

2018 GEO Work Programme Progress Report

This document is submitted to Plenary for information.

1 Introduction

This report has been prepared in fulfilment of the requirement of the Secretariat to “Compile an annual Progress Report on all activities, drawing on available reports of the GEO Flagships, GEO Initiatives, GEO Foundational Tasks and, to the best of its knowledge, of GEO Community Activities” (*GEO Rules of Procedure*).

2 2018 Progress Reporting Process

Progress reports prepared by GEO Work Programme (GWP) activities are based on a template developed by the Secretariat (see Annex B). In addition to the core self-assessment by each GWP activity, the template also included requests for information related to the GEO website renewal and communications activities, as a means of reducing the number of separate requests to GWP activity leads.

The template and schedule for the reporting process were reviewed and approved by the Programme Board Subgroup on Monitoring. An email request was sent to GWP activity Points of Contact on 14 May. Completed templates were requested to be returned to the Secretariat by 15 June. The chair of the Programme Board Monitoring subgroup reminded activity leads of the request during the GEO Symposium and offered assistance in completion of the templates. A reminder email was sent by the Secretariat on 26 June to Points of Contact of all activities that had not submitted a report by that date.

3 Summary of Reports Received

The number of activities that submitted progress reports is summarized below in Table 1. Just over half of the activities in the GWP submitted reports, with the rate of reporting similar for Flagships, Initiatives and Community Activities.

TABLE 1: 2018 PROGRESS REPORTS RECEIVED

	Total	Contacted	Received	Not Received	Inactive / Complete	% Received of those Contacted
Flagship	4	4	2	2	0	50%
Initiative	24	24	13	11	0	54%
Community Activity	35	34	17	16	2	50%
Foundational Task	7	6	3	3	1	50%
Total	70	68	35	32	3	51%

Table 2 provides a summary of progress reporting over the past two years. The format of the reports differed considerably: the 2017 reporting was quantitative and detailed, while the 2018 reporting was qualitative and brief. Reporting rates were slightly higher in 2018, although the specific activities reporting varied. Nearly one-third of GWP activities did not report in either year.

TABLE 2: COMBINED REPORTING STATUS 2017 AND 2018

	Both Reports Submitted	Only 2017 Report Submitted	Only 2018 Report Submitted	Neither Report Submitted	Inactive	Complete
Flagship	2	1	0	1	0	0
Initiative	6	5	6	7	0	0
Community Activity	10	5	7	10	2	1
Foundational Task	0	0	3	3	1	0
Total	18	11	15	22	3	1

4 Observations and Next Steps

Collection of systematic and comparable information on status of GWP activities has always been challenging in GEO. Pre-2016, information was collected informally through seconded experts in the Secretariat and formally through the Component Sheets. Since 2016, the Secretariat has been more reliant on ad hoc annual requests to GWP activity leads. These requests have had varying success in eliciting information but, as documented above, the coverage of the GWP is incomplete. With fewer seconded experts and more focus on engagement priorities, there has been less direct interaction with many of the GWP activities than in the past.

To address this issue, the Secretariat has launched a process to contact all GEO Flagships and Initiatives as part of the preparations for the 2020-2022 GEO Work Programme development. While the primary purpose will be to understand the status, challenges and needs of the activities, the Secretariat will also discuss with them ways to improve communications with the Secretariat, including how best to obtain status updates and other monitoring data.

ANNEX A

2018 PROGRESS REPORTS RECEIVED AS OF 24 SEPTEMBER 2018

FLAGSHIPS.....	4
INITIATIVES	8
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COMMUNITY ACTIVITIES	28

GEO Global Agricultural Monitoring (GEOGLAM)

GEOGLAM has hundreds of contributors from over 60 organizations in more than 28 countries and 16 inter-governmental agencies, encompassing national departments of agriculture, international organizations, universities, and research institutions among others.

Information products produced by the GEOGLAM community provide fundamental information on the state and changes of the agricultural landscape at the national, regional and global scale. User communities benefitting from GEOGLAM activities:

- Public Sector National- National agriculture ministries, statistical agencies, and research institutes
- Public Sector International- Food security organizations, food aid and capacity development agencies
- Private sector- Producer groups, commodity traders and production insurance

Services

- Monthly delivery of the Crop Monitor for the Agricultural Market Information System (AMIS) (since September 2013);
- Monthly delivery of the Crop Monitor for Early Warning (since February 2016);
- Development of the Asia-RiCE program, for rice monitoring in Asia (data requirements, Synthetic Aperture Radar (SAR)/Optical rice crop production information and monthly delivery of rice crop outlook);
- Development of Joint Experiment for Crop Assessment and Monitoring (JECAM) activities (Minimum data set requirements, cross-site SAR experiment);
- Development of the Rangeland and Pasture Productivity (RAPP) initiative (including the RAPP Map <http://map.geo-rapp.org/>, the Vegetation Cover Anomaly monthly distributed on www.geo-rapp.org)

GEOGLAM activities have made significant contributions to the body of agricultural monitoring research, and have effectively capitalized on them to build operational systems that strengthen national capacities that contribute to a near real time systems to derive global consensus on crop conditions. Working with AMIS, GEOGLAM has provided science-based consensus information contributing to the goals of the 2011 G20 Action Plan on Food Price Volatility. As GEOGLAM looks forward, we see a new emphasis on strengthening regional and national coordination and evolving GEOGLAM to produce more quantitative metrics that will improve current crop monitors and support the emerging priorities of Agenda 2030; Paris Agreement; and Sendai Framework. As we look beyond 2018, GEOGLAM will drive this evolution by seizing upon the opportunity provided by ever increasing access to open Earth observation (EO) data and the transformational power of new information technologies to deliver information to strengthen markets and global food security. GEOGLAM looks forward to providing their ever growing community of clients with constantly improving, policy relevant, timely, science-based, consensus information to assist in their decision making.

Global Observation System for Mercury (GOS4M)

Overview

GOS4M is increasing the availability and quality of Earth Observation data and information to contribute to the tracking of mercury released to the global environment with ultimate goal to anticipate changes at different geographical scales. GOS4M's specific objectives, partly achieved already, is the harmonization of metadata production, the fostering of archiving and data sharing provided by existing mercury monitoring networks and programs; and the development of advanced web services to support end-users in the implementation of the Minamata Convention. Such objectives will be attained by:

- Inviting existing regional mercury monitoring networks including, but not limited to: Global Mercury Observing System (GMOS), National Atmospheric Deposition Program (NADP), Asia Pacific Mercury Monitoring Network, Arctic Monitoring and Assessment Program (AMAP), European Monitoring and Evaluation Programme (EMEP), and the Environment Canada Network, to cooperate within GOS4M and share their outcomes and lessons learned;
- Elaborating a governance structure of the GOS4M that is involving already representatives of governments, monitoring networks, and UN Environment;
- Facilitating the cooperation with governments and institutions tracking mercury releases;
- Fostering the validation and testing of new methods and technologies in monitoring mercury contamination in air, water and terrestrial ecosystems in order to reduce the investment and running costs of monitoring networks;
- Preparing, archiving and sharing metadata;
- Developing a mirror site of the GEOSS Platform for searching and sharing monitoring data and information; and
- Creating an advanced Community Portal to help policy makers and stakeholders in their assessments.

Expected Benefits

By involving regional programmes and mercury monitoring networks, GOS4M is providing a substantial contribution to the Global Mercury Fate and Transport Partnership of UN Environment's Global Mercury Partnership (UNE F&T) and to the Expert Group on Effectiveness Evaluation of the Minamata Convention. To the UNEP F&T are contributing several countries (i.e., US, Canada, Japan, China) that have operational regional monitoring networks for a long time and their contribution is of fundamental importance in building a coordinated global monitoring network for mercury which will be based on the concept of federation of existing monitoring networks. The UNEP F&T is a cooperative effort of nations and stakeholders which was started in 2006 having as overarching goal that of reviewing and gathering peer-reviewed scientific knowledge, data and policy tools to assess the impact on human health and the global environment of mercury and its compounds released from natural and anthropogenic sources. GOS4M is providing to end-users continuous information on mercury concentrations and fluxes in and between the atmospheric, marine, freshwater

and terrestrial ecosystems as well as outputs from validated regional and global scale atmospheric and marine models. The foreseen (already occurring) contribution of GOS4M is to provide key information to all interested parties in assessing the effectiveness of measures that will be undertaken by countries in implementing the Minamata Convention. Information delivered through the activity of this Flagship may strongly support periodic assessments and evaluation of the effectiveness of measures that will be undertaken to achieve the goals that will be set by the 2nd Conference of Parties (COP2) that will meet on 18-23 November 2018 in Geneva.

Resources

Resources for implementing GOS4M derive from the EU program “European network for observing our changing planet” (ERA-PLANET)” [www.era-planet.eu] that is aimed to strengthen the European Research Area in the domain of Earth Observation in coherence with the European participation to GEO and the Copernicus initiative. The Integrated Global Observing Systems for Persistent Pollutants (IGOSP) project [www.igosp.eu] funded within ERA-PLANET is supporting GOS4M implementation through in-kind and cash resources around 8.3 M€ (33% of EU top-up fund and 66% of in-kind) have been allocated. Additional resources are derived from GEF projects within the UNEP F&T partnership activity and other ongoing collaborative projects.

Implementation Status

The main activity in 2017 was oriented to the preparation of GOS4M governance and to expanding the global coverage of GMOS to regions of Africa that do not have monitoring capabilities, including Congo and Ivory Coast. A meeting was held on 19th October 2017 at the United States Environmental Protection Agency in Washington, D.C. to discuss the GOS4M governance draft document. This meeting involved many proficient representatives of regional mercury monitoring networks and programs. The draft governance document was discussed and revised with contributions from all participants. Currently, the governance document is in its quasi-final revision stage; when completed, it will be made available to all interested parties and posted on the GOS4M web portal.

As complimentary information for the Washington meeting, a short report providing key information on existing regional monitoring networks measuring mercury in air and marine environments was discussed. This analysis helped disclose weaknesses in metadata provision, as in most cases data are available but not discoverable. This led to the preparation of metadata ISO compliant for that information.

During the 2017-2018 period a Membership Agreement & Data Policy document was prepared to establish member accession criteria to the Flagship, participation to governance bodies, cooperation in data sharing and intellectual properties of data.

A mirror site under the GEOSS Portal has been activated with support of ESA.

During the last year four out of eight planned Tasks have been partially or fully accomplished as follow:

Task GF-04.1: Establish a governance structure (Under discussion with US and Canada experts)

Task GF-04.2: Analysis of current infrastructures and archived information on mercury (Completed)

Task GF-04.3: Harmonization of information and production of metadata following standards.
(Completed)

Task GF-04.4: Implementation of GF-04 Portal with EUROGEOS Broker as core engine
(Completed)

Asia-Oceania GEOSS (AOGEOSS)

Member countries of AOGEOSS are highly engaged and committed to providing a long-term operational infrastructure, products, services, support and capacity building in accordance with the GEO Data Sharing Principles.

Data sharing and the complementarity of data platforms developed within AO region was a key component of regional GEOSS. The Open Data Cube (ODC), Japan's Data Integration and Analysis System (DIAS) and China's SpectrumEarth (SE) system were all recognised as mature systems addressing different needs within AO community. The entire community accepts the critical requirement for data providers to distribute open analysis-ready data (ARD) to power data processing platforms. Open Data Cube platform yields rapid results, and has fostered an active and engaged global community of contributors.

