

An aerial photograph of a coastal wetland, likely a salt marsh or mangrove system. The image shows a complex network of water channels, some wide and shallow, others narrow and winding. The water is a deep blue, while the surrounding land is a mix of light brown, tan, and green, indicating different soil types and vegetation. The overall pattern is highly irregular and interconnected.

GEO Highlights 2021



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GEO Secretariat

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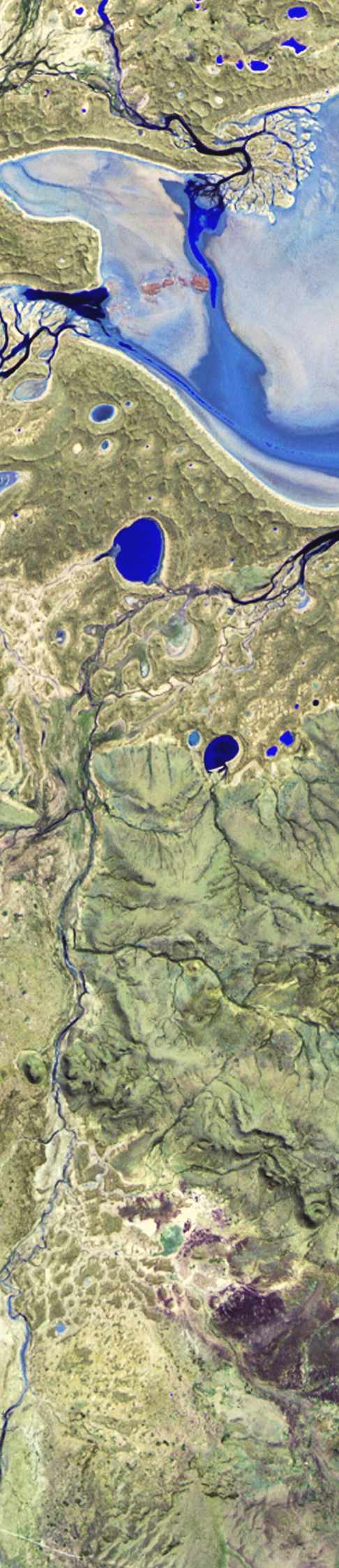


TABLE OF CONTENTS

1-4	Welcome Messages
5-6	GEO Overview
7-9	Equality, Diversity & Inclusion
10-14	GEO Work Programme Changes
15-17	Providing Tools for Sustainable Development
18-21	Informing Climate Action
22-26	Supporting Disaster Risk Reduction
27-30	Underpinning Urban Resilience
31-34	Safeguarding Human Health
35-37	Protecting Biodiversity & Ecosystems
38-41	Regional Collaborations
42-44	Open Data & Open Knowledge

Message from the Lead Co-Chair

The release of the GEO Highlights Report comes at the end of my mandate as GEO Lead Co-Chair, a mandate marked by a year of events that have profoundly impacted our society: wildfires in Canada, flooding and volcano eruptions in Western Europe, severe droughts in Eastern Africa or Oceania and the persistent disruptive effect of the COVID pandemics.

Those challenges sometimes have seemed or still seem overwhelming, but there are positive signals giving us the hope and energy to tackle them. For the first time, our science-based input was recognised in the recent UNFCCC COP26, and this aligns with our mandate to strengthen our engagement with the UN bodies.

Never before was Earth observation considered as essential to assess the state of our planet and propose reliable information and knowledge to our decision makers.

Never before was Earth observation considered as essential to assess the state of our planet and propose reliable information and knowledge to our decision makers. As stated in the Lead Co-Chair goals and objectives, we focused our attention as well on the commercial sector and in particular the SMMEs to help them grasp the benefits of the increasing availability of data to turn them into services capable of addressing societal challenges.



*Deputy-Director General Joanna Drake
European Commission*

But GEO had the ambition to reach less visible communities as well, and I am pleased that we succeeded to develop a more equal, diverse and inclusive GEO, a GEO open to the next generations, and a GEO through which knowledge is shared according to open principles, based on open knowledge practices.

The rich GEO Work Programme has significantly contributed to produce the systemic knowledge and evidence needed to make transformative changes in our society, to solve biodiversity and climate issues, and to live sustainably on a healthy planet. The achievements of GEO presented in this highlights report will help this tremendously. I am looking forward to continue engaging in this fascinating endeavour.

Deputy-Director General Joanna Drake
European Commission



Message from the Secretariat Director

The stakes have never been higher when it comes to translating scientific findings from Earth observations into policy decisions and actionable results.

The GEO Work Programme brings together Members, Participating Organizations, GEO Associates, and other partners to collaboratively develop Earth observation-based solutions to society's most pressing problems.

This report features success stories from around the world that address information needs in specific areas where Earth observation is critical to advancing engagement.

Today and now, GEO's collaborative and inclusive approach to harnessing Earth observations for societal benefit is more relevant than ever.

This year's showcase spans the entire range of Earth observations applications, from responding to rapid deforestation to minimising potential economic losses from hurricanes, to supporting wildlife management at national and regional levels.



*Yana Gevorgyan
GEO Secretariat Director*

The responsibility to create a sustainable future lies on the shoulders of everyone. Today and now, GEO's collaborative and inclusive approach to harnessing Earth observations for societal benefit is more relevant than ever.

We encourage everyone to learn more about the impact of our global partnership and join this rewarding journey to unleash Earth observations for impact.

Yana Gevorgyan
GEO Secretariat Director

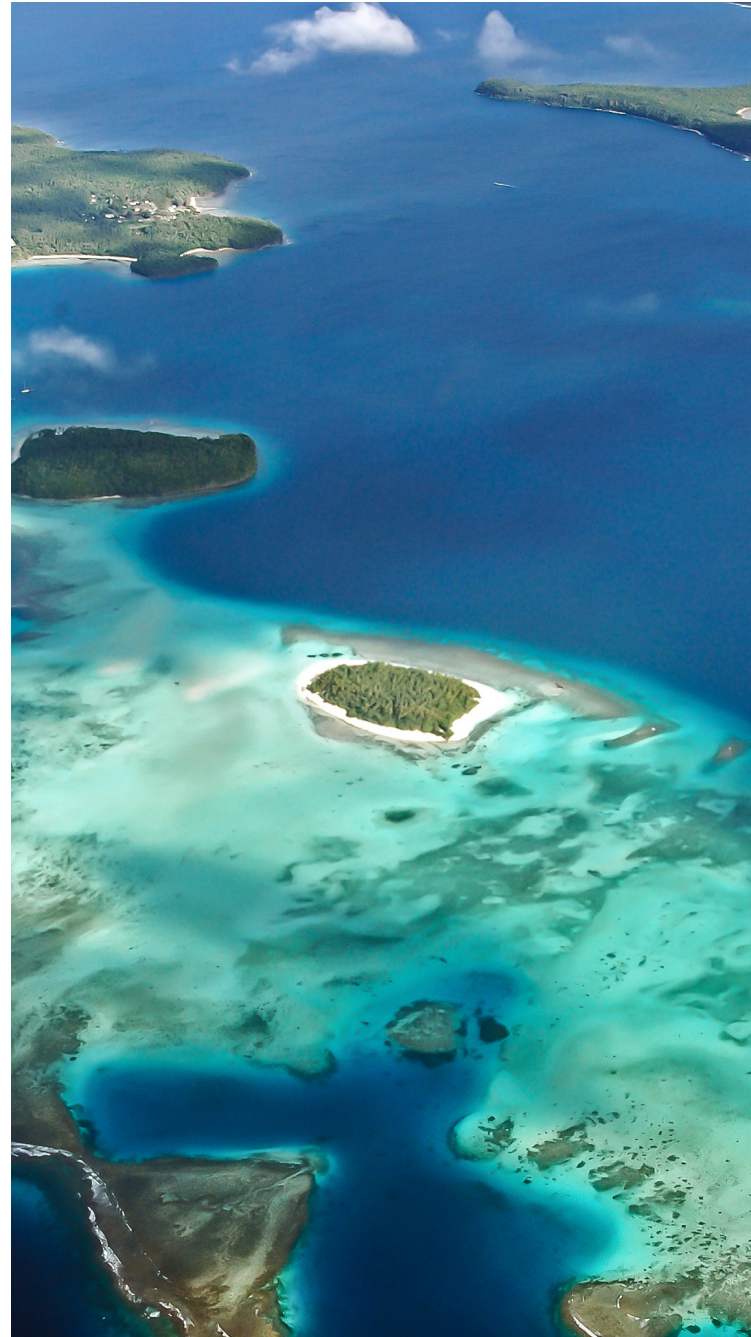


GEO OVERVIEW

The Group on Earth Observations (GEO) is a global intergovernmental partnership of 112 United Nations Member States plus the European Commission, 138 Participating Organizations, and 17 Associates, working to improve the availability, access, and use of Earth observations for a more sustainable planet.

GEO promotes open, coordinated, and sustained sharing of data, information, and knowledge about the Earth in support of better research, policymaking, decisions, and action across disciplines. The GEO community focuses on three global priority engagement areas: climate action, disaster risk reduction, and long-term sustainable development, with a new priority on resilient cities and human settlements to be discussed at the GEO-17 Plenary.

The GEO Work Programme is the primary instrument by which GEO implements its mission. The activities that comprise the GEO Work Programme are conceived, planned, and implemented by teams of researchers, technical experts, policy analysts, commercial sector representatives, and many other stakeholders to address information needs in particular domains for which Earth observations are critical. In most of these activities, the teams work to develop Earth observation-based applications, products, and services to support decisions as identified together with the intended users.



GEO is based on principles of Open Knowledge, where the results of GEO Work Programme activities are made available to anyone to use, share, adapt, and build upon. In this way, GEO supports capacity development at all levels in the use of Earth observations, especially in developing countries and among marginalized communities.

GEO Work Programme activities are largely funded through in-kind contributions from the various collaborating partners on a best-efforts basis, supplemented by voluntary financial contributions. The GEO Foundational Tasks are implemented in part by the GEO Secretariat through resources contributed by GEO Members to the GEO Trust Fund.

All new and existing 2020-2022 GEO Work Programme Flagships, Initiatives, Community Activities and Working Groups are open to new participants to bring their expertise in Earth observations, or their experience as users of Earth observation products and services, to help support social, economic and environmental policies, decision making and action.



Towards a More Equal, Diverse & Inclusive GEO

GEO strives to build an institution that provides a fair, supportive, and encouraging networking environment in which a diverse group of participants engage responsibly. It also aims to ensure that equality, diversity and inclusivity are fully considered, addressed, and embedded in the activities and decisions of GEO. The Equality, Diversity, and Inclusion (EDI) Subgroup of the GEO Programme Board was launched to support this strategic goal in early 2020.

Discussions within the Subgroup highlighted the need for GEO to establish and widely promote its vision and commitment to equality, diversity and inclusion through the production of a GEO-wide statement, which was shared with the whole GEO community for consultation in summer 2021 and will be put forward for approval by the GEO Plenary in November 2021.

The EDI statement outlines a five-pillar framework that envisions equality, diversity, and inclusion are considered in every aspect of GEO. These five pillars are:



Pillars of GEO Equality, Diversity and Inclusion



- **Community Leadership and Advocacy**

GEO is committed to increase the awareness within the Earth observations community of the benefits of inclusive participation by people from all sectors to create innovative solutions to local and global challenges.

