University of Geneva, CH Mark Noort, HCP International Hilcea Ferreira, INPE, Brazil	gregory.giuliani@unepgrid.ch m.noort@hcpinternational.com hilcea@dpi.inpe.br	Andiswa Mlisa amlisa@geosec.org
CD-02	Reinforcing engagement at national and regional level <i>(includes EO uptake for decision making)</i>	Secretariat Expert		Andiswa Mlisa amlisa@geosec.org Wenbo Chu wchu@geosec.org
CD-03	Assess the benefits from EOs and of their socio-economic value	Jay Pearlman, IEEE	jay.pearlman@jandfent.com	Robert Samors rsamors@geosec.org

SO	Secretariat Operations			
SO-01	Management and Support	Secretariat Expert		Patricia Geddes pgeddes@geosec.org
SO-02	Communication and Engagement	Secretariat Expert		Robert Samors rsamors@geosec.org
SO-03	Monitoring and Evaluation	Secretariat Expert		Giovanni Rum grum@geosec.org
SO-04	Resources Mobilization	Secretariat Expert		Robert Samors rsamors@geosec.org