AOGEOSS has engaged and coordinated users, stakeholders and partners working together on Earth observation activities in the Asia-Oceania region. GEOSS/AWCI, in collaboration with the International Flood Initiative (IFI), is establishing a Platform on Water and Disasters in each Member country and launches its activity. The Asia-Pacific Biodiversity Observation Network (AP BON) published three volumes of books on biodiversity observations in the Asia-Pacific region and have been contributing to the Convention on Biological Diversity (CBD) and the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES). Asian Rice Crop Estimation & Monitoring (Asia-RiCE) is expected to implement with other international frameworks such as Asia Pacific Regional Space Agency Forum, ASEAN-AFSIS, UN-ESCAP and MRC a Global Drought Monitor and Analysis Platform ([GDMAP](#)) that has been developed for user communities.

AOGEOSS committed to specific action on regional issues by committing to an AOGEOSS Mekong River Basin Pilot study, with user engagement to report its initial findings at GEO Plenary in Kyoto 2018. This pilot is a first step in mobilising all AOGEOSS task groups to demonstrate their integrated value to the critical challenges related to sustainable development within the Mekong. Vietnam, Cambodia and Laos will lead our engagement with users in the Basin and the Republic of Korea will lead the pilot. Follow-on pilots in the Himalayas and Indo Pacific will follow.

The AOGEOSS Coordination board, which consists of 12 experts from 8 countries, was officially set up and approved by Caucus at a meeting held in Washington D.C. USA in October 2017. With efficient coordination among the current task groups, a new Ocean, Coasts and Islands task group was formed. The improved structure and organization of activities will benefit the implementation of the AOGEOSS objectives and the work of each task group. The progress of the AOGEOSS activities and the outcomes of the First International Conference and Training Workshop on Asia Oceania GEOSS were summarized and Deqing Report was formed as important guidance for the future work of AOGEOSS community.

AOGEOSS is committed to taking concerted actions to realize the Sendai Framework for Disaster Risk Reduction, Paris Climate Agreement within the UNFCCC, and the 2030 Agenda for Sustainable Development by providing actionable Earth observation information, products and services in partnership with relevant implementation organizations.

Highlights

The **First International Conference and Training Workshop** on Asia Oceania GEOSS

The First International Conference and Training Workshop on Asia Oceania GEOSS was held in Deqing, China from 15 to 19 May 2018, by the Group on Earth Observations (GEO), ChinaGEO Secretariat, National Remote Sensing Center of China (NRSCC) and the Institute of Remote Sensing and Digital Earth, Chinese Academy of Sciences (RADI, CAS). The Workshop attended by 82 participants from 16 countries and training course by 24 participants from 12 countries. The Conference received updates from all AOGEOSS tasks in addition to growing our community by hearing from many pre-eminent scientists and officials interested in joining AOGEOSS. The Conference continued the work on establishing the AOGEOSS as a fundamental piece of regional infrastructure and an overarching vision for other EO initiatives in the Asia Oceania region and the training workshop on data processing and applications began our ongoing commitment to capacity building. Within the GEO community AOGEOSS is responsible for collecting and communicating the needs of users within the Asia Oceania region.

To maintain momentum, in addition to GEOSS AP Symposium, the Participants resolve to continue this international conference as a regular meeting of AOGEOSS focused upon a targeted workshop, a training course and a Coordination Board meeting. In this format the second AOGEOSS Workshop and Training Course will be held in Australia in 2019.

Data Sharing and Rapid Response to Natural Disasters

Under the coordination mechanism of AOGEOSS, a large number of ground observation data from China GEOSS, including 124,820 records in 2016, have been opened to the international community through GEO. China will continue to make Chinese satellite observation data available in 2017.

Countries of the region is coordinated to carry out the emergency response of remote sensing data for the major disasters. During the New Zealand earthquake in 2016, seven satellites with 219 view images (120GB in total) were organized to provide timely service for New Zealand, Australia and other countries. Also during the 2017 earthquake in Mexico, 146 scene images from 8 satellites (126.37 GB in total) were collected. A new mode of international disaster emergency cooperation is gradually established within the framework of the GEO, which will become the important supplement for other international disaster cooperation mechanisms.

Development of an Asia-Oceania Data Cube

The AO Data Cube aims to develop regional GEOSS Dataset to meet the demand of different users from various countries and to support the application of dynamic features of large volumes EO data. The newly formed Open Data Cube community provided a technological solution which can eliminate the burden of data preparation. This open platform yields rapid results, and has fostered an active and engaged global community of contributors. The Committee on Earth Observation Satellites (CEOS) has been a founding partner in the Open Data Cube (ODC) initiative. CEOS SEO and CSIRO are supporting deployment of the Vietnam Data Cube at Vietnam National Space Agency (VNSC) with the objective of developing radar cube technology for the ODC community. Its main applications are rice crops, forest management, and water quality.

GEO Carbon and GHG Initiative (GEO-C)

The GEO Carbon and GHG Initiative was launched in 2016, building on the legacy of the previous carbon tasks of the GEO 2006-2015 Work Plan.

The main achievement to now has been the increased recognition of the GEO-C policy-relevant mandate, as demonstrated by the strengthened engagement with UNFCCC and its technical body SBSTA, though the GEO-C participation and active contribution to the UNFCCC-SBSTA Research Dialogue and side events at UNFCCC-CoP.

Currently the initiative is run on a voluntary basis by its participants, who provide in-kind resources to support the GEO-C Secretariat and activities. Efforts are ongoing to raise the needed financial resources to ensure the full implementation of the work plan and the achievement of the planned milestones and deliverables.

One of the main challenge is to involve all the main actors at global level in order to reduce the gaps in terms of coordination and geographical coverage and obtain globally consistent results at different temporal (from quasi real time to yearly products) and spatial (local, national, regional and global) scales.

GEO Cold Regions Initiative (GEOCRI)

Summary of Progress

Progress has been made in GEOCRI Tasks since the beginning of the Work Programme period, especially during the past year (autumn 2017- spring 2018), and there are no significant deviations to the work plan. The progress achieved is mapped against the GEOCRI Implementation Plan, and is regularly monitored by the GEOCRI co-leads team.

Specific successes and advancements during the past year include: progress in the development of the Essential Cold Regions Variables (ECRVs), the ongoing consultation for the GEOCRI Community Portal Development and related participation to the Polar Data Planning Summit and efforts, and the recent developments in the infrastructures task, where a joint workshop is being planned for 2019.

Successes during the past year also include involvement in the science-policy interface, and the progress made in recognition of the policy mandate. Examples include the breakout session in the 2017 Arctic Circle Assembly in Reykjavik, and statements in the 2018 Arctic Observing Summit in Davos and in the Second Arctic Science Ministerial in Berlin.

Challenges have focused mainly on resourcing, as GEOCRI activities are currently dependent on in-kind contributions from the GEOCRI partners. Despite this, significant advances have taken place over the past year and a financial strategy and plan are in preparation for 2019 and for the Work Programme period of 2020-2022.

Areas for future development include securing funds to sustain and expand GEOCRI activities in the next GEO Work Programme period and initiating the transition from community consultation to Cold Regions-related operational EO products and services. To accomplish this, GEOCRI will continue to build stronger connections to polar data providers, e.g. through the ongoing polar data planning efforts. These connections go hand-in-hand with the successful development in the ERCVs and infrastructure networking developments, leading to a full data value chain that transforms EO data to tools and products for end users and decision making by a combination of open access satellite data, in-situ observations, modelling and predictions.

Feedback and input from the GEO Programme Board, Sustaining Arctic Observing Networks (SAON) and its committees, SAON ADC and SAON CON, are actively involved and contributing in GEOCRI. In addition, SAON has recently proposed ArcticGEOSS initiative to the GEO Work

Plan. Discussions are important for identifying the relationship and potential synergies between GEOCRI and ArcticGEOSS. Also, input and feedback is sought from the GEO Programme Board on how to best achieve the synergies and alignment between the GEOCRI activities and the SAON ArcticGEOSS proposal.

Sufficiency of Resources

The available resources at the moment consist of in-kind contributions. While they have been sufficient to maintain and allow progress in the GEOCRI activities along the current work plan for 2017-2019, there is definitely a need to raise financial resources to support GEOCRI to expand and sustain its activities in the future. For that, the GEOCRI financial strategy and plan for 2019 and for the 2020-2022 is in preparation and will be completed in 2018. The formation of an Advisory Group for GEOCRI will ensure additional consultation in securing sufficient resources for the years to come.

Implementation of Products and Services / Engagement of Users

The GEOCRI Community Portal Development consultation, and co-organising and participation to the Polar Data Planning Summit and following joint polar data planning efforts have been ongoing during the past year. The process has raised important discussions about data interoperability and source code issues, to which the data community will continue to find solutions. The potential end-users have been engaged during the ongoing consultation process regarding the GEOCRI Community Portal Development. User engagement and outreach has also taken place during the several meetings and events where GEOCRI has been present and presenting its activities. The User engagement will intensify towards the latter part of 2018 and in 2019 with active participation to the continuing Polar Data Planning efforts, and the approaching Arctic Science Ministerial, and the HiMAC2018 (hosted by FMI/ASC in Sodankylä).

In addition, GEOCRI aims for stronger involvement of community observing (also end-users of EO products and services) in the GEOCRI activities.

Status of Implementation Plan Milestones and Deliverables

The overall status of different tasks and their activities and related milestones and deliverables is presented in the GEOCRI Implementation Plan (Appendix 1), showing that progress has been made with especially many advances during the past year (between autumn 2017 and spring 2018). There are no significant deviations in the Tasks, and most activities under the tasks have either been reached or are in progress according to the planned schedule (details provided in column "Activities/Outcome in 2018").

During the past year, efforts have focused on: 1) the development of the Essential Cold Regions Variables (ECRVs), 2) the consultation for the GEOCRI Community Portal Development, and related participation to the Polar Data Planning efforts, 3) developments in the Infrastructure networking, and 4) the outreach to different communities, for example with the IEEE N&S to foster the agreement between IEEE and GEO with an emphasis on the collaboration on GEOCRI and AfriGEOSS. Deriving from these focus areas, GEOCRI has adopted a Data Value Chain approach, which incorporates the entire information services process that can be applied in the development and implementation of products and services for Earth cold regions addressing the selected SBAs and supporting the global policies (Appendix 3).

The GEOCRI co-leads team will discuss the general progress along the work plan its next telecom meeting in Aug-Sept 2018 and decide on actions and/or potential modifications in the Implementation Plan.

Status of a Policy Mandate

The importance of a policy mandate is recognised as a high priority in the GEOCRI. The current environmental and socio-political challenges in the cold regions further highlight the importance of science-policy interaction in informed decision making on a regional and global level. As an one example of this, GEOCRI arranged a joint breakout session “Scales of observations – Connecting Arctic Data, Information and People” in the 2017 Arctic Circle Assembly (Appendix 2) together with SAON, WMO, ICC, and EPB. GEOCRI also submitted a statement to the recent Arctic Observing Summit that took place in June 2018 in Davos during the Polar2018 (Appendix 3). GEOCRI also contributed to the GEO Statement to Arctic Science Ministerial in October 2018 (Appendix 4).

GEO Global Ecosystem Initiative (GEO ECO)

Task 1: Activities by Roger Sayre - USGS

The new Ecological marine unit (EMU) was presented at a number of major international events, including the American Association of Geographers 2017 Annual Meeting in Boston, the ACES Oceania Ecosystem Services Forum in Brisbane, the Esri International User Conference 2017 in San Diego, the 2017 GEO BON Steering Committee Meeting in Leipzig, and the American Geophysical Union 2017 Annual Meeting in New Orleans. The EMU is showcased at the GEO Plenary in Washington DC in November. The Ecological freshwater unit initiative is launched at a Freshwater BON side event of the GEO Plenary.