- **Creating a Welcoming and Supportive Environment**

GEO strives to maximise diversity in all GEO governance structures, including meetings and events, at all times.

- **Outreach and Engagement**

GEO proactively engages a diverse set of stakeholder communities to understand their needs through the GEO Work Programme, Regional GEOs, GEO communication channels, as well as national and participating organization coordination mechanisms.

- **Empowerment through Accessibility**

GEO advocates for and delivers on transparent and standardised accessibility to open Earth observation data, information, and knowledge through the Global Earth Observation System of Systems (GEOSS). it concise yet concrete!

- **Oversight and accountability**

The Equality, Diversity, and Inclusion Subgroup will conduct regular reviews of GEO' progress towards its stated EDI goals and provide recommendations to GEO governance and administration.

If you would like to contribute to the work of the EDI Subgroup, please email secretariat@geosec.org and put "EDI" in the subject line.

Engaging Youth in GEO

Since 2018, GEO has been supporting youth engagement through events including the GEO Indigenous Hackathons, the International Society for Digital Earth (ISDE) Youth Forum, and the Free and Open Source Software for Geospatial (FOSS4G) conference. Voices of youth groups such as the Indigenous Youth and the African Youth Advisory Board on Disaster Risk Reduction (AYAB DRR) are brought to attention of the GEO community.

To strengthen these efforts, a Youth Track is being organized for GEO Week 2021, enabling young people to share their work, to network across regions, and to find collaboration opportunities with the rest of the GEO community. The Youth Track will see the launch of the GEO Youth Community of Practice, where young professionals, students, recent graduates, and other volunteers will work together to advance youth participation in, and contribution to, all GEO activities.

If you are interested in joining the GEO Youth Community of Practice, please contact the GEO Secretariat at secretariat@geosec.org mentioning "Youth CoP" in the subject.



The GEO Indigenous Hackathon GEOHACK19 "Drone Workshop", GEO Week Canberra, Australia 2019

Digital Earth Africa becomes a GEO Initiative

Digital Earth Africa (DE Africa) became a GEO Community Activity in 2019 and was accepted by the GEO Programme Board as the newest GEO Initiative in May 2021. Leveraging decades of open Earth observation satellite images and cloud-based computing capacity, DE Africa has demonstrated its capability and impact in supporting key development areas such as water resources and flood risks, agriculture and food security, land degradation and coastal erosion, and urbanization. Different types of users can access and adapt DE Africa resources including DE Africa Map, Sandbox, Africa Geoportal and Online Training to meet their own needs.

In its latest phase, DE Africa aims to provide a routine, reliable and operational service, using Earth observations to deliver decision-ready products which will enable policy makers, scientists, the commercial sector, and civil society to address social, environmental and economic challenges on the continent and develop an ecosystem for innovation across sectors.

More importantly, DE Africa is taking firm steps to transition its capabilities and functions to Africa, which means it will be guided, managed, and operated by the African community. Key technology and user groups are now represented on the DE Africa Governing Board and the Technical Advisory Committee. In August 2021, the Program Management Office of DE Africa was established in the South African National Space Agency (SANSA), another key step.

DE Africa is funded by the Australian Government Department of Foreign Affairs and Trade and the Leona M. and Harry B. Helmsley Charitable Trust.



Digital Earth Pacific Responds to the Needs of the Pacific Islands

Digital Earth Pacific (DE Pacific), led by the Pacific Community (SPC) and its partners, is a key response to the call in the GEO Canberra Declaration to support inclusive participation by Pacific islanders and other island nations in GEO. As a new Community Activity, DE Pacific aims to provide an operational data infrastructure that makes current and historical, analysis-ready satellite data freely available and openly accessible to the Blue Pacific continent. It will use Open Data Cube technology to turn raw data into decision-ready products to inform policy and drive action at community, national and regional levels.

DE Pacific will initially focus on national government stakeholders across a broad range of sectoral ministries, specifically targeting policy gaps and opportunities for which decision-ready Earth observation products will add significant value. It will also empower the Pacific research community, specifically through links with the University of the South Pacific, by providing a common regional platform through which students and technicians can apply Earth observation data to local challenges.

The first phase of DE Pacific (2021) will develop the prototype Open Data Cube infrastructure with a series of 'early win' products for pilot countries (Fiji, Republic of the Marshall Islands (RMI), Tonga, Vanuatu) to address their national development priorities. Phase II of DE Pacific (beginning in 2022) will continue building the sustainable infrastructure for the Open Data Cube, while establishing the institutional governance to properly host the program.



Drone image courtesy of Digital Earth Pacific

Measuring Forest Biomass to Support Climate Action

Forest Biomass Reference System from Tree-by-Tree Inventory Data (GEO-TREES) is a new Community Activity included in the GEO Work Programme in 2021.

GEO-TREES aims to establish a global network of in situ biomass reference measurement sites, the Forest Biomass Reference System (FBRS), to complement existing and planned space-based forest biomass observation tools. These sites will provide integrated, multi-observational, multi-scale reference data to support global space-based forest biomass mapping, and will include high-quality georeferenced data on tree biodiversity.

GEO-TREES is a GEO response to the Paris Agreement call for accurate estimates of biomass and its changes – estimates for which each nation must prepare, communicate and maintain successive Nationally Determined Contributions (NDCs) that it intends to achieve.

In the 2022, GEO-TREES will consolidate its implementation plan and funding roadmap for FBRS, reach out to seek systematic funding, and link the activity with Global Forest Observations Initiative (GFOI) on forest biomass activities) and the Group on Earth Observations Biodiversity Observation Network (GEO-BON) on forest biodiversity activities.



Protecting Urban Heritage from Climate Change

The Urban Heritage Climate Observatory (UHCO), led by the United Nations Educational, Scientific and Cultural Organization (UNESCO) World Heritage Centre (WHC) and the Greek GEO Office (GGO), is a new Community Activity launched in April 2021.

Climate change is one of the most critical issues affecting World Heritage Cities. Increasing exposure to both slow-onset climate processes and extreme weather events is the most obvious threat to the existence of cultural and natural heritage sites. In the case of urban heritage, there is an additional critical need to integrate different aspects of the sustainable development agenda, including urban resilience and sustainable urbanization, with the protection of heritage values, especially in World Heritage Cities, considering the centrality of cultural heritage's social, ecological and economic dimensions for sustainable urban development.

Earth observations hold great potential to shield urban heritage from climate change risks. Especially in World Heritage Cities, Earth observation-derived information can facilitate the creation of bridges between climate change and cultural heritage communities and offer a framework for the design of joint, multi-disciplinary and multi-governmental approaches to tackle climate change risks and impacts on cultural heritage. Yet, gaps exist in relation to integration and usability of different Earth observation assets, along with increasing technical capacity.

UHCO aims to provide a forum for relevant partners to share good practices, needs and expertise; match user needs to Earth observation assets to enrich and coordinate processes for the preservation, monitoring, management of urban heritage, as well as communication and advocacy around local, national and international climate actions; and enable a modernization of practices through co-producing targeted tools and services focusing on climate change risks and impacts to urban heritage.



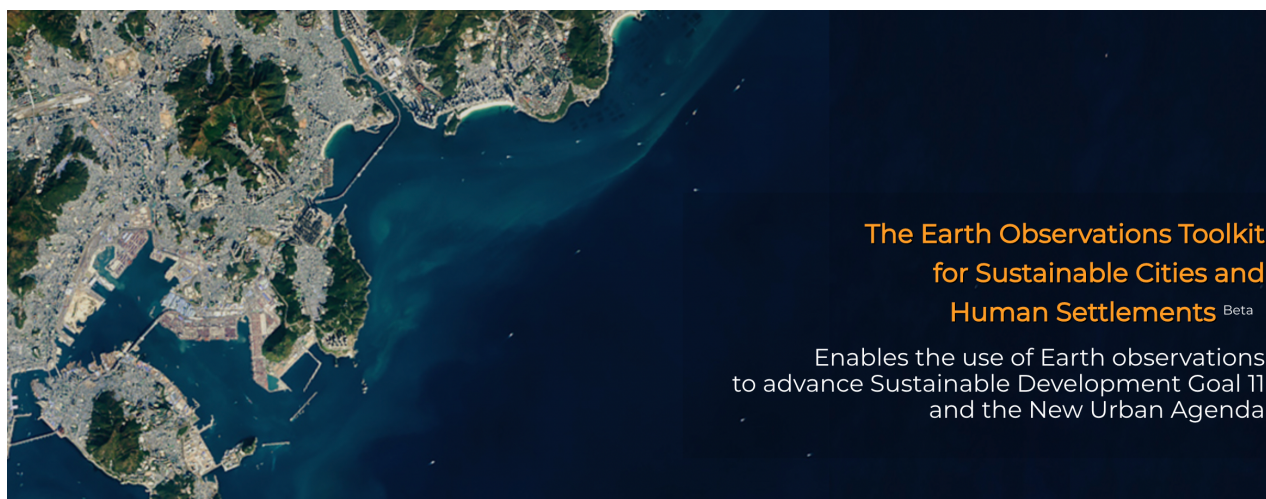
Earth Observations Toolkit for Sustainable Cities & Human Settlements

The Earth Observations for Sustainable Development Goals (**EO4SDG**) Initiative piloted the Sustainable Development Goals (SDG) Toolkit concept in 2020. While there were many Earth observation data, tools, methodologies, use cases and capacity development resources, it was not easy for users to find and select the tools fitting their purpose. The SDG toolkits will integrate all these resources and provide rich and coordinated guidance about using these resources to strengthen SDG monitoring, reporting and implementation efforts.

As the first of its series, the Earth Observations Toolkit for Sustainable Cities and Human Settlements was launched in February 2021 with contributions from over 40 organizations. It was a collaborative effort of the GEO community and the United Nations Human Settlements Program (UN-Habitat) dedicated to SDG 11 sustainable cities and communities and the New Urban Agenda.

The toolkit is an online, continuously updated resource which includes a catalogue of Earth observation data products and tools that can support the definition and monitoring of urban SDG indicators, as well as national and city-level experiences of Earth observation uses. The expected users are municipalities, national statistics offices, national mapping agencies, ministries, SDG custodian organizations and other interested stakeholders.

Given the potential broad applicability of this approach, the GEO community is exploring implementation of additional toolkits for other SDGs.



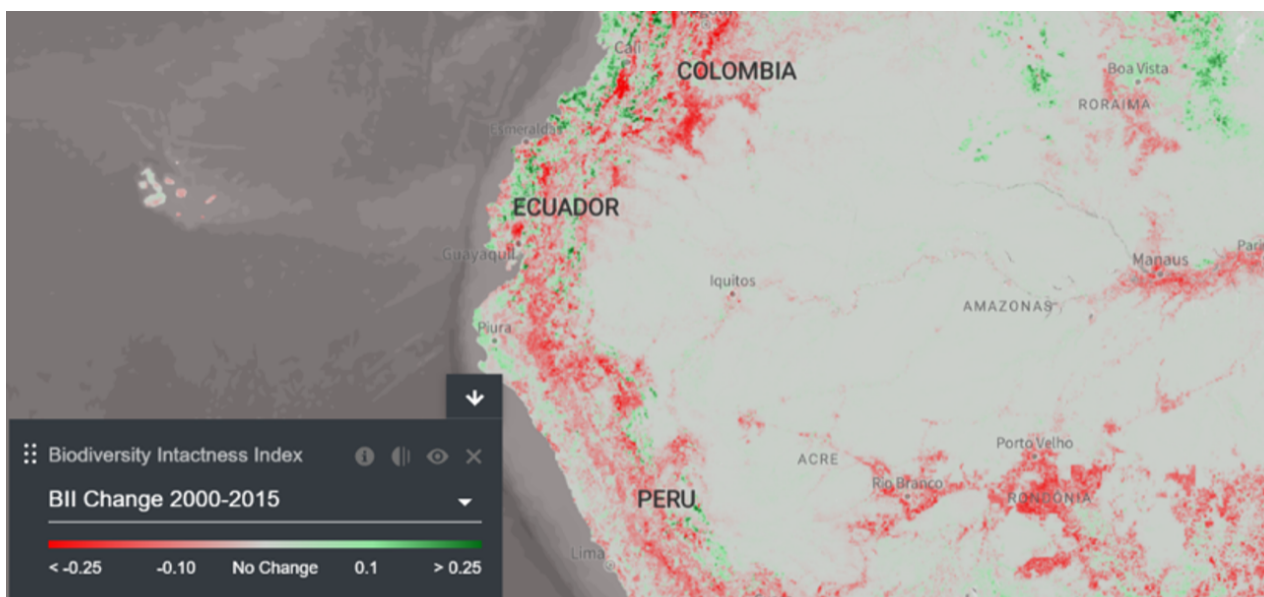
Colombia, Ecuador & Peru Monitor Life on Land

The EO4SDG initiative is piloting a project that integrates national statistics with data from satellites such as the NASA Global Ecosystem Dynamics Investigation (GEDI) to support national reporting of SDG 15 (life on land) indicators.

The three pilot countries – Colombia, Ecuador, and Peru – involved 75 representatives from 37 governmental and academic organizations to assess and validate the state-of-the-art data use in official national reporting. They received technical support from the United Nations Development Programme (UNDP) and researchers from Northern Arizona University, Montana State University, University of Northern British Columbia, and the University of Queensland.

The resulting datasets and indicators are incorporated into an existing decision support system based on the [UN Biodiversity Lab](#), a UNDP-led geospatial information platform that maps and monitors natural resources and environmental risks in real time. Through the UN Biodiversity Lab, data and indicators will be regularly updated through 2030.

This NASA-funded activity is among the premier efforts to integrate data development, monitoring, assessment, and policy under the Post-2020 Biodiversity Framework and thus demonstrates a pathway toward broader application in the 170 countries with which UNDP collaborates.



Biodiversity Intactness Index Change in Colombia, Ecuador, and Peru from 2000-2015. Credit- UN Biodiversity Lab, August 2021

Improving Accuracy of SDG Indicator Monitoring

The EO4SDG has been facilitating multistakeholder partnership in SDG monitoring and implementation at local, national, regional, and global levels. One of the approaches is to encourage GEO Members to form a coalition of Earth observation sectors, National Statistics Offices (NSOs) and relevant ministries, which could co-develop and apply methodologies based on Earth observations at the national or global level.



As one of these efforts, Japan recently responded to a request to verify UN Food and Agriculture Organization (FAO)'s new methodology for monitoring and reporting on SDG indicator 15.4.2, the Mountain Green Cover Index (MGCI). This new method leverages land cover map time series ESA-CCI and mountain elevation range data (GTOPO 30) resampled at 300 meters to compute the MGCI at national and elevation range levels for all countries. If countries have national land cover maps of higher spatial resolution and comparable or better quality, FAO advises them to leverage their national data sets following the same methodology and generation of MGCI values.

Japan Aerospace Exploration Agency (JAXA), a co-chair of the EO4SDG initiative, Japan's National Office of Statistics, and related agencies and ministries joined the validation effort. They compared the FAO's estimated values indicator 15.4.2 for Japan with indicator values based on nationally available data, such as high-resolution land use and land cover data produced by JAXA and the 10m resolution Fundamental Geospatial Data/high-resolution Digital Elevation Model by the Geospatial Information Authority of Japan (GSI).

Their findings confirmed the FAO proposed methodology for the generation of MGCI values and highlighted the importance of country validation efforts and the usefulness of leveraging national datasets, if available, to improve the accuracy of indicator monitoring and assessment, especially in the monitoring of small and highly heterogeneous landscapes.

GEO Assists Mozambique with Forest Monitoring

The GEO community is helping Mozambique to use open Earth observation data and methods to respond to rapid deforestation.

Experts from Brazil's National Institute for Space Research (INPE) are collaborating with the Government of Mozambique and its national forest inventory experts from the National Directorate of Forestry (DINAF), the National Directorate of Climate Change (DMC) under the Ministry of Land and Environment, and the National Fund for Sustainable Development (FNDS) under the Ministry of Agriculture and Rural Development. This support was made possible through the efforts of the GEO Secretariat and the Coalition for Rainforest Nations (CfRN), a new GEO Participating Organization.

Supported by the GEO-AWS Cloud Credits Programme, INPE experts trained an artificial intelligence algorithm in the cloud-based data cube to classify Landsat images using more than 80,000 in situ samples provided by the Mozambique partners.

The goal is to produce annual maps of land use and land use change, as well as forest cover assessments, for the entire Mozambique territory at 30 metre resolution. The project will result in a set of consistent and comparable maps spanning the period from 1990 to 2020. These maps will help institutions in Mozambique to estimate their national greenhouse gas emissions and deliver verification information for REDD+, a funding mechanism for sustainable management of forests and enhancement of forest carbon stocks in developing countries. During this project, staff in Mozambique agencies are being trained to create and process the data so they can maintain and develop the system independently.

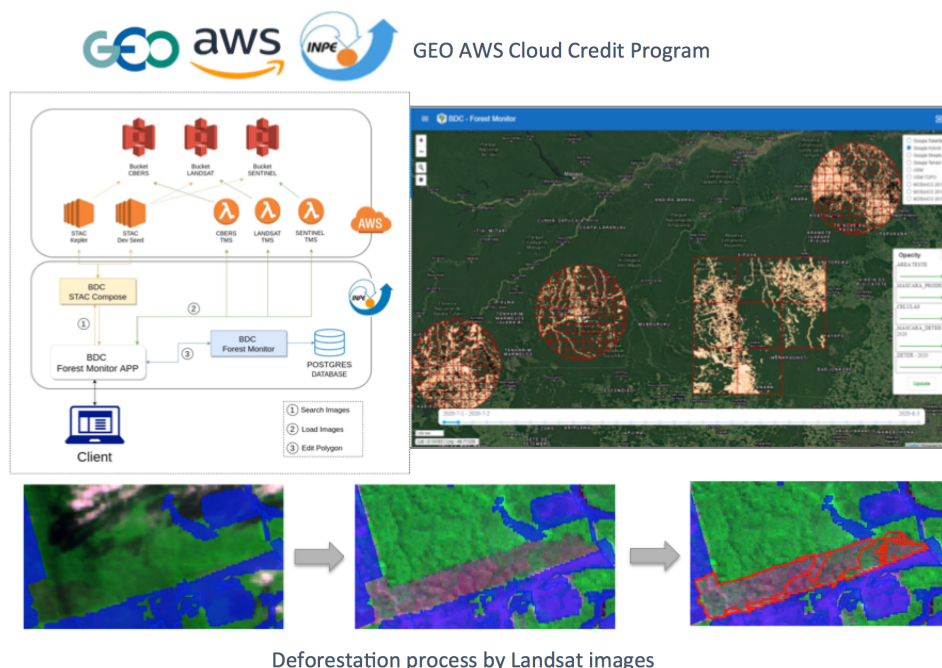


Brazil Improves Real-time Deforestation Detection

The National Institute for Space Research (INPE) of Brazil is using the credits received through the GEO-AWS Cloud Credit Programme to improve their ability to detect deforestation using satellite images in Brazil and other countries.

INPE started the Real-Time-Deforestation Detection System (DETER) project in 2014 and have been providing alerts of deforestation and forest degradation for the Brazilian Amazon biome since then. The crucial enhancement enabled by the cloud credits is access to a large volume of past and current images from multiple satellites, including Landsat-8, Sentinel-2 and CBERS-4, without downloading and maintaining the images in a local environment. Using the cloud-based DETER, interpreters can better assess areas where the deforestation process is intensive, easily choosing the best image, free of clouds and cloud shadows, among many images from different sensors and with distinct spatial resolutions.

INPE also used the cloud credits to process the satellite images for the DETER methods. They created Earth observation data cubes for Brazil from Sentinel-2 satellite images in the AWS cloud and developed an application called Data Cube Builder that runs on AWS service. The application produces Earth observation data cubes of Sentinel-2 images 20 times faster on AWS than on-premise hardware, without needing to download the images. This advancement in producing Earth observation data cubes is crucial for Brazil, and potentially for other countries as well, that require large volumes of satellite imagery to cover their territories.



GEO's Convening Power Supports GHG Monitoring

The GEO community was recently invited to help improve methods for using Earth observation data in greenhouse gas accounting.

The Task Force on National GHG Inventories of the Intergovernmental Panel on Climate Change (IPCC-TFI) has been developing tools to support governments in preparing their land representation to estimate GHG emissions from the Agriculture, Forestry and Other Land Use (AFOLU) sector. Meanwhile, the underpinning science and technology of cloud computing, machine learning, and data cubes have evolved to meet the needs of countries aiming to develop inventories for their GHG emissions. The Technical Support Unit (TSU) of the IPCC-TFI invited the GEO community to contribute to these efforts.

The GEO Secretariat and the GEO Flagship Global Forest Observations Initiative (GFOI) identified the [SEPAL platform](#) operated by the United Nations Food and Agriculture Organization (FAO) as a suitable environment to enable countries with significant forest areas to access cloud computing services and latest tools provided by the scientific community.

A virtual workshop was convened that brought together over 150 experts from GEO Work Programme activities, the scientific community, and other stakeholders to explore new tools in SEPAL. Following the workshop, IPCC TFI-TSU started working with software developers from SEPAL and from Boston University to support its inventory software to be used by the United Nations Framework Convention on Climate Change (UNFCCC) Parties in preparing their land representation for land-related categories in the national GHG inventory.



Farm in the Netherlands, image credit ESA

GEO Reaches Out to Climate Policy and Finance

The GEO Climate Policy and Finance Workshop, held on 21-23 September 2021, provided GEO with a broad endorsement to further its contribution to climate action and define its added value within the Earth observation community. The theme of the event reflected the importance of Earth observations in supporting full implementation of the UNFCCC Paris Agreement. It was also an important milestone towards enhancing the participation of the GEO community in the 26th Conference of the Parties (COP26) to the UNFCCC in November 2021, in Glasgow, United Kingdom.

Workshop discussions highlighted how GEO Work Programme activities and GEO partners are enabling national climate adaptation and mitigation by providing actionable Earth observation data and information to governments. The workshop also strengthened collaboration between GEO and several key Earth observation and climate partners, including the World Meteorological Organisation (WMO), the Committee on Earth Observation Satellites (CEOS), and the Green Climate Fund (GCF).