Task 2: Activities on trends and changes in PAs

A set of remote sensing variables for mountain, arid/semiarid and coastal Protected Areas (PAs) in Europe, Middle East and South Africa will be defined and made available, to allow for the analysis of ecosystem trends and changes in the last 15 years. The analysis of changes in meteo-climatic drivers (based on temperature and precipitation) for a set of PAs in Europe and elsewhere is on-going, setting the stage for extensions to other regions of the world.

Task 3: Environmental Impact Assessment (EIA) big data visual platform

An online web viewer has been deployed which facilitates access to EO data and processed analytics. The data can be accessed and retrieved in user friendly formats. Such monitoring data is essential for EIA and periodic reporting requirements and supplements the activities of EU member states.

Task 6: Future Ecosystem Scenarios and Related Uncertainties

Several PAs in Europe are utilizing statistical and process based models to predict future states and services provided by ecosystems through the inclusion of CORDEX climate change scenario drivers. Utilizing an ensemble approach, the uncertainties both within the prediction scenarios (multiple realizations of instances with the same scenario descriptors) as well as application of various scenario predictions aids in the description of uncertainty in future status predictions

Through stakeholder engagement for various PAs across Europe, potential policy and management pathways have been identified and are being integrated into future simulations of the PAs. Variability of the time lag response of systems to policy and management actions and the efficacy of such actions are incorporated into models to determine probable future states through ensemble modelling.

Task 7: Activities on the Earth Critical Zone

Strengthen the links of GEO ECO with international programmes including the study of the Earth Critical Zone, such as CZO, CZEN, ILTER, eLTER, and participate in events of such programs in order to share expertise, approaches and visions;

Support the establishment of new Earth Critical Zone study sites in specific areas and the development of a joint vision of volcanic supersites as global sites for environmental studies (ecosystem, climate, hydrology, interactions between geological and environmental processes).

Current resources

At the moment, funding is secured by EU projects ECO-POTENTIAL (2015-2019), SWOS (2015-2018) and the Italian project NextData (2012-2018). In kind and cash contributions for ELU/EMU mapping at USGS and Esri and for the EIA big data visual platform based on RS-GPS - Web GIS by the Chinese Academy of Forestry are provided. Finally, in kind contributions for other activities are provided by participating institutes.

Establishment of the Community of Practice

A Community of Practice is here intended as a Community of users and producers of information and knowledge (and often people are at the same time producers for somebody else and users of the knowledge provided by others) who are united by the will of making scientific results and Earth Observation data useful for ecosystem conservation and management. One of the goals of GEO ECO is to create an Ecosystem Community of Practice, composed by managers and staff of Protected Areas, policy makers, local communities and other stakeholders, with the aim of determining the applied needs that should inform the research and data collection activities. This effort started in the framework of the EU H2020 ECO-POTENTIAL project with a meeting in early May 2017 in the San Rossore Park, Pisa (Italy).

GEO Global Network for Observation and Information in Mountain Environments (GEO GNOME)

Since incorporated into the GEO Work Programme 2017-2019 as a GEO Initiative, GEO-GNOME has sought to connect and facilitate access to diverse sources of mountain observation data and information regarding drivers, conditions and trends in biophysical and socio-economic processes of change at different scales. During its first year, the community involved in GEO-GNOME completed its first task as depicted in the original GEO-GNOME Work Plan of 2016, providing a tool to visualize spatial delineation of mountains to number of key physical criteria. Delineation of mountain regions is an important first step in the collection and provision of global change data and information relevant to mountains.

In mid-2017, following a change in leadership at the Mountain Research Initiative (MRI), the co-leads of GEO-GNOME, MRI (Carolina Adler) and the National Research Council, Italy - CNR (Elisa Palazzi), revised the original 2016 GEO-GNOME Work Plan and proposed a new draft with a view towards consolidation of tasks in line with human and other resources available to complete the proposed tasks, given that the original budget envisaged for GEO-GNOME under the terms of a new contract by MRI with its main funder, did not materialize as expected. The revised work plan was submitted to the GEO Secretariat in July 2017, and subsequently approved at the GEO Plenary meeting in Washington DC, in October 2017.

Despite achieving its first objective and associated tasks, much of the activity at GEO-GNOME had stalled due to the absent funds. To refine and bring the work plan to fruition during 2018-2019, a review of the GEO-GNOME work plan with its active core contributors, as well as others identified as having key expertise, knowledge and interest on the subject matter, was called for. The GEO-GNOME co-leads, together in collaboration with the Institute for Earth Observation at EURAC Research, Italy, convened the “GEO-GNOME Status and Scoping Workshop”, held 23-25 May 2018, in Bern, Switzerland. The workshop provided a much-needed opportunity to revisit key questions and utility of GEO-GNOME in providing policy-relevant information in mountain regions and global policy contexts such as the Paris Agreement, Sendai Framework and Sustainable Development Goals (SDGs). Furthermore, the opportunity to discuss new scientific questions and identify a new research agenda to support a scientific basis for earth observation in mountains was also achieved.

A new GEO-GNOME is currently being compiled based on the results of the workshop and will be made available to the GEO Secretariat as soon as possible and well ahead of the GEO WP Board deliberations prior to the GEO Plenary 2018, in Kyoto Japan.

GEO Global Water Sustainability (GEOGLOWS)

Since 2016 when GEOGLOWS was approved as a GEO initiative the significant progress through the support of NOAA, NASA, CNES, ECMWF, BYU, the World Bank and Switzerland. Currently, the most significant technical elements of GEOGLOWS are (1) the definition of Essential Water Variables; (2) application of Earth observations for Global Streamflow forecasting; (3) applications of Earth observations for social science applications. Milestones that have been achieved include the formation of an International Steering Committee co-chaired by Dr Angelica Gutierrez and Mrs. Rose Alabaster; the formation of four Working Groups which have been coordinating tasks related to the Initiative’s deliverables; and the affiliation of 40 investigators from NASA and CNES with the project. Two annual meetings have been held bringing experts from around the world to formulate activities under GEOGLOWS, to discuss progress on the formulated projects, and to explore new technologies and opportunities in the water field. In addition, GEOGLOWS actively participated in the 2017 GEO Plenary with a Side event and an Exhibit. This was facilitated by a grant from NASA. The Initiative is making progress toward having a permanent secretariat.

In-kind contributions from, and Implementations of the Global Streamflow Forecasting in the operational environment include the following organizations: SENAMHI-Peru, INDHRI-Dominican Republic, CEMADEN-Brazil, and IDEAM-Colombia. Other Implementations have been achieved through partnerships with the NASA-SERVIR Program in Bangladesh, Nepal, and Tanzania,

GEOGLOWS maintains on the GEO Web site, a living document describing the activities of the Initiative along with its most recent work plan. As the project advances, numerous presentations are given at scientific events and conferences, and videos and story maps are developed for documentation.

Under the Essential Water Variables (EWV) project, and for coordination in the development of the EWV, GEOGLOWS engaged in 2018 intergovernmental mechanisms of the United Nations, including programs of UN Environment. GEOGLOWS will continue strengthening these connections and collaborations, within and outside of GEO activities, for determining these variables both for water quantity and water quality.

One of our objectives for 2018, was to establish a connection to an intergovernmental government organization in Africa. This objective was achieved at the GEOGLOWS Business meeting with the participation of Mr Canisius Kanangire, Executive Secretary of the African Ministries Council on Water (AMCOW) <http://www.amcow-online.org/>. With Mr Kanangire and other partners in the region, GEOGLOWS is exploring areas of collaboration under the Initiative.

GEOGLOWS is actively working on capacity development providing workshops in collaboration with local organizations and has been working with native groups in Colombia to use Earth observations to address water issues which stem from industrial development with environmental impacts.

Geohazard Supersites and Natural Laboratories (GSNL)

Below is a summary of the progress with respect to the planned tasks (see Table 5.1 and 5.2, pp. 13-14 of the Implementation Plan).

Task	Task (% completion)	Task progress summary
1.1	Management (70%)	<p>A draft for the new governance structure has been submitted to the Scientific Advisory Committee (June 20, 2018) and is under evaluation.</p> <p>Seven new Supersite progress reports have been received and evaluated and are available on our website. Two more are under evaluation.</p> <p>Constant collaboration with the CEOS agencies within the WG Disasters has resulted in their support to three new Supersites and a Natural Laboratory. Full coordination with the CEOS Disaster Pilots and Demonstrators is in place.</p> <p>Meetings of the GSNL community are organized yearly at AGU and EGU.</p>
1.2	Networking activities (40%)	<p>GSNL has established the San Andreas Fault Natural Laboratory and three new Supersites: multi-hazard Supersite in the Southern Andes of Chile, Virunga volcanoes in D.R. Congo, Gulf of Corinth in Greece, all supporting local end users.</p> <p>GSNL closely coordinated with EPOS, UNAVCO, the ESA GEP, for the provision of data and processing services to the Supersites.</p> <p>GSNL has established contacts with WB and UNISDR exploring the possibility to fund activities of Supersites in developing countries.</p> <p>GSNL has presented the initiative to researchers and stakeholders in 14 different countries, stimulating the participation in the initiative. A few new Supersite proposals are now in preparation.</p>
1.3	Data provision (60%)	<p>GSNL analyzed the various Supersite contexts and issued the GSNL Data Policy Principles, to promote the adoption of the GEO Data Sharing Principles in the long term.</p> <p>GSNL has implemented e-collaboration, processing and information services through the GEP and the EVER-ESTVRE.</p> <p>GSNL obtained further support from the CEOS, with access to over 5000 new images. We are still pursuing JAXA support to the initiative. We have established new procedures for satellite data access using specialized data infrastructures as the UNAVCO SSARA and the GEP. GSNL has documented the new data access procedures on our website.</p> <p>GSNL has set up an agreement with ESA to provide access to over 10,000 COSMO-SkyMed satellite images through the ESA GEP portal.</p>

Task	Task (% completion)	Task progress summary
1.4	Dissemination & Outreach (75%)	<p>GSNL has created a new website and discontinued the one managed by GEO Secretariat. We have prepared new material for dissemination, as a GSNL brochure and a 4-page summary.</p> <p>GSNL has placed all the Supersite reports on the website, and we are gradually extracting success stories from each report for more immediate communication of results.</p> <p>GSNL has started to use the Research Object Hub (ROHUB) to implement a repository for the scientific results and other information generated within the Supersites.</p>
2.1	Supersite management (60%)	<p>Comprehensive reports are submitted and evaluated by the SAC and the CEOS every two years from the date of establishment of the Supersite.</p> <p>Coordinators have been instructed by the GSNL Chair on the satellite tasking and data request procedures.</p> <p>Supersite coordinators maintain communication with their scientific communities and report on the achievements. They re-assess the results from the scientific community and provide the relevant information to their national end users.</p> <p>A few Supersites are now supported, at least in part, by national or regional projects. The new Open Science approach has started to be implemented at some Supersites; the technological resources are available to support this step (e.g. the EVER-EST platform), but the community still needs to be fully engaged.</p> <p>In some cases there is now a clear acknowledgement by the end users of the importance of the Supersite to improve the hazard assessment.</p>
2.2	Supersite community building (40%)	<p>Community building around Supersites is being developed through dissemination at scientific meetings. Capacity building at some Supersites is provided through exchanges of personnel and through the use of common resources for e.g., remote data processing.</p>
2.3	Supersite infrastructure maintenance & development (50%)	<p>A few Supersites have developed their own data infrastructures to share in situ data. Others use community infrastructures.</p> <p>Most satellite data are now provided through specific portals, and data become available in few hours to 2-3 days from acquisition.</p> <p>Scientific results and information for hazard assessment are constantly provided to the Supersite end users through the local coordinators. In some cases the</p> <p>The Iceland and Ecuador Supersites are using the EVER-EST VRE for EO data processing on virtual machines.</p>
2.4	Supersite dissemination /outreach (10%)	<p>Supersite coordinators provide on request material showcasing the results of their Supersite.</p>

The rest of the program period will be dedicated to the remaining subtasks.