In addition, GEO will support assessment of progress toward the long-term goals of the Paris Agreement through the Global Stocktake process, particularly by applying Earth observations to the construction of aggregate assessments of greenhouse gas emissions and global indicators on climate impacts. The workshop also raised awareness of how Earth observations can strengthen the evidence base for public and private investment decisions on climate action. Workshop participants discussed ongoing initiatives by development banks and the finance and insurance sectors in using Earth observation data and information for their own analysis and decision making. The GEO Climate Finance workstream was officially launched during the workshop and will be continued in 2022 with more hands-on workshops and targeted engagements.



Clarity on GEO's role

Increased awareness of the unique contribution of GEO activities to support national and global climate action.

Endorsement to initiate process for a prospective GEO mandate under the UNFCCC.



Climate finance piece

Official launch of the GEO Climate Finance workstream: more hands-on work and engagements planned for 2022.



Collaborations

Improved collaboration with GEO members, participating organisations and new partners from the sustainable finance industry.

Key outcomes of the GEO Climate Policy and Finance Workshop

Informing On-Time Reservoir Management in Honduras during Hurricanes

The two hurricanes Eta and Iota arrived in Honduras in less than a month in November 2020. This created a significant challenge for the Honduran national electrical power company (ENEE) due to the danger to the El Cajon Dam. The priority was to safeguard the lives of about 23% of the country's population and to minimize the potential economic losses in the Sula Valley which generates 65% of Honduras's GDP.

Before the arrival of Eta, ENEE was using forecasting tools with horizons of up to 3 days. However, the information from these models was insufficient to estimate the volume of runoff that Hurricane Iota would bring thirteen days later and thus to inform a longer-term water management strategy.



El Cajón Dam in Honduras. Photo credit Manuel Conde (ENEE)

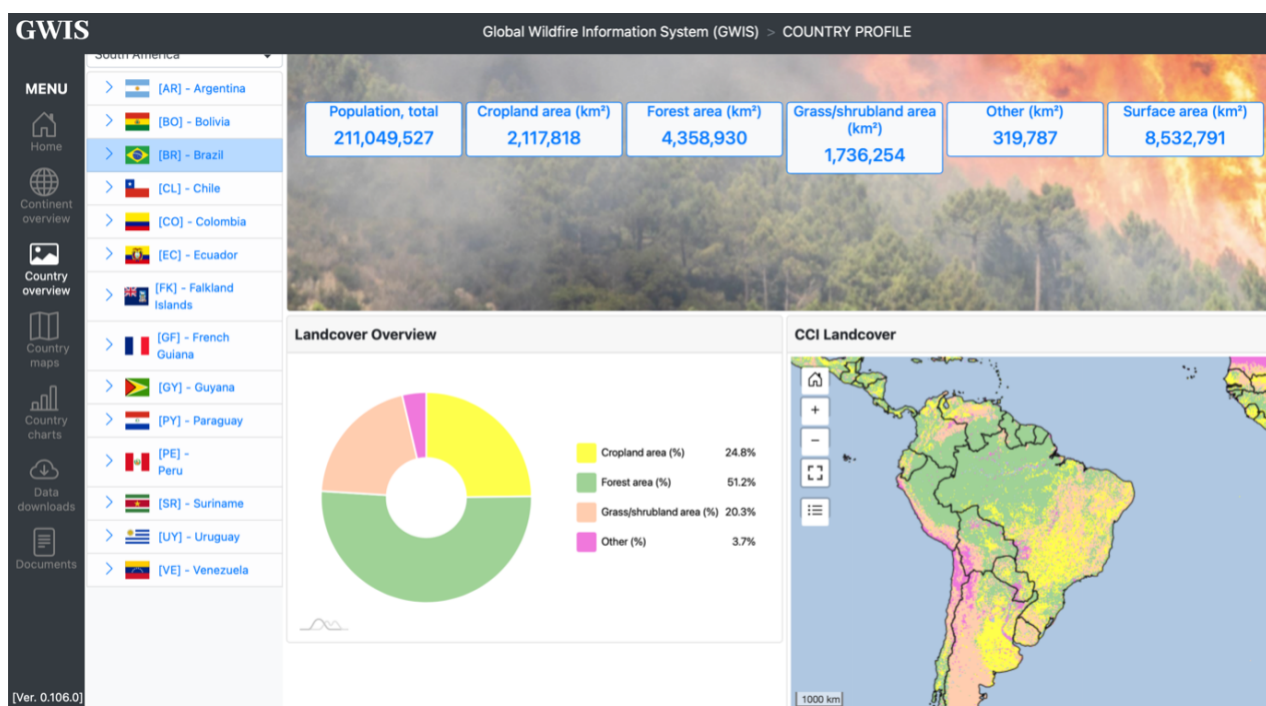
The Streamflow Forecast service operated by GEOGLOWS and the European Centre for Medium-Range Weather Forecasts (ECWMF) can provide a 15-day discharge forecast. ENEE used the forecast directly from the web portal to define a series of water releases between the storms to recover reservoir storage capacity, while following discharge protocols. In addition, when Hurricane Iota arrived, ENEE also decided to close the gates to detain El Cajón's outflow so as not to add to the extreme flows of the uncontrolled Ulua and Cuyamapa Rivers, thus giving the best opportunity for the flood wave to pass through the Sula Valley.

The use of the Streamflow Forecast service considerably reduced socio-economic losses and damages in the Sula Valley. Without the controlled water releases prior to Iota, power generation would have been stopped and 94 million m³ of water would have been released through the free spillway of the dam, causing a greater disaster. Compared to Hurricane Mitch in 1998, it is estimated that economic losses were reduced by 40%, with a considerable portion attributed to the GEOGLOWS Streamflow Forecast.

Supporting Wildfire Management at National and Regional Levels

The GEO Initiative Global Wildfire Information System (GWIS) recently took steps to encourage further use of its services by national wildfire management authorities particularly in the Latin America and Caribbean (LAC) region, where wildfires have caused huge socioeconomic losses and environmental damage.

The Country Profile application was recently added to the GWIS service suite to provide country-specific historical overviews of wildfire patterns and damage. National fire services may use this tool to assess the impact of wildfires in a consistent and comparable way. Together with the other two applications, Current Situation Viewer and Long-term Fire Weather Forecast, GWIS now offers comprehensive wildfire management tools based on open Earth observation data and methods.



GWIS Country Profile for Brazil

In addition to providing open knowledge, more active support is provided by the newly launched European Union-LAC Policy Dialogue Project on wildfire management collaboration. GWIS has been chosen as the technical platform for this project. This enables GWIS to work formally with key stakeholders in the LAC region to help them adapt the GWIS services to their national context and improve the capability of wildfire early warning, forecasting, and impact assessment.

GWIS also provides a common tool for the LAC countries to understand the fire situation and coordinate fire-related policy making at the regional level. Since July 2021, weekly situation reports on wildfire evolution in the LAC region have been distributed to wildfire management authorities in these countries as well as to relevant international organizations such as UN Food and Agriculture Organization (FAO), UN Environment Program (UNEP) and Amazon Cooperation Treaty Organization (ACTO).

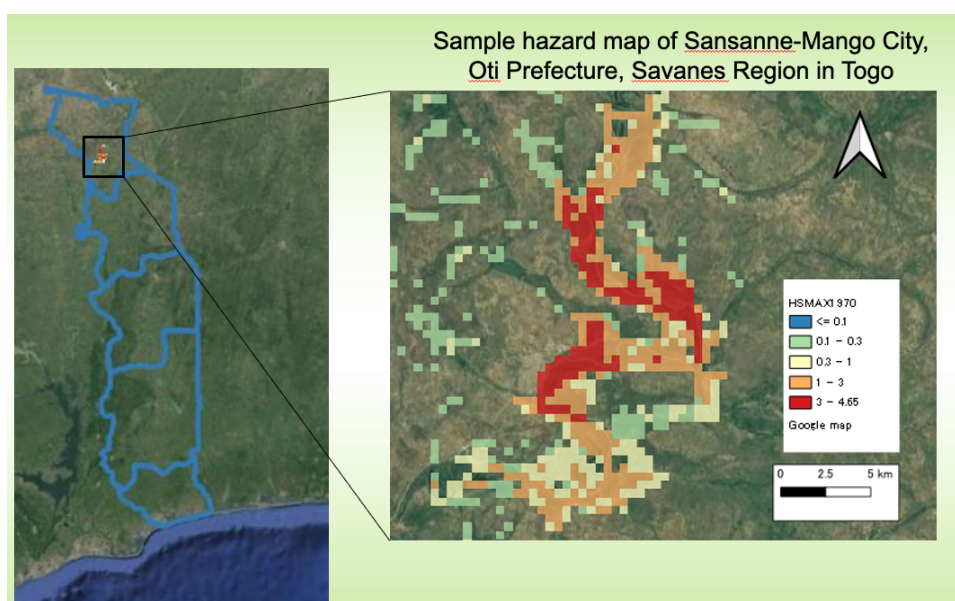


Empowering Local Professionals to Address Water Hazards

The GEO Initiative Data Integration and Analysis System ([DIAS](#)), in collaboration with the UNESCO International Centre for Water Hazard and Risk Management ([ICHARM](#)), created an e-infrastructure providing integrated solutions for water-related issues. As local ownership has proven to be critical in sustaining the services, DIAS has focused its recent efforts on preparing local practitioners to use the infrastructure independently.

Twenty-nine leaders from the HELP Davao Network, representing national and local governments, private companies, academia, non-governmental organizations, and media, participated in a series of e-learning courses. They were trained to use visual tools such as hazard maps generated by the DIAS real-time flood monitoring system to create local flood-related evacuation and contingency plans. Philippine government organizations (i.e. Department of Public Works and Highways, Department of Science and Technology, and the Philippine Atmospheric, Geophysical and Astronomical Services Administration) own and manage their data in the DIAS and now are capable of using the system to send out official early warning/alerts, analyze risks, and create hazard maps.

A similar effort in West Africa involved 288 experts, mostly from national meteorological hydrological services and crisis management bureaus. Nearly 200 trained and certified experts are currently working with communities along the Volta River Basin and the Niger River Basin to develop local evacuation and contingency plans using the hazard maps they produced. Another 30 experts have been certified to teach others to use the e-learning modules so the process will be self-sustaining.



Sample online tutorial on how to create a local flood hazard map

Global Satellite Navigation Data for Real-Time Tsunami Forecasting

Ten years ago, when Japan's northern coastal areas were hit by the Tohoku tsunami, it took several days to grasp the entirety of the vast damage. Now, Earth observations, combined with artificial intelligence (AI) and machine learning (ML), can be used to assess threats and prepare ahead of time, to evaluate impacts as they unfold (as little as 20 minutes after earthquake occurrence), and to respond more quickly in the aftermath to save lives during recovery operations.

Geodesy4Sendai, a GEO Community Activity led by GEO Participating Organizations the International Association of Geodesy (IAG) and the International Union of Geodesy and Geophysics (IUGG), is participating in a new tsunami early warning collaboration with the recently established ITU Focus Group on Artificial Intelligence for Natural Disaster Management, organized jointly with WMO and UNEP.

A Topic Group "AI for Geodetic Enhancements to Tsunami Monitoring and Detection" has begun to look at relevant best practices in use of Global Navigation Satellite Systems (GNSS) data. The group is exploring the feasibility of using AI to process GNSS data in countries where exporting real-time data is prohibited by law, and to establish protocols for development and sharing of export-permitted products derived from AI and related methods. The group is also considering innovative communications technologies for transmitting real-time GNSS data to countries or regions with limited bandwidth capacity, where using AI for decentralized, data-derived product sharing could enable the transmission of life-saving information over limited communications infrastructure.