GEO Human Planet Initiative: Spatial Modeling of Impact, Exposure and Access to Resources

The Human Planet Initiative uses remote sensing data from satellite image archive and population data from census data to produce multi-date global built-up areas and global population density grids for use in crisis management and urbanization, urban resilience and to support international framework agreements. The most recent built-up area and population density grids are used in operational disaster alert models (i.e. GDACS), in disaster impact

models and start to be used for disaster risk assessment where the human settlement layers are used as exposure layers. The exposure information aggregated at national level are used in system of indicators for humanitarian assistance such as INFORM. The multi-date built-up area and population are tested for use in building indicators for SDGs reporting (i.e. SDG 11.3.1).

The Human Planet Initiative has delivered:

- Global Built-up area spatial grids (4 epochs, 1975, 1990, 2000, 2015)
- Global population density spatial grids (4 epochs, 1975, 1990, 2000, 2015)
- Settlement models that partitions the global built up areas in settlement types including cities, sub-urban areas, towns, villages and rural areas

All the information is available through the GEOSS Portal:

Sufficiency of Resources

Most activities are carried out within the work program of the partner organizations with in-kind contributions. In 2018 NASA funded projects for US partners to support the HPI. However, due to the increasing demand for population and settlement information, it should be considered to upgrade the HPI to a flagship project. In that case the project would require a secretariat and funds to manage the flagship project.

Status of Development and Implementation of Products and Services

Current information products will continue to be updated. More products are expected also by other members of the HPI. ESA will support the HPI through its Urban Thematic Exploitation Platform, which will serve as an HPI data hub. The possible new HP flagship initiative would extend the work of the current HPI by integrating/contributing more to other GEO flagships projects (i.e. EO4GEO), initiatives (i.e. Ocean and Society: BluePlanet), and community activities (i.e. Earth Observation for Disaster Risk management). That would expand the work of HPI into a more coordinated body of activities within the GEO ecosystem.

User Engagement

The following international institutions (policy users) are currently using HPI data for the development of a global definition of cities and settlements: European Commission Directorate General Regional and Urban Development, Directorate General EUROSTAT, OECD, FAO, World Bank; other international bodies that follow the work closely, UN Statistical Office, UN Habitat)

- Office for the coordination of Humanitarian Affairs (OCHA) as well as the Humanitarian Office of the European Commission (ECHO) rely on HPI for operating Global Disaster Alert and Coordination system (GDACS), and to generate data for the system of Indicators INFORM.
- Government of India, Ministry of Finance, Department of Economic Affairs for its Economic Survey 2017

Status of Implementation Plan Milestones and Deliverables

The work was conducted as planned within the activities of the single participating institutions.

Progress on recognition of a policy mandate

The policy mandate is provided by EC, OECD, FAO as discussed above. However, a number of other international and national bodies (i.e. India see below) rely on data produced within the HPI.

GEO Wetlands Initiative (GEO WETLANDS)

GEO-Wetlands was initiated in 2016 based on joint resources from several on-going national and international projects. Most of these projects either finished already or will end soon (2018 or 2019). Additional resources are of highest priority for continuing the efforts and building on achievements, that are:

Tools & Methods

- Methods for different wetland applications developed by partners for specific wetland types, regions or user-needs
- Toolboxes and guidelines developed by different projects available for the community to allow user-friendly application of innovative tools.

Information & Knowledge

- Pilot of the GEO-Wetlands Community Portal operational and continuously filled with information products, guiding users to data and knowledge and demonstrating EO potentials.
- Use cases and demonstration results available highlighting possibilities and value of different EO aspects for wetlands.

Community & Users

- Huge networks of users established through different projects and now coming together within GEO-Wetlands.
- Many training events, workshops and conferences focusing on the use of EO for wetland mapping, monitoring and inventorying held by GEO-Wetlands partners.

Policy & Partnerships

- Key stakeholders like the Ramsar Convention on Wetlands and UN Environment either directly involved in GEO-Wetlands or in close collaboration.
- GEO-Wetlands directly involved in the process of integrating EO approaches into monitoring and reporting systems for global frameworks like the SDGs and the Ramsar Convention.

Outreach & Communication

- GEO-Wetlands presented and actively involved in many national and international conferences and events.

- Pilot website for GEO-Wetlands was established, currently being reworked and evolved into a wetland knowledge-hub.

Milestone status

No.	Due	Title / Description	Status
M1	Dec 2016	GEO-Wetlands approved by GEO Programme Board	achieved
M2	Mar 2018	Draft Resolution on GWOS accepted by Ramsar Standing Committee, for eventual adoption at Ramsar COP13 in October 2018	dropped
M3	May 2018	GWOS infrastructure pilot operational (based on SWOS results)	achieved
M4	May 2018	Knowledge-hub pilot operational and accessible through GWOS Portal-Pilot	ongoing delayed
M5	Oct 2018	GEO-Wetlands Side Event and GWOS demonstration at Ramsar COP13	on track
M6	June 2019	Fully operational GWOS demonstrator for some specific user-groups / use-cases	on track
M7	Dec 2019	GEO-Wetlands office established	unclear

Clarification of milestone deviations

M2 – Target was cancelled and will most probably be pursued at a later stage. Instead, GEO-Wetlands contributed to the development of a Ramsar Technical Report on the use of EO for wetland mapping monitoring and inventorying.

M4 – Still under progress and delayed but will be achieved through the current redesign of the GEO-Wetlands website.

M7 – Achievability of this goal is still unclear and dependent on acquisition of additional resources.

The major challenge for GEO-Wetlands is overcoming its project based character, that makes long-term planning and operationalization of services (e.g. website, community portal, on-demand mapping) difficult. The major area of improvement for the initiative is to identify sources for funding core-components and services. A lot has been achieved since 2016, but a stronger effort and support is required to successfully move from the “project phase” into a more operational long-term phase.

GEOSS-EVOLVE

The starting point of GEOSS EVOLVE was the recognition at the GEO XII Plenary in 2015, that whilst GEOSS had developed significantly in the first decade of GEO, it was necessary to connect better the data services and products, from both space and in-situ, offered by GEOSS to GEO flagships and initiatives, and community platforms, improve data management and

sharing, and ensure the evolution of the infrastructure in the light of the rapid technological developments. On all these fronts there has been good progress, and particularly with respect to connecting better to user needs. This has happened through two main strands of activity:

- The first is the development of regional nodes of GEOSS (AmeriGEOSS, AfriGEOSS, Asia and Oceania GEOSS, EuroGEOSS) which responds to the need to address better user needs at regional and local level, but also leverage regional resources to respond to global priorities such as the Sustainable Development Goals (AmeriGEOSS is an excellent example in this respect).
- The second strand, has focused on developing further the GEOSS Common Infrastructure (becoming a real platform: the GEOSS Platform) through regular meetings with GEO initiatives and flagships, and three Data Providers workshops attended by more than 100 organisations. This strand has been led by the Foundational Task on the GCI, coordinated by the GEO Secretariat, with which GEOSS EVOLVE established an excellent partnership.
- The Data Providers' workshops have also been an excellent opportunity to advance the implementation of the data management, and the data sharing principles. Extended guidelines have been produced for data management, including machine-readable icons, and for community data portals to ensure interoperability within the GEOSS.
- The development of GEOSS regional nodes, the emergence of data cubes and cloud-based Big Data analytics, and of Artificial Intelligence to make sense of the vast array of data available in GEOSS are issues that offer enormous opportunities but also raise new challenges for the governance of GEOSS. In particular, we must strive to keep GEOSS as an open system of systems based as far as possible on an open data commons, and avoid creating new silos and barriers. We have started the reflection on these issues in GEOSS EVOLVE with a first document expected for the GEO XV Plenary, but these are issues that will require our attention for the years to come as technology advances rapidly, and policy priorities shift.

Highlights

- As part of the GEOSS EVOLVE initiative, we have carried out an in depth analysis using machine learning techniques of 1.8 million metadata records representing about 95% of all GEOSS data content, and 1.3 million user searches in the GEOSS infrastructure. This analysis allows for the first time to have an overview of the data demand and supply in GEOSS and of the key characteristics of the users of GEOSS by region, and type (Government, academic, commercial).
- The GEOSS EVOLVE initiative also has developed the GEOSS Data Management Principles (DMP) Implementation Guidelines (IG) document, has initially improved the document by conducting an internal review during 2016-2017, has further improved the document by conducting a joint external review of the document with the GEOSS Data Sharing Principles document during 2017-2018, and has submitted the GEOSS DMP IG to the GEO Secretariat for publication during Spring 2018.
- Discussions took place between the GEOSS Data and Access Broker team and the NextGEOSS project to document the interoperability between this project and the GEOSS platform. This contributes to the important challenge of ensuring interoperability across the regional nodes of GEOSS. Additionally, the open GEOSS API (until recently the DAB API) which was not based on open international standards

has been submitted recently to the OGC for consideration as a standard, so that a core element of the GEOSS Platform is recognized by the international community.

GEO Vision for Energy Initiative (GEO Vener)

Sufficiency of resources

All the activities are funded or supported by in-kind contribution.

Status of development and implementation of products and services

- Copernicus Atmospheric Monitoring Services (CAMS) services and products dedicated to solar energy (Mc Clear and MC Radiation) are available online.
- Energy Community portal webservice-energy.org available online.
- Global Atlas for renewable energies available online with more than 2000 resources and tools. NASA Power GIS available online.
- Copernicus Climate Change Services (C3S) European Climatic Energy Mixes (ECEM) demonstrator available online.
- Sensor Observation System in beta mode implemented and available through the Energy community portal.
- Tools for impact assessment of photovoltaic systems worldwide (ENVI PV) developed in link with International Energy Agency (IEA) available online.

User Engagement

Since 2013, GEO VENER has conducted Solar Training for professionals every January; PhD training in the different members of the GEO VENER initiative. Webinars. Other actions not well documented.

Status of Implementation Plan milestones and deliverables

Implementation Plan to be revised.

Progress on recognition of a policy mandate

The International Renewable Energy Agency (IRENA) was approached during the mandate of the previous GEO Secretariat Director to be part of GEO and to recognize the importance of the GEO VENER Initiative. This recognition of GEO and of GEO VENER needs a decision of the IRENA Plenary, but this is not on the IRENA agenda at the moment.

Global Wildfire Information System (GWIS)

Sufficiency of Resources

GWIS benefits from stable funding for development and operation from the EU Copernicus Program and in kind contributions from its partners in terms of development of methods and tools that are integrated in the system. The European Commission Joint Research Centre has established, under the umbrella of the EU Copernicus program, agreements for the provision of data supporting the different modules of the system. The European Centre for Medium

Weather Forecast (ECMWF) in UK and MeteoFrance in France, provide medium range weather forecasts that are used for the computation of several fire danger indices at the global scale. Other space organizations such as eGEOS in Italy, DLR in Germany, NOA in Greece and Sertit in France, will shortly contribute to the provision of data in the areas of active fire detection and burnt area mapping at European and global scale.

GWIS benefits from other products and service provided by the Copernicus program. In the area of emissions, GWIS publishes data derived by the Copernicus Atmospheric Monitoring Program (CAM5) managed by ECMWF.

NASA provides a decisive contribution to GWIS through 3 projects funded under the NASA ROSES program in the area of: (1) forest fire danger assessment, (2) global observation of active fires from geo-stationary satellite sensors and (3) the exploration of MODIS and VIIRS archives in NASA LANCE services

Status of development and implementation of products and services

Currently, GWIS provides information on wildfire danger, active fires from MODIS and VIIRS satellite sensors, historical archive of burnt areas from MODIS LANCE and emissions from the Copernicus Atmospheric Monitoring Service.

User Engagement

Being a global system, the involvement of users in GWIS is mainly done through the provision of data through the GWIS services. However, as foreseen in the overall scope of the system, GWIS supports regional networks of users. In 2018, GWIS contributed to the organization of the 10th Southern African Fire Network (SAFNET (South Africa Network) meeting at the Kruger National park in South Africa from April 16th to 18th, 2018.

Status of Implementation Plan Milestones and Deliverables

The WP of GWIS is progressing according to plan. In the period 2017-2019, 6 activities were foreseen and progress has been achieved in each of them:

1. The GWIS prototype has been further developed by incorporating new information sources and new datasets for wildfire danger, active fires and burnt areas.
2. Annual GWIS workshop were organized in Santiago de Chile (2016), London (2017). The 2018 annual workshop will take place in Maryland on October 1st-2nd, 2018. The 2019 annual workshop will take place in Campo Grande (Brazil), in connection with the Wildfire 2019 conference.
3. Links have been established with the wildfire emissions community and data from the Copernicus Atmospheric Monitoring Service (managed by ECMWF) are published in EFFIS. Data from the Global Forest Emissions Database (GFED) will be established shortly. Through NASA ROSES funded project, the links to communities dealing with the production of fire danger assessment, active fire mapping and burnt area mapping have been strengthened.
4. GWIS is active in publicizing and making data available through a series of platforms and metadata catalogues, especially the GEOSS Community Portal. GWIS has participated in meetings, webinars and workshops organized by the GEOSS community.
5. Capacity building activities have been further developed by supporting meetings of the GOFI Fire IT Regional networks and receiving user's feedback that will allow

customizing GWIS data and products to the needs of the national and regional wildfire management services.

Oceans and Society: Blue Planet

GEO Blue Planet has made significant progress since 2016, in (1) establishing and populating its formal governance structure, (2) engaging with and bringing into GEO a wide range of relevant organisations, programmes and projects, (3) building up two of its four established Working Groups (“Developing Capacity and Societal Awareness” and “Users and Networks”), and (4) starting to develop projects and engage stakeholders.

One of the priorities has been to support the Sustainable Development Goals, firstly through working with UNEP, the Custodian Agency for Indicator 14.1.1. (plastic pollution and eutrophication), to help them to identify existing sources of data and methodologies for measuring proxies for eutrophication. Secondly, Blue Planet engaged with EO4SDG and, through this collaboration, obtained a grant from NASA to organize a workshop in St Vincent and the Grenadines in February 2018 that brought together stakeholders engaged in the implementation and monitoring of the SDGs in the Caribbean SIDS.

In 2018, Blue Planet started to develop thematic WGs, by accepting proposals from the community for WGs on (1) “Understanding Flooding on Reef-lined Island Coasts (UFORIC)”, and (2) Earth Observations for Surveillance and Prevention of Water-Related Diseases. UFORIC aims to launch a Project on developing an early warning system for marine flooding in Pacific Islands. The WG on Water-Related Diseases is initiating a dialogue between different parties interested in this topic, with a view to exchanging best practices and reaching out to other relevant initiatives within GEO, such as EO4Health and the Human Planet Initiative.

Blue Planet also co-organised a Workshop with IOCARIBE of IOC UNESCO, UNDP Barbados and the Organisation of Eastern Caribbean States (OECS) in May 2018, hosted by the Ministry of Education of Mexico and Mexico National Council of Sciences in Mexico City. These organisations are proposing a Caribbean Monitoring Pilot Project that immediately addresses significant region-wide issues (Sargassum, Oil Spills) while creating a lasting framework for further expansion. The Project will stress end-to-end system development directed at providing observation- and model-based products developed by and for local practitioners and decision-makers. The workshop aimed to introduce the project goals, engage collaborators in project activities, develop an organizational structure and implementation plan, and consider how to sustain this and additional regional Ocean Observing projects.

In terms of the cross-cutting WG deliverables, the WG on Developing Capacity and Societal Awareness has produced a [brochure](#) on the products and services of ocean and coastal observations, aimed at the general public, which was launched at COP-23 in November 2017. The group “Ocean Communicators United” also contributed to the work of the WG a [Guide and Template](#) on Writing Communication Strategies. Finally, a manuscript on “Challenges for global ocean observation: the need for increased human capacity” was submitted to the Blue Planet Supplemental Issue in the Journal of Operational Oceanography in March 2018.

Blue Planet still faces challenges related to its best-effort nature and is actively seeking support for (1) a European Secretariat node, and (2) the WGs and projects listed above.

Capacity Building Coordination

The GEOCAB portal is operational, although updating of information is needed. It is proposed to integrate the portal within the GEO website. The portal is already brokered to the GEOSS Platform.

A side event was implemented during the GEO Week 2017 titled “From Data to Decisions and Impact: New practices on capacity building for EO”. A capacity development symposium is scheduled for 2019 and a proposal for a side event has been submitted for the GEO Week 2018.

The Capacity Building (CB) Working Group received support from the GEO Secretariat in 2017, but secondment of the CB coordinator ended in 2017. As of May 2018, a new “virtual” secondee has been appointed, financed by the Faculty of Geo-Information Science and Earth Observation of Twente University in the Netherlands.

The CB Working Group had started a baseline assessment of capacity building providers, ongoing programmes and activities. Although quite a lot of data were gathered, the team concluded that time and resources are lacking to capture all capacity building activities in, and related to, GEO. Therefore, a task team started a review process on the mandate of the CB Working Group, defining realistic and feasible tasks and considering the reduced Secretariat support to the Working Group. The focus will probably be more on monitoring and impact measurement of CB activities, followed by sharing best practices and providing guidelines and methodologies.

GEOSS Platform Operations

The last 3 years have been critical for the evolution of the GEOSS Platform Operations. Since 2016, many improvements have been implemented to the former GEOSS Common Infrastructure (GCI) to evolve it into a GEOSS Platform. The GEOSS Platform is designed to be more user-friendly and with enhanced usability to facilitate the discovery and accessibility of EO to end users.

Main milestones of the last 3 years have been:

- Establishment in 2016 of the annual GEO Data Providers workshop event; the event has been repeated in 2016, 2017, 2018 with incremental success and high adoption of the GEOSS Platform work by the community. 3rd GEO Data Providers Workshop executive report
- 2016 Release of the enhanced GEOSS Portal with improved user interface; For technical details please refer to: <http://www.geoportal.org/community/guest/about>
- 2017 Release of the GEOSS Platform Reusable Components: GEOSS Mirror, GEOSS Widget, GEOSS VIEW, GEOSS APIs. For technical details please refer to the [GEOSS Platform Manual](#).

In 2017, 2 additional critical components have been implemented:

- New simplified Registration process called GEOSS Yellow Pages; done with the in-kind contribution support of the University of Geneva
- The GEOSS Status Checker implemented with the in kind support of the USGS – component that assess the “Health Status” of the provided resources.

- 2018 Evolution of the GCI to a GEOSS Platform and towards a Knowledge Hub

For technical details please refer to the document [From GCI to GEOSS Platform](#).

Parallel to those important milestones, the number of new international and multidisciplinary EO data providers has greatly and constantly increased to an actual number of more than 175 brokered data catalogues, which comprise more than 5000 data providers with more than 415 million discoverable and/or accessible Earth observations.

Parallel to the higher amount of available observations, the number of queries from multiple institutions (e.g. WMO; Universities; Private Sector and users) have increased.

The GEOSS Platform outreach effort has included GEO institutional workshops (Plenary, Work Programme, European Projects, Symposia), user-community workshops (Disasters, Water Climate, Food Security, SDG) and community-solicited workshops (Unicef, GEO-Chile, GEO-GNOME, AtlantOS, WHO) and in other important international venues (EGU, EO Summit, ESAW, CEOS WGISS).

The GEOSS Platform has strengthened the linkages with the GEO Flagships, GEO Initiatives and Community activities, by leveraging the Platform Reusable Components; this is resulting in making the GEOSS Platform the central hub for EO necessary to the GWP activities, as well as EO information products and services resulted from GEO Activities.

The GEOSS Platform constitutes the basic infrastructure to be leveraged to move towards the knowledge hub, as it has been recognized and endorsed by the community as the largest open data repository in the world.

GEOSS Platform Operations works in close collaboration with the GEOSS-Evolve Initiative, especially regarding the evolution of the Platform.

The 3rd GEO Data Providers Workshop was held at the ESRIN, the establishment of the European Space Agency (ESA) in Frascati (Italy) from the 2nd to the 4th of May 2018. The event was co-organized by the GEO Secretariat, ESA, CNR-IIA (Italy), United States Geological Survey (USGS) and the University of Geneva (Switzerland). The Joint Research Centre of the European Commission contributed to the event report.

The workshop brought together more than 200 data providers and users from more than 133 organizations from 33 countries and 5 continents and provided a space to share experiences and knowledge that can improve the ways in which Earth observations are managed, communicated, disseminated and used to enhance the Global Earth Observation System of Systems (GEOSS).

GEOSS Satellite Earth Observation Resources

Successes

The seven CEOS Virtual Constellations for GEO – Atmospheric Composition (AC-VC), Land Surface Imaging (LSI-VC), Ocean Colour Radiometry (OCR-VC), Ocean Surface Topography (OST-VC), Ocean Surface Vector Wind (OSVW-VC), Precipitation (P-VC), and Sea Surface Temperature (SST-VC) – were created to harmonize efforts among space agencies to deploy Earth observation missions with the aim to close emerging data gaps and help space agencies avoid duplication and overlap in Earth observation efforts and establish and sustain a global Earth observation network.

Significant progress has been made in the last year, organizing the community and advocating for Passive Microwave (PMW) continuity. The SST-VC notes progress with two, complementary missions that if successfully put into operations will fill the looming gap in PMW imagery. While not yet fully approved, the ESA Copernicus Imaging Microwave Radiometer (CIMR) will focus on low frequency/high resolution channels and would result in a step-change in EO capability with potential to revolutionize SST and sea ice monitoring from space. The second area of progress is from JAXA on the AMSR2 follow-on mission, AMSR3. AMSR3 entered the pre-project phase in September. Both AMSR3 and CIMR have proposed launches in the 2022-2025 timeframe. The two missions are highly complementary and would provide an unprecedented coverage and revisit of the global ocean and high latitude sea ice conditions.

The AC-VC was commissioned to define the key characteristics of a global architecture for monitoring atmospheric CO₂ and CH₄ concentrations and their natural and anthropogenic fluxes from instruments on space-based platforms to reduce uncertainty of national emission inventory reporting and to track changes in the natural carbon cycle caused by human activities and climate change. Over the course of the last 18 months, a dedicated team of researchers, space agency representatives, and scientists have created a White Paper, titled “A Constellation Architecture for Monitoring Carbon Dioxide and Methane from Space.” This White Paper proposes an architecture of a future greenhouse gas constellation designed to address the objectives outlined in the paper, and recommends a three-step plan to implement the architecture.

The LSI-VC has been incredibly successful in moving forward with the development of the CEOS Analysis Ready Data for Land (CARD4L). Analysis ready data (ARD) is no longer a desire of global users, but is now becoming a requirement and an expectation and it is clear that space agencies need to make it easier for global users to get ARD. CARD4L are satellite data that have been processed to a minimum set of requirements and organized into a form that allows immediate analysis with a minimum of additional user effort and interoperability both through time and with other datasets. There is a CEOS website for ARD – www.ceos.org/ard

The OST-VC was successful in securing agency leadership to place Sentinel-3A and -3B in tandem mission first as this is common to previous altimeter missions for long-term record. This successful proposal is already paying off in detecting small inter-satellite processing differences. The OST-VC is also investigating how to link with other observables such as sea surface temperature and ocean color to determine surface topography.