Such an effort would lay the groundwork for expanding the use of these methods in developing countries which suffer from increasing tsunami threats in addition to other climate change impacts such as sea level rise.

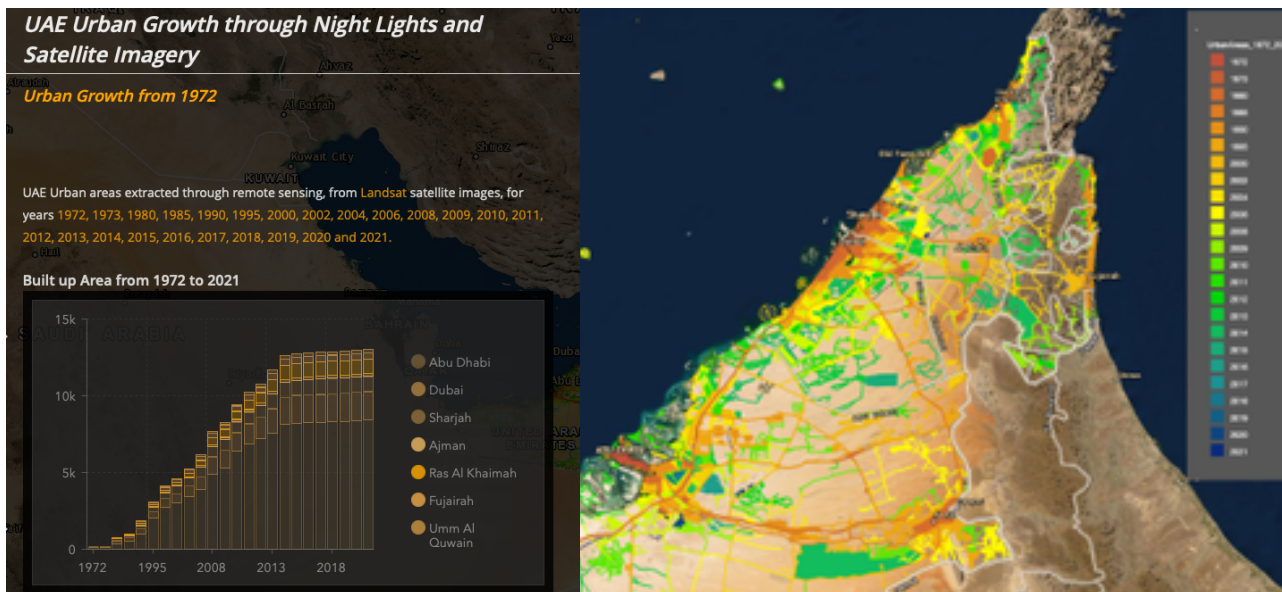


Simulation of an anticipated mega quake (M9) in Kochi City, Japan, produced by supercomputer and AI/ML

Tracking Urban Growth through Satellite Imagery and Statistics

The United Arab Emirates (UAE) combined open satellite imagery with other key national and demographic data to calculate a key SDG indicator and support land use and development planning. The project, which was contributed by the UAE Federal Competitiveness and Statistics Centre (FCSC) as a use case to the Earth Observation Toolkit for Sustainable Cities and Human Settlements, aimed to calculate the ratio of the land consumption rate to the population growth rate (SDG indicator 11.3.1).

The project began by extracting built-up areas from Landsat satellite images from 1972 to 2020. This showed the growth and development patterns of major roads, infrastructure, and buildings on a national and sub-national level. The FCSC then used nightlight maps from NASA to identify areas illuminated at night during the period of 2010 to 2019, indicating an increase in urban areas, and human activities.



United Arab Emirates Urban Growth through Night Lights, Satellite Imagery and Statistics

In addition to calculating the indicator, combining these two sets of data with selected national statistical indicators – including electricity consumption, GDP, and population – aids understanding and visualization of a variety of population, land-use, and economic trends. This work is expected to eventually support future forecasting for national development plans.

Identifying Informal Settlements with Higher Accuracy

Mexico's National Institute for Statistics and Geography (INEGI) has benefitted by using open data, open algorithms, and cloud computing capacity in understanding complex characteristics of human settlements, such as slum severity.

INEGI started with using a collection of annual geomedian Landsat multispectral mosaic data covering Mexico's national territory from 1989 - 2019. A mosaic is a composite image created by combining the most appropriate pixels from a collection of source images. To get the annual geomedians, INEGI uses a method implemented in the Open Data Cube, fed with multispectral Landsat images from Mexico's territory.

INEGI then brought the external number records database to train the algorithm. The database provides a coordinate for each house and building that is officially recorded. The density of exterior number records in a grid of 1km² is considered as a measure of urbanization and a training dataset.

Once constructed, the training set works as input data for the machine learning algorithm. In this case, INEGI analysts first used the Extra-Trees algorithm, a generalization of the Random Forest algorithm. Secondly, with collaboration from academia, they incorporated deep learning algorithms to receive even better results.

The results illustrated that machine learning algorithms can identify urban areas with a high density of houses and buildings and distinguish them from those with less density or those with no houses at all. The first algorithm performs this task with an accuracy of more than 80%, while machine learning algorithms are getting above 92% accuracy. Accurate measurement of urbanization will allow effective tracking of urban population living in informal settlements in Mexico.



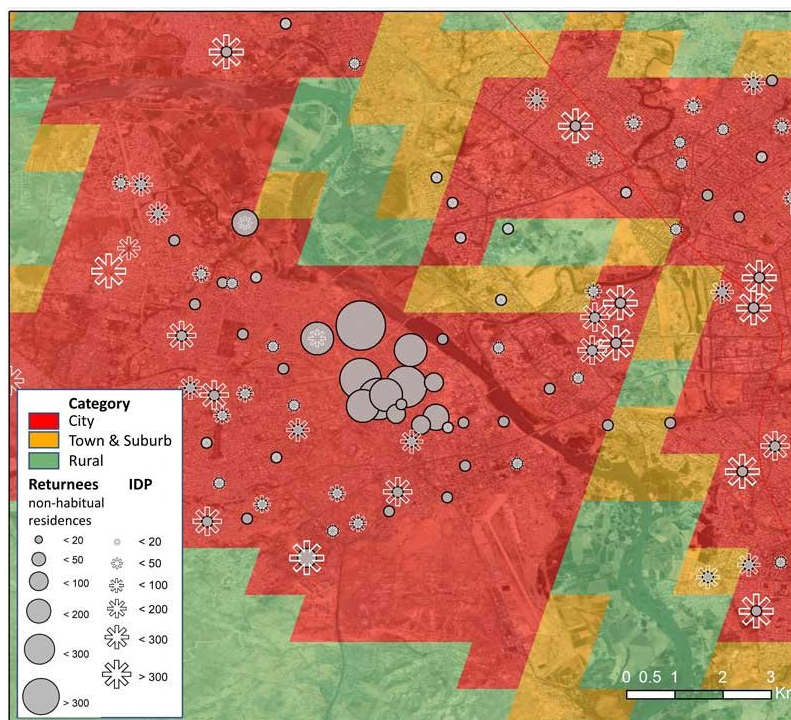
Supporting Displaced & Vulnerable Returnees

The Global Human Settlement Layer (GHSL) products of the GEO Human Planet Initiative (HPI) have been widely used for disaster risk reduction and crisis management, environment protection, urbanization, and sustainable development.

The International Organization for Migration (IOM) uses the GHSL data to better understand how people are internally displaced due to conflicts and disasters around the world. By combining the GHSL Settlement Model grid (GHS-SMOD) with its own survey data from the Displacement Tracking Matrix (DTM), IOM is able to map the locations of displaced and vulnerable returnees accurately and then quantitatively assess spatial distribution of these people. By applying GEO Human Planet Initiative’s definition of urbanization, IOM can provide better information for context-specific assistance to displaced and vulnerable returnees.

An analysis in Iraq identified that displaced and vulnerable returnees are mostly found in cities (43%) or peri-urban areas (23%). The proportion of vulnerable urban households varies across governorates (from 21% to 86%). This analysis helps decision-makers and responders think about how to identify, design, improve and run policy interventions, as well as where support is needed. Ultimately, it will provide a platform to bring diverse stakeholders together in order to improve social cohesion, which has deteriorated during the conflicts.

Combining settlement typologies and DTM data provides improved information that supports better decision making. It has been tested in Iraq, Ethiopia and Nigeria, and is replicable to other conflict contexts.

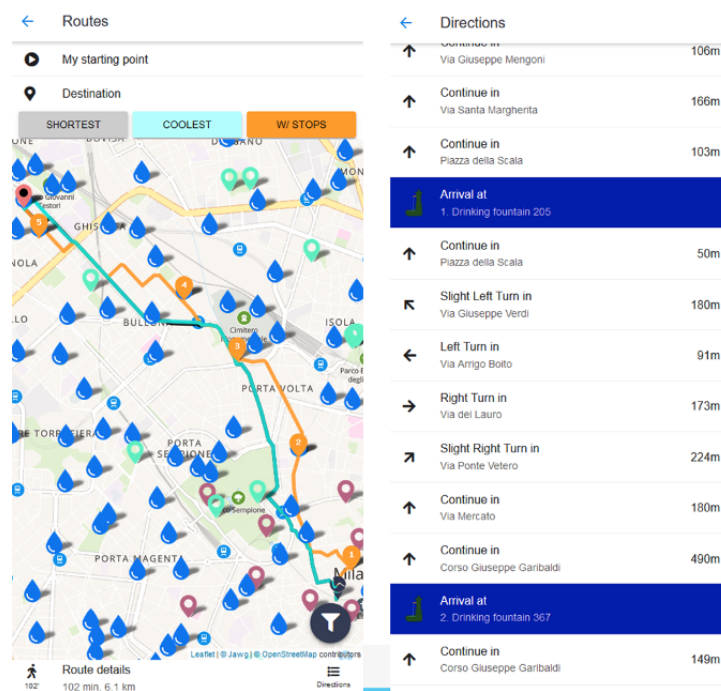


Spatial distribution of displaced and vulnerable people in Mosul, Iraq

Helping Cities Become Heat-Resilient

Heatwaves are one of the deadliest extreme weather events where hot weather is accompanied by humidity, especially in countries with an oceanic climate. The risk is higher in cities where the high population density, combined with the urban heat island effect, escalates the severity and duration of heatwaves.

Health impacts of hot weather are largely preventable if populations, local governments, and health and social care systems are prepared. EXTREMA Global, part of the GEO Global Urban Observation and Information (GUOI) Initiative, is building a suite of solutions for heat resilience based on open Earth observation data as well as climate and atmosphere models.



Cool routes add-on service, recommending stops at drinking water spots in Milan

EXTREMA Global provides tools to city authorities for long-term planning, seasonal preparedness, and day-to-day management during heatwaves. City authorities then feed updated information about cooling spaces to citizens and visitors for free via the EXTREMA Global multilingual mobile app. The information includes temperature reading and heat risk at the user’s location, nearest cooling spaces and drinking water spots, cool routes for pedestrians and bikers, an air quality index, and cooling spaces rating add-ons. In addition, there is a dashboard for city authorities, high-resolution maps of city hot spots, and planning and analytics tools.