The OCR-VC is implementing the 2012 International Network for Sensor Inter-comparison and Uncertainty Assessment (INSIT-OCR) White Paper and focusing on coordinating cross-agency activities with respect to system vicarious calibration and collaboration on space instrument accuracy and stability to maximize the quality of OCR data records. OCR-VC is working closely with the International Ocean-Colour Coordinating Group and other calibration/validation leaders.

Challenges

CEOS concluded, in 2010, that CEOS would work with WMO and CGMS to explore possibilities for closer coordination on radio frequency matters because CGMS and WMO were more "active in this domain." In February 2011, CEOS spoke with CGMS and WMO and agreed that on a technical level, coordination on frequency matters is good but that coordination is not translating to success in guarding frequencies. CEOS also concluded that frequency coordination is dealt with by national delegations, which often have a number of competing interests to deal with and it was not clear how CEOS could contribute to the national

processes. As such, while CEOS is lead of this Foundational Task, it has not engaged in any frequency spectrum management activities nor have any inputs to WRC 2019 Conference been prepared.

Advancing Communications Networks

The Advancing Communication Networks working group has convened twice in 2017 and twice so far in 2018. Work is ongoing in the identified activities for the period, with strong progress in engaging with AfriGEOSS and supporting African NRENs to explore developing capacity in the region. This was via an extensive outreach program across Africa coordinated by ASREN. Further work is being undertaken to document the approaches taken and challenges experienced by WMO, AfricaConnect2 and GÉANT, in engagement and development of the various telecommunication infrastructures which contribute to GEO and GEOSS. This is a deviation from activity 1 for the period.

Another notable achievement is the start of a series of requirement gathering sessions which will be run in different continents. The aim is to develop a snap shot of current telecommunications requirements of data providers and data users and to monitor this over time. The requirement gathering sessions also serve to provide a means of the ACN group engaging with a wider audience and understanding their needs and requirements for the GEOSS communications networks. The first requirement gathering session was held at the 3rd GEO data providers workshop.

Work is still ongoing with the implementation of a pilot of eduRoam and eduGAIN at a WMO site in Brazil. However, progress was slowed by the necessary reconfiguration of key systems that might have impacted on operations, and therefore had to be tested prior to implementation. Brazil appreciated the assistance of GÉANT in addressing the configuration issues and are now preparing to work on the pilot. They will be reporting to WMO on the progress in mid-September 2018.

Current resources in the working group are provided as an in-kind contribution. Currently this is sufficient for meeting the proposed activities for the group. However, development of a website and a larger community around this activity are required for the activities of the WP to have a sustained and lasting impact.

Copernicus Atmospheric Monitoring Service (CAMS)

CAMS is part of the European flagship programme Copernicus. It has been operating since the beginning of 2015 with an operational budget is of 76M€ for the period until the end of 2020. Activities are managed and partly implemented by the European Centre for Medium-Range Weather Forecasts and partly by means of contracts involving about 50 entities from more than 15 European countries.

CAMS is operational and enforces the full, free and open data policy of Copernicus. Specifically, it delivers the following services:

- daily production of near-real-time analyses and forecasts of global atmospheric composition;
- reanalyses providing consistent multi-annual global datasets of atmospheric composition with a frozen model/assimilation system;
- daily production of near-real-time European air quality analyses and forecasts (including also pollens) with a multi-model ensemble system;

- reanalyses providing consistent annual datasets of European air quality with a frozen model/assimilation system, supporting in particular policy applications;
- products to support users in the environmental policy sector, adding value to “raw” data products in order to deliver information products in a form adapted to policy applications and policy-relevant work;
- solar and UV radiation products supporting the planning, monitoring, and efficiency improvements of solar energy production and providing quantitative information on UV irradiance for downstream applications related to health and ecosystems;
- greenhouse gas surface flux inversions for CO₂, CH₄ and N₂O, allowing the monitoring of the evolution in time of these fluxes;
- climate forcing from aerosols and long-lived (CO₂, CH₄) and shorter-lived (stratospheric and tropospheric ozone) agents.

All the products can be found on the CAMS website at <http://atmosphere.copernicus.eu> using the catalogue search tool. Support functions are also available to the users.

User uptake is continually monitored in CAMS and through surveys. The current number of registered users is in excess of 8000. On a quarterly basis, the number of “active” users (effectively downloading data) is in excess of 1200. But this only represent the direct users. The audience of CAMS is much larger. CAMS air quality bulletins aired several times daily on Euronews are seen by 18 million users. Many smartphone applications relying on CAMS data have numbers of downloads in excess of several hundreds of thousands.

CAMS supports several policy areas that are pivotal for the European Union, especially in the areas of air quality, of greenhouse gases and of the ozone layer. Working with the World Meteorological Organisation and the World Health Organisation, CAMS intends to support monitoring the indicators of the Sustainable Development Goals which are within its thematic remit.

Copernicus Climate Change Service (C3S)

C3S delivers operational data and climate information services on a range of topical and sectoral areas. Based on these baseline services, many other value-added products can be tailored to more specific public or commercial needs.

C3S is developed and operated in a way that complements the established range of meteorological and environmental services that are operated nationally. The strong involvement of current service providers and relevant academic communities ensures that C3S fully benefits from existing infrastructure and knowledge. It also ensures that the Service is implemented consistently with the EU principles of complementarity and subsidiarity.

The service elements for C3S are procured by means of competitive Invitations To Tender (ITT), and delivered by about 200 companies and organisations across Europe.

2018 is a critical year for C3S as it becomes operational. It also enforces the full, free and open data policy of Copernicus.

In a nutshell, the portfolio of C3S consists of:

- Observation collection and processing. This includes data rescue activities, access to reference networks, access to climate archive, and high resolution datasets over Europe. This also includes satellite reprocessing for climate reanalyses
- Observational gridded products. This includes climate data records providing information for 22 Essential Climate Variable products
- Global Climate Reanalyses
- Regional Climate Reanalyses
- Multi-model seasonal forecasts (current providers: ECMWF, Meteo-France, UKMO, DWD, CMCC)
- Access to global and regional (over Europe) climate projections
- Sectoral Information System: A series of end-to-end demonstrators as well as operational production of climate impact indicators in the area of a number of economic sectors: Energy, Water management, Tourism, Insurance, Agriculture, Health, etc.

In the near future, service evolution may include an attribution (attribution of extreme weather to climate change) as well as a decadal prediction service.

Earth Observations for Cultural Heritage Documentation (CULTURAL HERITAGE)

The following planned activities have been implemented in 2017:

- Continuous update of the CA-24 activity website;
- Mobilize multi-disciplinary communities in Earth observations;
- Contribution to CIPA Symposium in Ottawa, Canada, 28/8 – 1/9 2017. CIPA is the Scientific Committee on Heritage Documentation of the International Committee on Monuments and Sites (ICOMOS). It provides a forum to international organizations, scientists, stakeholders and wide public exchange of know-how, experiences and ideas;
- Contribution to the COST (European Cooperation on Science and Technology) i2MHB (Innovation in Intelligent Management of Heritage Buildings) meeting in France, 21-23 March 2017;
- Conducted a summer school at the Vergina archaeological site in Greece, promoting innovation in the use of Earth observations and GEOSS in cultural heritage activities (funded by Baden-Württemberg Stipendium BWS+); and
- Offered an intensive course in mobile and web mapping for cultural tourism (Spain, Armenia, Georgia) through the ERASMUS+ funded HERITAG project.

Earth Observations for Disaster Risk Management (EO4DRM)

Successes

Since 2016, significant progress has been achieved in relation to four thematic pilots, the development of a Recovery Observatory, and the revitalization of the Geohazard Supersites and Natural Laboratories (GSNL).

In 2014, the Working Group kicked off a Volcano Pilot, a Seismic Hazards Pilot and a Flood Pilot. All three presented their final results to the 2017 Committee on Earth Observation Satellites (CEOS) Plenary. These pilots achieved significant technical success and demonstrated in their respective areas how satellite data can make a difference and improve risk reduction. A Volcano Demonstrator and a Seismic Hazards Demonstrator have been approved in 2018 to further capitalize on this success and develop a robust user base internationally. The Seismic Hazards Pilot also led to the creation of a Geohazards Lab which provides advanced tools to the international seismic community. Several flood activities are expected to be re-scoped and developed in the GEO DARMA project under the leadership of regional institutions in Asia, Africa, and the Caribbean.

The Haiti Recovery Observatory (RO) was triggered in December 2016 after Hurricane Matthew decimated southwestern Haiti. After two years of operations, the RO has successfully developed a strong working relationship with its three Haitian champions: the National Centre for Geo-spatial information (CNIGS), International Center for Tropical Agriculture (CIAT) and the National Observatory of the Environment and Vulnerability (ONEV). These organizations have improved their use of satellite imagery and are standardizing products that will be available not only to track recovery from Matthew but will be available after future events. The RO has a strong capacity building program to ensure a legacy after recovery.

Challenges and Areas for Improvement

The Working Group recognizes the need to improve how it captures and promotes user success stories; in some cases, users have been meaningfully engaged and this success was not well communicated outside the thematic working group (for example, the Flood Pilot with strong success in Caribbean and Southern Africa; Volcano Pilot with strong success in Latin America, Recovery Observatory which has developed a solid user base in Haiti, but has struggled to communicate success internationally of a project that takes places solely in French).

All CEOS activities are conducted on a best-efforts, no-exchange-of-funds basis. This means some elements of projects are challenged from a funding viewpoint, which creates delays while resources are identified or secured. This has proved challenging for the establishment of a global Volcano Demonstrator, which has since adopted an iterative, multi-year approach. It may also prove challenging for the GEO DARMA regional projects and for the Generic Recovery Observatory envisaged as a further development of the Haiti experience, replicated on a global basis after other major events.

In summary, several Working Group activities present real user success stories, and more work will be undertaken to promote this success through the CEOS website and during DRM events globally, such as the recent Understanding Risk forum where the Working Group showcased its most recent activities.

2017-2018 Highlights

- In 2017, data analysis from the Volcano Pilot led volcano observatories to change their assessment of risk and to provide warnings to the public or move ground monitoring devices to areas actually at risk.
- In 2017, rapid-science products were produced after earthquakes to show co-seismic and post-seismic deformation, which can then be used by civil protection agencies in preparing for aftershocks or assessing damage in affected areas.
- In 2018, CEOS approved the start of the Volcano and Seismic Hazard demonstrators and the first GEO DARMA project on flood monitoring in Myanmar.
- In 2017 CEOS approved two new supersites: Southern Andes and Virunga Volcanoes Supersites and the continuation of Ecuador and New-Zealand Supersites.

Earth Observations for Geohazards, Land Degradation and Environmental Monitoring (EO4GEOHAZ)

There are two sub-groups defined under Earth Observation and Geohazards Expert Group (EOEG). The landslide working sub-group has reviewed past activities and future actions in order to deliver the following pan-European landslide hazard reviews and databases:

- A review of landslide hazard maps integration into land use and urban planning
- A review of landslide monitoring test sites in different physiographic, climatic and geological environments.
- The report and database of damaging landslides

The EOEG Earth Observation working sub-group has reviewed past activities and future actions in order to increase the application of Earth Observation technologies to Geoscience (geohazards and raw materials) within the Geological Surveys in Europe:

- The website for the GEO Community of Activity: “Earth Observations for Geohazards, Land Degradation and Environmental Monitoring”, was introduced
- The progress of H2020 Geo-Cradle and U-Geohaz has been discussed
- The metadata table for collecting information about existing spectral databases (soil, rocks, minerals) was prepared and distributed
- The invited talk “Earth Observation in support of sustainable mining by the Geological Surveys of Europe” was presented at the 2018 METS conference (<http://www.mets2018.eu/en/>)

Furthermore, a review on landslide hazard maps integration into land use and urban planning and updated damaging landslide database are being under development during 2018.