Pilot services of EXTREMA Global have been applied in Athens, London, Milan, Rotterdam, and Kalamata. The dialogue is ongoing with many more cities proceeding to preparatory actions. It also serves as a platform where cities share good practices, success stories and learns from each other.

GEO Community Response to the COVID-19 Pandemic

At the beginning of the COVID-19 pandemic, GEO created a [repository](#) of projects using Earth observations to support COVID-19 response and recovery actions. The repository currently includes more than 40 projects which are contributed by GEO Work Programme activities, GEO Members, Participating Organizations and Associates for further use or adaptation in the wider GEO community.



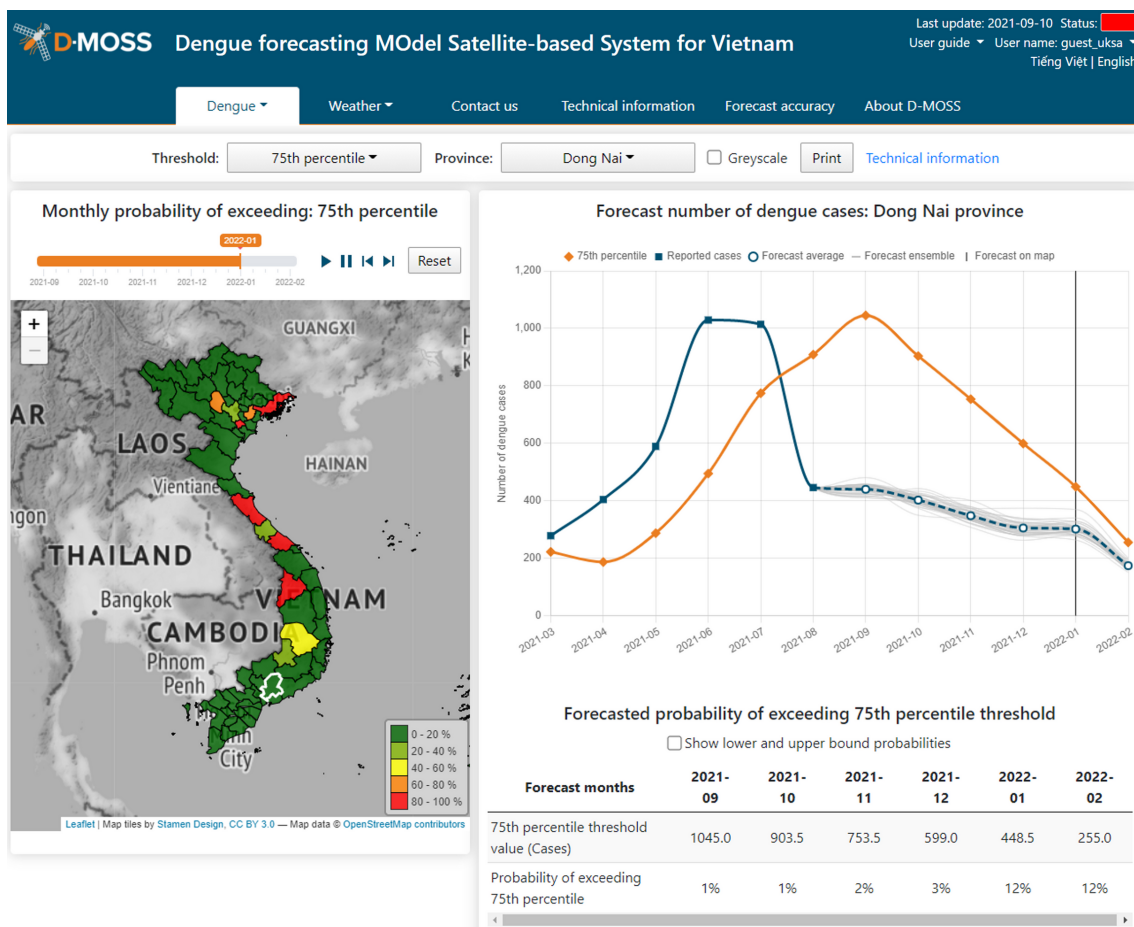
The GEO Health Community of Practice ([CoP](#)) has offered an open platform to convene Earth and health science experts in a more proactive way during the COVID-19 pandemic. Through community teleconferences and webinars, CoP members have exchanged information, shared Earth observation data and tools to support COVID-19 responses, and identified opportunities of collaboration. With nearly 400 members, and 40 to 120 participants in each teleconference, the CoP has allowed opportunities for GEO Work Programme activities to explore health linkages in their tasks. The topics have included air and water quality, disaster preparedness and management, environmental determinants and seasonality, and One Health and zoonotic disease transmission. The CoP has also compiled a list of relevant [COVID-19 funding opportunities](#) and challenge competitions.

Several GEO Health Community of Practice members have participated on the [WMO COVID-19 Task Team](#) and have contributed to the [first report](#) on the *Review on Meteorological and Air Quality Factors Affecting the COVID-19 Pandemic* in March 2021. Together with the WMO Study Group on Integrated Health Services (Co-chaired by GEO Health CoP Lead), they have hosted a series of virtual roundtable events to share lessons learned and discuss actionable meteorologically-informed decision-making to inform the COVID-19 response.

Forecasting Dengue Fever in Vietnam

Dengue fever, a mosquito-borne disease, is present in over 150 countries world-wide, affecting 390 million people per year. In Vietnam, the number of cases of dengue fever has increased by 100% since 2000. This led scientists to develop a project as part of the GEO Initiative Earth Observations for Health (EO4HEALTH), the Dengue Model Forecasting Satellite based System (D-MOSS) funded by the UK Space Agency’s International Partnership Programme.

The transmission of dengue fever is dependent on a variety of climate and socio-economic factors, including water availability which plays a crucial role in creating or destroying suitable mosquito breeding grounds. Traditional mitigation actions are based on reported dengue fever cases and local knowledge, leading to a reactive rather than proactive approach of disease control. D-MOSS is able to forecast dengue outbreaks for each of the 63 provinces in Vietnam and for every month up to six months in advance.



D-MOSS graphical user interface showing the forecast number of dengue cases for the province of Dong Nai over the next six months

The system also performs well at predicting when an outbreak will not occur. So far in 2021, D-MOSS has correctly forecasted a dengue outbreak 24 times in 8 provinces of Vietnam. It is helping health officials to develop dengue prevention and control strategies in advance of an outbreak and is contributing to reducing dengue cases and mortality rate.

D-MOSS takes the form of a web-based service based on open and non-proprietary software, and it is flexible to deploy in platforms including cloud-based virtual storage and application processing. In addition to Vietnam, it is also being implemented in Malaysia and Sri Lanka. Advanced discussions are also taking place with other countries in South East Asia



D-MOSS Training Workshop

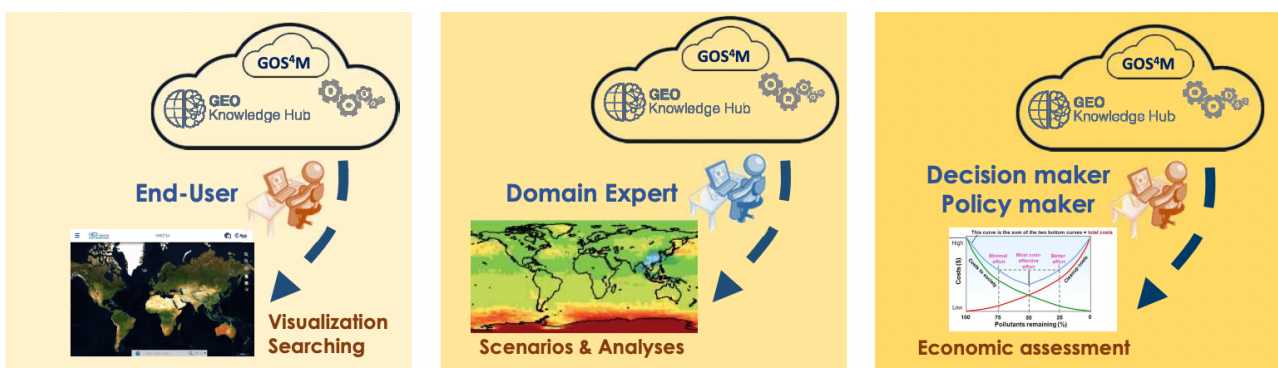
Open Tools for Assessing Impacts of Mercury Contamination

In 2021, the Global Observation System for Mercury ([COS4M](#)) makes its integrated multi-model and multi-domain computational platform operational to support effectiveness evaluation of the Minamata Convention on Mercury. The platform quantifies and visualizes linkages between anthropogenic sources and mercury contamination on the Earth system and human health at different geographical and temporal scales.

The platform, called the [GOS4M Knowledge Hub](#), is designed to house and deploy any number of different modelling components. It currently operates a Chemical Transport Model emulator, HERMES, for the short-term assessment of mercury emissions reduction policies, coupled with a biogeochemical model for the long-term assessment of mercury emissions reduction policies. It is ready to incorporate any verified models developed in house or shared by partners to reduce assessment uncertainty.

The platform provides an interactive and user-friendly interface to access and manipulate state-of-the-art mercury modelling outputs. By changing mercury emission scenarios in several clicks, scientists, decision-makers and citizens can easily obtain predicted mercury deposition scenarios as well as expected concentrations in biota, projected for a period of 30 years.

The platform significantly reduces the time needed to run the models by deploying data and models in the cloud. This allows users, including non-experts, to generate policy scenario assessments in seconds, compared to days or weeks in a traditional way.



The GOS4M Knowledge Hub

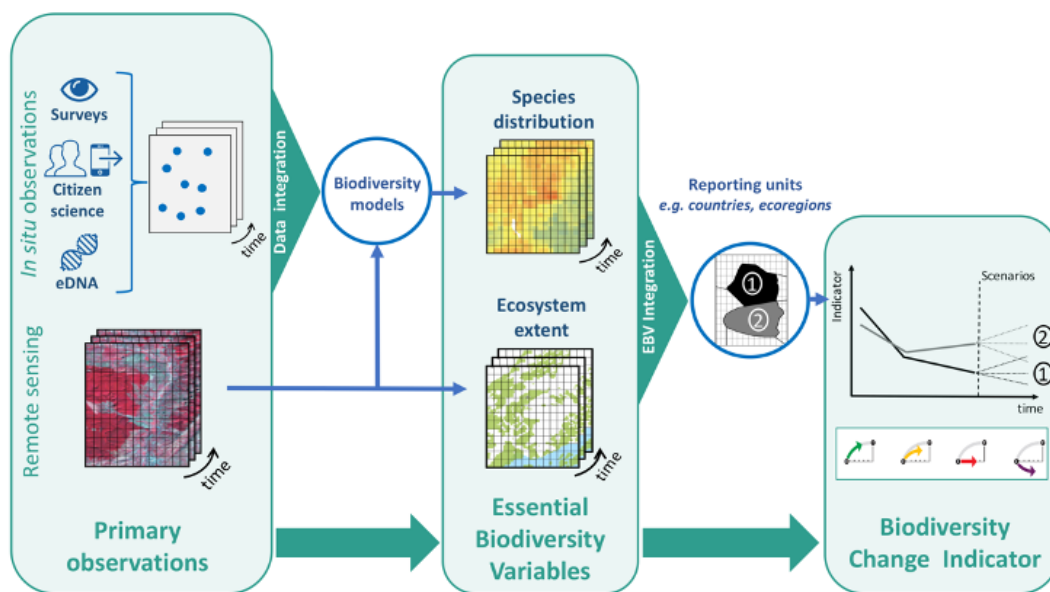
GEO Supports Development of Post-2020 Global Biodiversity Framework

IGEO’s Biodiversity Observation Network (GEO BON) has been working with the United Nations Convention on Biological Diversity (CBD) to develop indicators for the Post-2020 Global Biodiversity Framework, the world’s most ambitious commitment towards safeguarding biodiversity.