EOEG members were invited to participate in EuroGEOSS project proposal: EuroGEOSS Showcases: Showcasing and promoting users’ uptake of GEOSS through a coordinated and innovative approach for the benefits of Europe (the H2020 project, starting in 2019).

So far, the activities are mainly covered by in-kind resources.

Earth Observations for Health (EO4HEALTH)

As an integral part of the GEO Health Community of Practice, EO4HEALTH has leveraged the continued development of global networks of stakeholders that enhance shared scientific findings and promotion of Earth observation tools and data.

EO4HEALTH has supported the dissemination of project findings and Earth observation tools to the scientific community and public through conferences, NASA Applied Remote Sensing Training (ARSET) online and in-person trainings, and social media technology.

EO4HEALTH has supported projects that link satellites and data products to public stakeholders in the air quality and public health communities. First, the GEO Health Community of Practice (<http://www.geohealthcop.org/>) facilitates a global platform for multidisciplinary stakeholders who use Earth observations to inform and enhance decision-making in health applications. Second, NASA Health and Air Quality Applied Sciences Team (HAQAST) (<https://haqast.org/>) remains a prime method for public communication efforts that promote new team applied research, connects the team with stakeholder organizations, and offers a mechanism to communicate scientific findings related to air quality and health to the public and professionals. Third, the NASA Applied Remote Sensing Training (ARSET) program offers in-person and webinar beginning and advanced training sessions on remote sensing of an array of environmental applications

EO4HEALTH has supported the GEO Health Community of Practice in the development and elaboration of the Work Plan draft.

Financial resources are sufficient to implement the WP activity.

Current and potential end users have been actively engaged in these activities. Current steps continue to expand connections with the public health community.

Earth Observations for the Water-Energy-Food Nexus (EO4WEF)

This activity was launched in 2015 with a Belmont Forum grant provided to support a series of regional workshops on the Water-Energy-Food (WEF) Nexus. The WEF Nexus component has continued with some in-kind support from NASA and other interested organizations.

The COMPASS effort began in 2017 with support in kind from CCNY (New York) and Griffiths University in Australia (through the Water Futures Programme). Prospects of longer-term support for COMPASS are relatively good. COMPASS has succeeded in producing some sample near real-time assessment products which has provided “proof of concept” for potential funders and users of the system.

The WEF Nexus has engaged stakeholders as part of its regional workshops and has plans to engage stakeholders in future steps in the development WEF information products. Next steps for the WEF Nexus activities involve the completion of a synthesis document and framework for implementation and user need assessment workshops.

COMPASS will continue to develop a more robust analysis system by increasing its range of data inputs, expanding the number of assessment products and engaging in stakeholder consultations. With encouragement from GEO it could possibly develop a stand-alone GEO initiative proposal.

GEO-CRADLE

GEO-CRADLE has occasionally faced some linguistic, cultural, legal, political and diplomatic challenges during its implementation, given that it runs over a very diversified and complicated region (e.g. some portals, data and services available only in the local language, strict legislation framework for soil samples export, political conflicts and disputes about territories and names). However the project has successfully tackled all such issues and all the tasks were finally implemented.

GEO-CRADLE ran for the first time in the North Africa-Middle East–Balkans (NAMEBA) region an analytic inventory and assessment of the existing EO capacities, monitoring capabilities, and scientific skills which are available for integration and supplementary support to EU capacities. This survey is ongoing and based on this feedback the Networking Platform is set up providing useful information about the profile and the capacities of 269 stakeholders in 29 countries across the entire value added chain – with the vast majority of them (191) having accepted to provide free and open access to their profile and capacities (update 13/06/2018). This database is searchable with simple and advanced query modes by using filters relating to the country, field of expertise, capacities, skills. GEO-CRADLE sustains this network of actors with a lasting activity which ensures the exchange of know-how, brings organisations together, and facilitates the team up/partnering process at regional level for identifying and solving common challenges, and setting up consortia for addressing the specifications of regional calls, any time a new call is open (examples: EuroGEOSS Call, EuroGEOSS Request 2018 for Expressions of Intent, PRIMA, CHIST-ERA, EO4SD).

Furthermore GEO-CRADLE has set up a Regional Data Hub (RDH) with free and open access, serving as a gateway that facilitates the access of the regional actors and EU partners to useful datasets and portals from the regions that use open standards. This plays a unique regional role, amongst others, in the direction of the implementation of the Sustainable Development Goals (SDGs). The RDH integrates advanced IT technology based on the GEO DAB APIs and DKAN for easy access and discovery of regional EO data. Millions of datasets are now available by accessing through the RDH to GEOSS and regional / local portals.

GEO-CRADLE also for the first time ran an in depth reporting of the user needs in the four thematic areas of the project, which are highly related to the objectives of several SDGs: adaptation to climate change, improved food security & water extremes management, access to raw materials, and access to energy. More than 40 priority proposals were drafted and after consolidation a number of common regional service delivery and capacity building challenges were promoted. The Pilot Activities were implemented successfully, engaging the relevant end users and addressing regional challenges. They provided very useful EO services and data, which are also publicly available on the Regional Data Hub. Some of these services have been considered as good cases for potential EuroGEOSS services.

In parallel, GEO-CRADLE organized 16 Regional Workshops which supported knowledge sharing / capacity building, engaged more stakeholders and end users, provided participants with a unique cross-sector networking opportunity (e.g. an enhanced cooperation between academia and industry), identified the potential local challenges and needs that can be addressed by EO, enhanced growth and innovation in the geo-information sector, and enabled more informed decision making.

GEO-CRADLE is now working on drafting a Roadmap for the Implementation of GEO, GEOSS and Copernicus in the NAMEBA region. The roadmap will be elaborated taking into account the synthesis of the results from the thorough gap analysis, at the regional and the country level,

to present an updated and valid overall picture of the gaps and needs in terms of capacity building, resources (including human), funding, coordination mechanisms. It will weigh the readiness and maturity of each country to address the identified gaps and pursue the means to cover the needs and establish the appropriate flow direction of further exchange of know-how and best practices. The roadmap will be identifying all regional challenges as they result from the collaboration with the regional stakeholders during the implementation of the GEO-CRADLE and will be setting the priorities for GEOSS and a potential regional initiative to cope with these challenges in an effective and collective manner.

Global Ecosystems and Environment Observation Analysis Report Cooperation (GEOARC)

The Global Ecosystems and Environment Observation and Analysis Annual Reports are the main achievement of this project. In 2017, GEOARC published three thematic reports and corresponding data sets, such as The Belt and Road Initiative Ecological and Environmental conditions thematic report, The Impacts of Global Natural Disasters on Vegetation thematic report and Supply Situation of Maize, Rice, Wheat and Soybean thematic report.

The annual reports and data sets were publicized through international conferences and training activities. The series of annual reports and data sets shared and distributed on the national integrated Earth observation data sharing platform can help expand the scope of the reports. The cumulative number of downloads for the current annual report reached 15,499 times, and the download number of annual report data products reached 11,176 times. The data sets and data papers are also published in the "Journal of Global Change Data & Discovery". They have received full attention from scholars and undergraduate students. The download number of data sets reached 27600 times and the cumulative download amount was 7011GB.

The project pushed the annual reports and data sets for the service and application departments of the annual report on remote sensing monitoring of the ecological environment, including 5 units, such as the Satellite Environment centre of the Ministry of Environmental Protection of China, the Chinese Academy of Forestry, the Chinese Academy of Meteorological Sciences, the China Institute of Water Resources and Hydropower Research, the Ministry of Water Resources of the People's Republic of China. The results and data sets of the annual report are applied to the core business of the above-mentioned units. The application departments also make suggestions for improvement.

GEOARC have organized several discussions on strategic planning of annual reports, and combined with the goal of sustainable development goals (SDGs), plans the theme of future annual reports. The annual report for 2018 is in preparation, which are focused on The Belt and Road Initiative Ecological and Environmental conditions, Supply Situation of Maize, Rice, Wheat and Soybean and the Spatial and Temporal Distribution of Global Carbon sources and sinks. What's more GEOARC needed to do is to involve more researchers as in the fields of policy, economics and society to make more beneficial suggestions for decision-making.

Global Flood Awareness System (GLOFAS)

The Global Flood Awareness System (GloFAS) is part of the Copernicus Emergency Management Service and provides complementary, added-value flood forecasts independent

of administrative and political boundaries. It couples state-of-the art weather forecasts with a hydrological routing model, and, with its global-scale set-up, provides downstream countries with information on upstream river conditions as well as continental and global overviews.

- GloFAS now produces fully operational global ensemble flood forecasts since 23 April 2018
- GloFAS has shown its potential as a decision-making tool through many floods
- GloFAS has supported Red Cross operations in Africa and South America

GloFAS is able to predict floods up to two-three weeks in advance depending on the situation and river size. It became fully operational recently, which guarantees a 24/7 service as part of the Copernicus Emergency Management Service..

GloFAS' principal objectives are to improve preparedness and response for floods at a global level by providing

- added value flood forecasting information to the relevant national authorities complementary to existing national systems
- international organizations with global scale, comparable, and basin-wide flood forecasting information.

Activities for the period 2017-2018

Development

The main activity over the period was the preparation for the operational service. This was achieved on the 23 April 2018. Other developments during this period have included an extension of the forcing data to 30 days, using the ECMWF extended-range forecast where available, and seasonal forecast product, which is now available online. The seasonal outlook was developed in collaboration with the University of Reading, and is produced once a month providing a river flow outlook up to 4 months ahead. Furthermore, a new model calibration has been performed and is foreseen to be released during the fourth quarter of 2018.

User Engagement

The interaction with the GloFAS user community has been very intense and fruitful during the period. GloFAS shares data with a number of research groups, institutions and NGO's all over the world. This includes, for example, CEMADEN (Brazil), SENAMHI (Peru), the Regional Integrated Multi-Hazard Early Warning System for Africa and Asia (RIMES), Red Cross/Red Crescent Climate Centre, and many more. These are using the output for their own decision making and are refining the product for further dissemination. One particular successful event was the GloFAS workshop "Hydrological Services for Business" which was held 8-9 May in Reading. It attracted users all over world together to discuss how the GloFAS output can be used and improved for their specific needs.

Future Plans

The important developments over the coming period will be to develop a better validation of the output against observations, to constantly improve forecast skill and to make the output more available through archiving and access through a number of services.

Resources

GloFAS is an activity under the COPERNICUS Emergency Management Service. Other resources are through funded projects and in-kind contributions from users and developers.

Contributors

- The European Commission - Joint Research Centre (JRC) manages the GloFAS project as part of the Copernicus Emergency Management Service - and additionally contributes to the system with further research and development.
- The European Center for Medium-range Weather forecasts (ECMWF) operates the GloFAS system and ensures a 24/7 service and provides basic research support.
- The University of Reading (UK) conducts research using GloFAS forecast products as well as liaising with end-users through the GloFAS Community initiative.
- CEMADEN (Brazil) performs validation of GloFAS forecast products for Brazilian river basins.

Himalayan GEOSS

Himalayan GEOSS does not have dedicated financial resources. Currently, ICIMOD is combining Himalayan GEOSS activities with its SERVIR-HKH and Regional Database initiatives which are working on very similar objectives in the Hindu Kush-Himalayan (HKH) region. Application services are being developed on drought monitoring, high impact weather assessment and flood early warning, and regional land cover monitoring system.