The standardized and repeatable Essential Biodiversity Variables (EBVs) developed by GEO BON connect primary biodiversity observations to biodiversity indicators that can be applied at multiple spatial scales. Several indicators based on EBVs, such as the Species Habitat Index, Genetic Diversity and Rate of Invasive Alien Species Spread, and their monitoring methodologies, have been included in the Proposed Headline Indicators for the Post-2020 Global Biodiversity Framework published by CBD in July 2021.

To expand support for these indicators from CBD Parties, GEO BON is collaborating with the CBD Secretariat and the UN Environment Programme World Conservation Monitoring Centre (UNEP-WCMC) to organize a capacity development webinar series. This ongoing webinar series introduces selected indicators, describes how they are measured, and explains how they can be interpreted and reported so that Parties and other organizations can track national progress in biodiversity monitoring.

Reporting on biodiversity indicators will require wide availability of multiscale, cloud-based biodiversity data. GEO BON’s partnership with Microsoft to establish BON-in-a-Box 2.0 will provide an integrated biodiversity information system that will fill the technical support gap in calculating indicators and provide biodiversity change forecasts to support government policy decisions.



Essential Biodiversity Variables (EBVs)

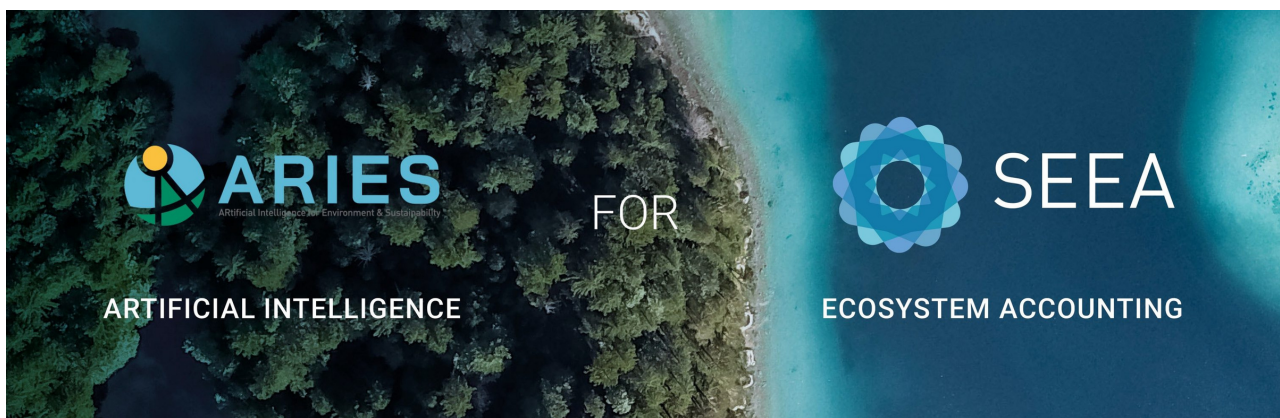
GEO Contributes to Ecosystem Accounting

The GEO Initiative Earth Observations for Ecosystem Accounting (EO4EA) was invited to help shape a new global framework for understanding and valuing nature. A key role for EO4EA has been to show how in situ and remotely-sensed data may be incorporated into statistical and accounting frameworks. Satellite data is considered as the one of the major technological means to address the scalability and consistency of accounts.

The formal adoption of the System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA EA) by the United Nations Statistical Commission (UNSD) in March 2021 marks a great leap towards valuing nature properly. This new statistical framework moves beyond GDP and takes better account of biodiversity and ecosystems in national economic planning. It will also support monitoring of many indicators of the post-2020 biodiversity framework and the Sustainable Development Goals.

EO4EA collaborated in designing Artificial Intelligence for Environment & Sustainability (ARIES) for SEEA Explorer, an integrated, open-source modelling platform which lowers some of the barriers to compiling ecosystem accounts. This application can generate ecosystem accounts for any user-specified terrestrial area in the world (such as a country, administrative region, watershed, etc.), by using freely available global satellite data and models, and rapidly computes these accounts online, using a web browser.

For the next phase, EO4EA will work with other initiatives in the GEO Work Programme, including GEO-BON, and continue developing methodological guidance for using Earth observations to measure and monitor ecosystem extent, ecosystem condition, and ecosystem services for the purpose of ecosystem accounting.



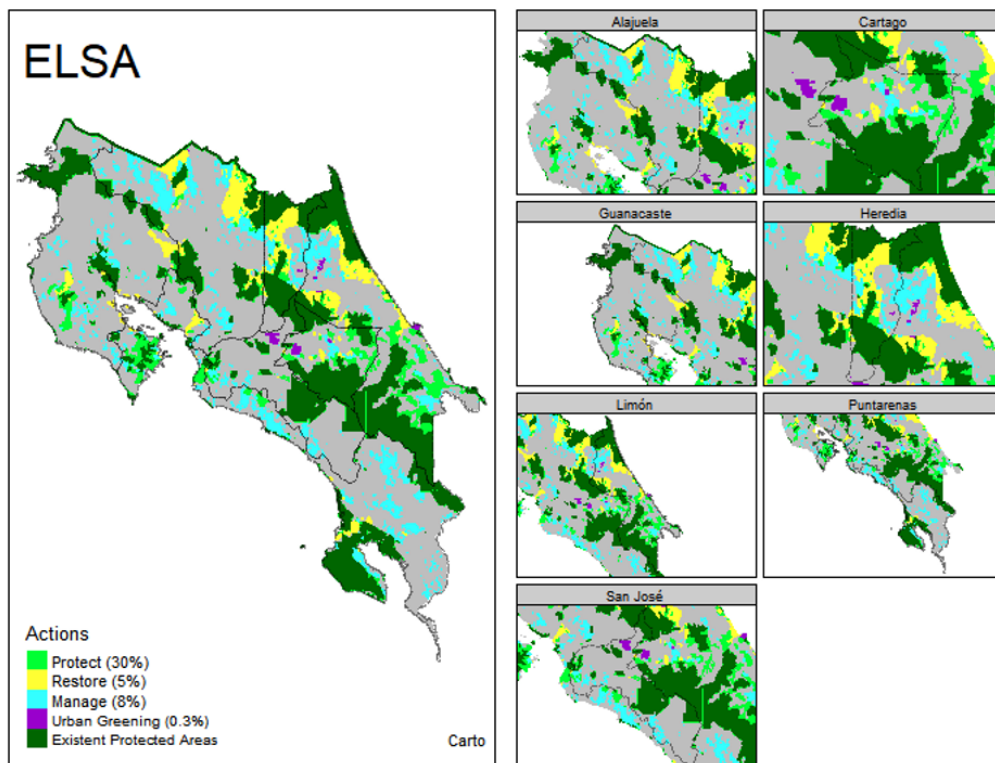
Costa Rica Leverages Earth Observation to Develop National Adaptation Plan

Costa Rica used credits received through the GEO-AWS Cloud Credits Programme to improve identification of priorities for nature-based actions, including protection, sustainable management, restoration, and urban greening.

The project “Improving linkages between Earth observations and ecosystem services models”, was led by the Costa Rica Ministry of Environment and Energy (MINAЕ), in partnership with the United Nations Development Program (UNDP) and Stanford University’s Natural Capital Project. Its aim was to integrate Essential Biodiversity Variables (EBVs) derived from Earth observations to improve the accuracy, accessibility, and relevance of ecosystem service modeling.

The results of the project, along with other information layers on climate and social features, were used in the latest maps of Essential Life Support Areas (ELSAs), which are areas where nature-based actions can most effectively deliver on multisectoral development priorities. Each feature was weighted by stakeholders and local experts to identify their relative importance.

In 2021, these ELSA maps were used by MINAЕ as an input to develop Costa Rica’s National Adaptation Plan 2022-2026.



Identification of Essential Life Support Areas (ELSAs)

AfriGEO Strengthens Regional Capacity

AfriGEO has grown to be a sought-after partner when it comes to applying Earth observation solutions to address development challenges at various levels in Africa. It plays a critical role in the use of Earth observations for decision making, articulating regional needs, providing opportunities for exchange and engagement, and strengthening regional capabilities.

For example, AfriGEO collaborated with the GEO Global Water Sustainability (GEOGLOWS) Initiative to fill data gaps and thereby improve hydrological model outputs. This work now supports water monitoring and management in over 30 river basins in Malawi, Tanzania and Kenya.

AfriGEO helped transfer capabilities of the GEO Global Agricultural Monitoring Initiative (GEOGLAM) to countries in the continent. Early warning systems on crop productivity were recently implemented in Ethiopia and Rwanda, in addition to Kenya, Uganda and Tanzania which adopted and adapted the services earlier.

Under the framework of the GEO Land Degradation Neutrality (GEO-LDN) Initiative, AfriGEO is working on concrete capacity development approaches on the theme of land degradation, including advanced graduate-level education as well as short-term training, through Massive Open Online Courses (MOOCs) and face-to-face courses.

AfriGEO also strives to foster small, medium, and micro-sized enterprises, promoting access to open data, cloud computing and other resources. The upcoming AfriGEO Symposium, whose theme is “Open Science for Growing African Industries in Earth Observation”, is a key opportunity to catalyze conversations leading to partnerships and sustainable economic growth by enhancing use of Earth observation data.



AfriGEO Workshop on Land Degradation Neutrality 2020

AmeriGEO Empowers National GEOs

The first-ever Ministerial Roundtable was convened at the AmeriGEO Week held in August 2021, where ministers who have not yet engaged at the global level explored connecting Earth observations to their national agendas. The Roundtable involved ministers from Bolivia, Colombia, Costa Rica, El Salvador, Nicaragua and the United States, representing the agriculture, environment, and disaster management ministries of their governments.

The Ministerial Roundtable is a natural result of AmeriGEO's engagement and collaboration strategy with a focus on developing and strengthening National GEOs in the Americas region since 2017.

Operational agencies and other targeted user groups of Earth observation services are often not aware of recent technological advancements, thereby limiting their ability to take advantage of them. AmeriGEO addresses this gap by advocating that countries establish a national GEO to bring together users and providers of Earth observation-based solutions within the country, as well as empowering them with the open resources contributed by the entire GEO community.

Taking a leadership role in AmeriGEO provides an additional incentive for a country to bring key stakeholders to the table. In 2019, Peru was elected as co-chair of the Americas Caucus and AmeriGEO and started to create a strategy to build a robust national GEO. Peru's practical approach was to leverage the national and regional capacities to incorporate PeruSAT-1 observations within the national decision-making process. In early 2021, Peru and AmeriGEO co-organized the Peru Mapathon-200 which successfully convened national authorities and research institutes working on disaster preparedness and response. Results of the Mapathon were made available at the national disaster platform to support future decision-making.

In addition to Peru, national GEOs have also been established in Canada, Mexico and the United States and are being explored in other countries in the Americas.



AOGEO Takes Concerted Actions for Regional Challenges

Asia-Oceania GEO has been making active contributions to GEO global Flagships and Initiatives in many areas, including agriculture, biodiversity, disaster resilience, oceans, and the water cycle. AOGEO also continuously monitors new challenges emerging in the Asia-Oceania region and is determined to take actions based on integrated Earth observation solutions.

In a recent example, a [report](#) delivered by the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP) revealed that the region is not on track to meet the ambitions of the 2030 Agenda, with data availability remaining a key challenge. In response, AOGEO convened Earth observation experts and officials from National Statistical Offices (NSOs) of Japan, Malaysia, Mongolia and Fiji at the [13th AOGEO Symposium](#), which was organized by Japan Ministry of Education, Culture, Sports, Science and Technology (MEXT) in March 2021. It was concluded by the symposium participants that AOGEO should support countries in using Earth observation data integrated with traditional statistics for SDG monitoring and reporting, in partnership with UNESCAP and NSOs. AOGEO is now working to share concrete country use cases, and to provide access to available data, methodologies, tools, and services for SDG monitoring and reporting.

Capacity development is another area of action identified at the 13th AOGEO Symposium. AOGEO has trained hundreds of frontier practitioners and young professions from over 20 countries in the region. Aiming at co-designing and using EO-based solutions in the region, it is now building towards a Regional Capacity Development Center (RCDC), which was launched by the National Remote Sensing Center of China (NRSCC), International Center for Integrated Mountain Development (ICIMOD) and Aerospace Information Research Institute of Chinese Academy of Sciences (AIRCAS) on 12 July 2021.



EuroGEO Delivers EO Applications for Users

EuroGEO, the Regional GEO for Europe, aims at developing innovative Earth observation applications to benefit society. It federates a large European GEO community, concentrating its efforts on the downstream part of the EO value chain, and contributing to leverage Copernicus and research and innovation activities within GEOSS.

One example is the Harvester Seasons app for forestry, which combines static maps of trafficability – whether equipment may pass on the soil - with weather and seasonal forecasts. It gives up to six months foresight identifying good or bad conditions within six classes, enabling forestry operations to operate sustainably, both economically and environmentally.

This application has been developed within the [e-shape](#) project, which is being coordinated by [ARMINES](#) and is funded under the European Union's Horizon 2020 Programme. The e-shape project was launched to support EuroGEO and deliver prototype services for multiple end users. It represents a significant effort to demonstrate EO-based operational services complementing the Copernicus programme.

Another example is the [Agrowth platform](#), which provides a crop monitoring service offering information and/or actionable advice at the level of the individual parcel. It does this by combining EO data from Copernicus Sentinel-1 and Sentinel-2, along with relevant vegetation indices, soil and weather data, using artificial intelligence technology.

In alignment with the main priorities of GEO, e-shape currently includes 32 cloud-based pilot applications under seven thematic areas to address societal challenges, foster entrepreneurship and support sustainable development. These applications are becoming progressively available [on-line](#). The solutions presented have been developed to improve services that already existed or to respond to global challenges such as climate change and the COVID-19 pandemic.



Smart Farming. Courtesy of EuroGEO

GEO Encourages Open Knowledge Practices

The GEO-17 Plenary will discuss an Open Knowledge Statement, which provides a rationale and impetus for greater sharing and accessibility of the results developed in the GEO Work Programme, including through the GEO Knowledge Hub. This Statement represents another step down the path towards providing GEO Members and Participating Organizations with the best evidence-based information from Earth observations possible.

Openness in knowledge generation can help address society's local, regional, and global needs by creating an inclusive and interconnected environment. The digitalization era offers new possibilities to improve timely, equal access to knowledge, increasing the credibility and trust of academic findings, and political decisions that are expected to be based on verifiable facts.

The GEO Open Knowledge Statement presents the following principles with respect to the generation, dissemination and uptake of Open Knowledge: Open Science; Open Access; Citizen and Participatory Science; Open Data; Open Reproducible Research; Open Software; Open Infrastructure; Open Hardware; Open Education; Open Evaluation; and Diversity of Knowledge.

GEO strongly encourages practices that comply with the principles of Open Knowledge outlined above. These practices are expected to increase the impact of the GEO Work Programme and shorten the time from discovery to application. The Statement was prepared by a drafting team comprising members of the Capacity Development Working Group and others in the GEO community, and presented to the Data Working Group, the Programme Board and the Executive Committee for consultation earlier this year. The full text of the Statement can be accessed on the [GEO-17 webpage](#).



GEO Knowledge Hub: Sharing EO Solutions

GEO Work Programme activities have developed many useful solutions, based on in-depth research, to address a wide range of societal challenges. These applications include the Sen2Agri application for crop monitoring, the Hermes application for measuring mercury pollution, the Global Human Settlement Layer describing global built-up environments, and the Global Wildfire Information System for wildfire monitoring and alerting.

However, many of these applications are not yet widely known and fully shared among all potential beneficiaries to support their evidence-based decisions. To remedy this gap, and to raise awareness of the reproducible applications and methods generated across the GEO Work Programme, GEO began development of the GEO Knowledge Hub. The GEO Knowledge Hub is a central cloud-based digital library, where all the Earth observation-based solutions developed by GEO Work Programme activities can be made available as open knowledge, to be applied, adapted and re-used by anyone.

Several GEO Work Programme activities have been working with the GEO Secretariat to make their results available through the GEO Knowledge Hub during its pilot phase, including Global Agriculture Monitoring (GEOGLAM), Global Observation System for Mercury (GOS4M), the Human Planet Initiative (HPI), the Global Wildfire Information System (GWIS) and the Open Earth Alliance. Deep dive to these knowledge packages can be found here.

In addition to making the results of GEO Work Programme activities more accessible to potential users, the pilot phase of the GEO Knowledge Hub has demonstrated that it can help GEO Work Programme activities document and organize their work more systematically, and ensure its longer-term preservation. The GEO Knowledge Hub is planned to be operational by the end of 2021. All GEO Work Programme activities are welcome to contribute as Knowledge Providers by making their results discoverable, accessible, and re-usable through the GEO Knowledge Hub.



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Towards a GEO In Situ Data Strategy

GEO's Data Working Group is leading an effort to develop a strategy to advance access to and sharing of in situ data for the benefit of all users. This effort responds directly to commitments in the 2019 Canberra Declaration and the GEO Strategic Plan 2016-2025.

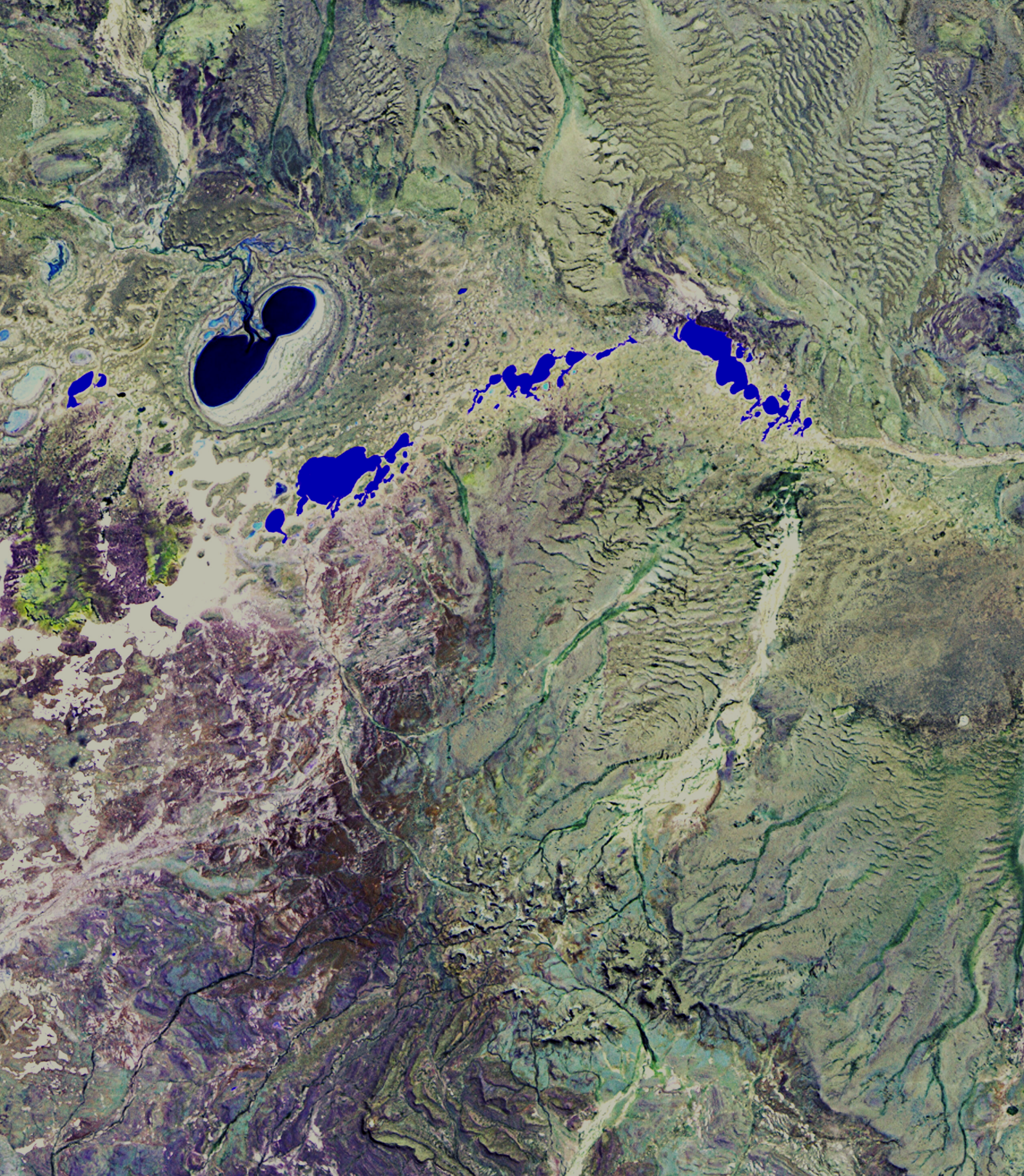
Since its founding, GEO has recognized the importance of in situ measurements and has advocated for open access to and sharing of this data. Much progress has been realized over the past decade on opening remotely-sensed data, but there has been less progress on in situ data. This is in large part due to the tremendous diversity of in situ data, and the much larger number of organizations that collect and manage this data. While some international organizations, such as the World Meteorological Organization, coordinate in situ data within specific domains, there is no single coordinating body for in situ Earth observation data as a whole.

Efforts toward a GEO in situ data strategy will focus on:

- Engaging existing networks that coordinate in situ data within specific domains;
- Identifying common barriers to data sharing (e.g. data formats, costs of making data available, licenses, sustainability, incentives, etc.) and propose ways to address these barriers;
- Prioritizing observations needed to advance GEO Work Programme activities and engaging entities that are best placed to provide access to key data sets; and
- Proposing practical actions to increase access to data that will be most relevant for advancing the GEO engagement priorities.

A series of consultations are planned in 2021 and 2022 to ensure that the strategy and its objectives are owned and contributed to by the entire GEO community.





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