A two-day regional workshop on Himalayan GEOSS was organized successfully from 10-11 August, 2017 in Kathmandu, Nepal. The workshop provided a platform for policy dialogue and exchange of technical knowledge focusing on operationalization of the Himalayan GEOSS Initiative. The workshop was participated by the representatives from government, key regional and international partners working with EO and geo-information in HKH countries. As a follow up of the workshop, a concept paper on implementation of Himalayan GEOSS was prepared and endorsed by the partners.

The implementation framework provides guidelines for Himalayan GEOSS activities in the period of 2018 to 2022. The framework proposes the formation of Steering Committee that provides guidance for implementation modalities of Himalayan GEOSS initiative, and more focused Technical Working Groups for providing inputs in prioritized thematic areas. Also, it identifies the priority intervention areas in the form of priority themes (i.e. agriculture and food security, water resources, disaster reduction, land use and land cover change and ecosystem services), capacity building of regional countries in the use of EO and geospatial technologies, and establishment of regional data sharing platform. Further, the framework alludes to building partnerships with various national and international initiatives, space agencies, professional organizations, private sectors, and aligning the efforts of Himalayan GEOSS with the priorities of development partners to build synergies in SDG goals and foster partnership with Global Partnership for Sustainable Development Data (GPSDD) and others.

Dialogue on GEO membership of remaining HKH countries (Myanmar, Afghanistan and Bhutan) was initiated with partners. Further follow up will be made during the coming years.

Integrated City-Region Systems Modelling (RESILIENCE-IO)

Resilience-IO is currently delivering a global investor roadshow to secure the funds needed to build and scale the digital tools and supporting activities to support demonstrations in 200 city-regions, with good early success.

We have established two new demonstrator city-regions, in Medellin, Colombia and in the Hunter Valley in Australia. These are both starting as pilot projects focussed on major resilience challenges within the context of each city-region. Users are engaged in a data collection and modelling co-development process within these and our existing demonstrator regions.

We have also just completed a partnership with Rezatec and the European Space Agency exploring how Earth Observation analysis, combined with the resilience.io platform, can precipitate more resilient infrastructure planning, investment and management. The case study with Scottish Canals will be published in 2018.

We are contributors to the EO4SDGs group and are in a strong position with expertise and experience to support the emerging urban resilience impact area. We also continue to focus on the regional implementation of the Sendai Framework, the Sustainable Development Goals, the Paris Climate targets as well as the UN Habitat New Urban Agenda.

Mult-Source Synergized Remote Sensing Products and Services (GEO MUSYQ)

Since 2016, the research group has collected multi-source data and MuSyQ has generated 10 global biophysical parameter products. Up to now, the collected global multi-sensor datasets include MODIS-Terra/Aqua, MERSI-FY3A/B/C, and VIRR- FY3A/B/C from 2010-2015; the generated 10 global biophysical parameter products are Aerosol Optical Thickness, Vegetation Index, Leaf Area Index, Fractional Vegetation Coverage, Land Surface Reflectance, Fraction of Photosynthetic Active Radiation, Photosynthetic Active Radiation /Downward Shortwave Radiation and Net Primary Productivity from 2010-2015. Support includes data from remote sensing data centres, algorithms developed by the partners, validation data from the Chinese validation network, and other support from related projects in the Ministry of Science and Technology of China, Natural Science Foundation of China, Chinese Academy of Sciences et al. These sources have well-supported the operation and further development of MuSyQ.

MuSyQ service have supported the monitoring and analysing the typical ecological environment elements and hot environment issues. GEO MuSyQ products have been directly used to support the 'Environmental and Ecosystem Monitoring' Task in AOGEOSS to evaluate the environmental situations of Asia and Ocean area. Some of the generated products have been utilized in, and were the major data source for, the GEOARC (Global Ecosystems and Environment Observation Analysis Report Cooperation) report which was launched by the Ministry of Science and Technology of China in 2012, and approved as a GEO Community Activity in 2017.

MuSyQ's key idea is to integrate multi-sensor data to produce commonly-needed remote sensing products with high accuracy and good spatial-and-temporal continuity. Open sharing of these products has led to their use in AOGEOSS and the GEOARC work. In addition, the team

has organized several international conferences and training workshop to promote MuSyQ, and the leader and partners have been invited by several organizations and universities to present the related work. With such exchanges and communications, MuSyQ has engaged users, attracted potential users, and enquired about users' demands for further improvements.

Besides the data collection and product processing, more attention is required to product validation to ensure its quality. This is also a general challenge in remote sensing and is the subject of considerable research. Another important area of future work for is to promote MuSyQ products more broadly by engaging potential professional users in fields such as ecology, environmental protection, socio-economics, etc. In this way, MuSyQ can provide more and better services to support the SDGs.

Space and Security (SPACE & SECURITY)

The main activities foreseen to be conducted in the frame of the Space and Security Community Activity during the reporting period (2016-2018) include:

- Providing a forum for discussion and to organize capacity building initiatives;
- Establishing and fostering cooperation with key entities and stakeholders;
- Collecting user requirements and needs;
- Identifying observational and capability gaps to be filled by space assets;
- Exploring how to take maximum benefit from the usage of very large quantities of heterogeneous data (Big Data);
- Identifying, developing and assessing innovative applications, services and platforms encompassing the whole data lifecycle;
- Contributing to the implementation of relevant projects in the framework of research and innovation initiatives such as Horizon 2020 (e.g. focusing on the "Secure Societies" societal challenge); and
- Building synergies with relevant GEO activities.

During the reporting period, one of the main areas of focus of the activity was to engage stakeholders of the Space and Security community, collect requirements, and grow the participation of relevant institutions in the Space and Security Community Activity.

Leveraging the institutional role of the EU Satellite Centre (EU SatCen) leading the Community Activity, the engagement process addressed EU Member States and other relevant EU Agencies. The dialogue was conducted in the frame of:

- The Technical Working Group and Expert User Forum Meetings held several times per year at SatCen premises with the participation of Member States and relevant EU Agencies;
- The Big Data From Space Conference (2016 and 2017 editions) organized jointly with ESA and JRC; and

- The Big Data in Secure Societies Workshop (2016 and 2017 editions) organized by the EU SatCen in the frame of the Big Data Europe project (H2020).

Two new contributors to the Activity were added in 2017 and 2018: European Space Agency and UNESCO-Institute for Water Education.

With respect to participation in relevant innovation activities, EU SatCen is a task leader in the H2020 NextGEOSS project, where its main role is to implement the Space and Security Innovation Pilot, link the project with the Space and Security Community Activity, and contribute to the dissemination and communication of the project results in the Space and Security Community.

In terms of links with other initiatives, EU SatCen is participating in the EuroGEOSS initiative as a member of the coordination group and is aiming to strengthen the connection and create new synergies with the participating organizations and members of EuroGEOSS.

The efforts related to the SSCA activities are voluntary and are supported by participation in relevant research and innovation activities, which are mainly conducted as H2020 Projects.

Thorpex Interactive Grand Global Ensemble Evolution into a Global Interactive Forecast System (TIGGE)

The TIGGE database currently (June 2018) has over 2500 registered users. The Sub-seasonal to Seasonal (S2S) database has over 850 registered users. The potential downstream indirect users include all users of weather forecasts: the general public, decision makers, farmers, the energy sector, human health and civil protection etc.

The TIGGE database continues to acquire and serve data from 10 data providers. Recently, India's National Centre for Medium-Range Weather Forecasts joined the group of data providers, supplying their ensemble forecast to TIGGE. The size of the database is 2.7 PiB and the service delivers an average of 10 TiB of data per month to some 200 users.

For the S2S database, it has been a period of consolidation. The database started activity in 2015, and during the last 2 years it has seen the addition of data from the 11 data providers originally planned. At the same time, it has been able to successfully accommodate changes in the configuration of various forecasting systems, such as upgrades to their models, changes in the number of ensembles and/or changes in the frequency of production. The size of the database is 80 TiB and the service delivers an average of 15 TiB of data per month to some 80 users.

In 2017 an S2S user survey was conducted, with questions ranging from current research topics using the S2S dataset, to how to improve the dataset or how satisfied users were with the service and documentation. The survey report may be accessed from the following address: http://www.s2sprediction.net/file/database/S2S_survey_report-1.pdf

ANNEX B
2018 PROGRESS REPORTING TEMPLATE

Brief Description of the GEO Work Programme (GWP) Activity

Title of the GWP Activity (Applies to all GWP Activities – Flagships, Initiatives and Community Activities)

Format: Full title (Acronym)

Example: GEO Global Agricultural Monitoring (GEOGLAM)

Overarching Tagline (All GWP Activities)

Format: [overarching purpose] + [overarching activity].

This information will support improvements to the WP activity descriptions on the GEO website.

Example: GEOGLAM is helping reduce food insecurity and food price volatility.

Value Statement (All GWP Activities)

This information will support improvements to the WP activity descriptions on the GEO website.

Please provide a one sentence statement of how the activity is working to achieve the above mission.

Format: [policy framework supported, if relevant] + [slightly more detailed description of what the activity delivers to achieve the above stated purpose].

Example: Using Earth observations, GEOGLAM reinforces the international community's capacity to produce and disseminate relevant, timely and accurate projections of agricultural production at national, regional and global scales.

Progress and Impacts Achieved

Self-Assessment of Progress (All GWP Activities)

Please provide a brief (fewer than 500 words) assessment of the progress achieved in the WP activity since 2016.

This assessment will inform Programme Board preparations for the 2020-2022 Work Programme and an edited version will be included in documentation provided to GEO-XV Plenary.

The assessment should include discussion of:

- *Whether available resources (financial and in-kind) are sufficient to implement the WP activity;*
- *Status of development and implementation of products and services (where applicable);*
- *Whether users or potential users have been engaged and how;*
- *Status of Implementation Plan milestones and deliverables (Initiatives and Flagships only); and*
- *Progress on recognition of a policy mandate (Initiative and Flagships only);*

The assessment should aim to provide a fair and balanced summary of progress, including successes, challenges and areas for improvement.

2017-2018 Highlights (Optional – complete if relevant)

Briefly highlight one to three recent examples of outcomes or impacts on policy, environment, users or beneficiaries attributable in part to the work of this GWP activity **that occurred in 2017 or 2018.**

Examples provided may be featured in GEO's annual Highlights Report or on the GEO website, in which case follow-up questions may be sent to you.

Previous Impact Highlights (Optional – complete if relevant)

*Briefly highlight one to three examples of outcomes or impacts on policy, environment, users or beneficiaries attributable in part to the work of this GWP activity **that occurred prior to 2017.***

Submissions may be featured in GEO communications materials, in which case follow-up questions may be sent to you.

Supporting Documents (Optional – complete if relevant)

Please attach or provide links to documents that provide evidence of outcomes and/or impact achieved by the Work Programme activity. These may include, for example, reports provided to funders or other organizations; statistics on usage of products or services; feedback or testimonials from users; official recognition from other organizations, etc.

Communications Update

Relevant Links (Optional – complete if relevant)

Website: (*www...*)

Twitter: (*@handle & URL*):

Facebook page: (*name / URL*):

Other:

Key Upcoming Events (Optional – complete if relevant)

Format: Event title, Dates, Location, Website

Links to Recent Publications or Communications Products (Optional – complete if relevant)

Format: Title, year released, URL

Communications Contact Person(s) (All GWP Activities)

Format: Name, position, organization and email address

Please identify the person responsible for running the website, social media if relevant, and who can inform GEO Secretariat of updates, events, and achievements. The GEO Communications Manager will follow up with this person for any questions or media inquiries. This person may be the same as the primary Point of Contact for the GWP activity or may be different.