



# 2020-2022 GEO WORK PROGRAMME

SUMMARY DOCUMENT  
VERSION 4 -- AS APPROVED BY GEO-XVI





## Preface

This document is the fourth and final version of the 2020 to 2022 Group on Earth Observations (GEO) Work Programme Summary Document. It describes the seventh such GEO Work Programme (formerly GEO Work Plan) since GEO began in 2005.

As will be described in greater detail in the next section, the process of developing a GEO Work Programme unfolds over a period of approximately one year, from the approval of the last update to the previous Work Programme, to the approval of the new Work Programme by the GEO Plenary. An important part of this process involves broad consultation with all members of the GEO community, including the organizations and individuals who contribute their time and resources to the activities that comprise the GEO Work Programme, GEO Members and Participating Organizations, and many other stakeholders. The present document is the product of this consultation process, which has been guided and overseen by the GEO Programme Board.

More specifically, this Summary Document is a compilation of the Executive Summaries from the implementation plans submitted by teams of GEO Members and Participating Organizations. The format for these implementation plans was revised by the Programme Board for the 2020-2022 GEO Work Programme call, building on the experience gained in previous Work Programme cycles. The full implementation plans may be accessed by clicking on the short names of the activities on the summary pages in this document, or via the GEO website.

Now that the Work Programme development process has concluded, the Programme Board and the Secretariat shift their attention toward ongoing monitoring and engagement with each of the activities. Specific opportunities for improvement and collaboration identified during the development process will form the basis for this ongoing engagement. New activities will also continue to be welcomed into the Work Programme throughout the 2020-2022 period.

Comments and contributions to improve the Work Programme activities are welcome and you are invited to provide them to the points of contact of those activities directly; their contact information is provided in this document at the end of each activity summary.

For general comments on the GEO Work Programme Summary Document, to propose additional contributions to GEO Work Programme activities, or to ask questions regarding the Work Programme development process, please contact the GEO Secretariat at [secretariat@geosec.org](mailto:secretariat@geosec.org).



# Table of Contents

Preface .....	i
Table of Contents.....	iii
Status of Activities .....	vii
Introduction to the GEO Work Programme .....	1
Components of the GEO Work Programme .....	1
Process of Development.....	2
Becoming Involved in the GEO Work Programme .....	3
Brief History of the Group on Earth Observations.....	5
GEO Engagement Priorities .....	7
GEO Work Programme Linkages to the UN 2030 Agenda.....	8
GEO Work Programme Linkages to the Paris Agreement .....	9
GEO Work Programme Linkages to the Sendai Framework.....	10
GEO Flagships.....	11
GEO Biodiversity Observation Network (GEO-BON) .....	11
GEO Global Agricultural Monitoring (GEOGLAM).....	13
Global Forest Observations Initiative (GFOI).....	16
Global Observation System for Mercury (GOS4M).....	18
GEO Initiatives.....	20
AquaWatch (AQUAWATCH).....	20
Data Access for Risk Management (GEO-DARMA).....	22
Data Integration and Analysis System (DIAS).....	24
Earth Observations for Ecosystem Accounting (EO4EA).....	26
Earth Observations for Health (EO4HEALTH) .....	28
Earth Observations for the Sustainable Development Goals (EO4SDG).....	30
GEO Capacity Building in the North Africa, Middle East, Balkans, and Black Sea Region (GEO-CRADLE) .....	32
GEO Global Water Sustainability (GEOGLOWS) .....	34
GEO Human Planet (HUMAN-PLANET).....	36
GEO Land Degradation Neutrality (GEO-LDN).....	38
GEO Vision for Energy (GEO-VENER).....	40
GEO Wetlands (GEO-WETLANDS) .....	42
Geohazard Supersites and Natural Laboratories (GSNL) .....	44
Global Drought Information System (GDIS) .....	46
Global Network for Observations and Information in Mountain Environments (GEO-GNOME) .....	48

Global Observation System for Persistent Organic Pollutants (GOS4POPS) .....	50
Global Urban Observation and Information (GUOI) .....	52
Global Wildfire Information System (GWIS).....	54
Oceans and Society: Blue Planet (BLUE-PLANET) .....	56
<b>Regional GEOs .....</b>	<b>58</b>
Africa Group on Earth Observations (AFRIGEO).....	58
Americas Group on Earth Observations (AMERIGEO) .....	60
Asia-Oceania Group on Earth Observations (AOGEO).....	62
European Group on Earth Observations (EUROGEO) .....	64
<b>GEO Community Activities.....</b>	<b>66</b>
Advancing Communication Infrastructure and Services (ACIS) .....	66
Arctic GEOSS (ARCTIC-GEOSS).....	68
Chinese High-resolution Satellite Data Resources (CSDR).....	70
Climate Observation, Simulation and Impacts (CLIMATE-OBS).....	72
Copernicus Atmosphere Monitoring Service (CAMS) .....	73
Copernicus Climate Change Service (C3S).....	74
Digital Earth Africa (DE-AFRICA) .....	75
Earth Observation and Copernicus in Support of Sendai Monitoring (EO4SENDAI-MONITORING).....	77
Earth Observation Industrial Innovation Platform for Sustainable Development (EO-IIP) .....	79
Earth Observations for Disaster Risk Management (EO4DRM).....	80
Earth Observations for Managing Mineral and Non-Renewable Energy Resources (EO4MIN) .	82
Earth Observations for the Atlantic Region (ATLANTIC-EO).....	83
Earth Observations for the Water-Energy-Food Nexus (EO4WEF).....	85
Enhancing Food Security in African Agricultural Systems with the Support of Remote Sensing (AFRICULTURES).....	87
GEO Citizen Science (GEO-CITSCI) .....	89
GEO Essential Variables (GEO-EV) .....	91
GEO Global Ecosystems (GEO-ECO) .....	92
Geodesy for the Sendai Framework (GEODESY4SENDAI) .....	94
Global Agricultural Drought Monitoring (AGRI-DROUGHT) .....	96
Global Crop Pest and Disease Habitat Monitoring and Risk Forecasting (CROP-PEST-MONITORING).....	97
Global Ecosystems and Environment Observation Analysis Research Cooperation (GEOARC) 98	
Global Flood Awareness System (GLOFAS).....	99
Global Flood Risk Monitoring (GFRM) .....	100
Global Land Cover (LAND-COVER) .....	102
Global Observation of Deltas and Estuaries (DELTA&ESTUARY) .....	103
In-Situ Observations and Applications for Ecosystem Status of China and Central Asia (IN-SITU-ESC).....	104

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Multi-source Synergized Quantitative Remote Sensing Products and Services (MUSYQ) .....	105
Next Generation Earth Observation Services (NEXT-EOS) .....	106
Night-time Light Remote Sensing for the Sustainable Development Goals (NIGHT-LIGHT)...	107
Space and Security (SPACE&SECURITY) .....	109
Space Climate Observatory (SCO) .....	110
The International Grand Global Ensemble (TIGGE).....	112
Understanding the Impacts and Value of Earth Observations (GEO-VALUE) .....	113
<b>Foundational Tasks.....</b>	<b>115</b>
A New Structure for GEO Foundational Tasks .....	115
GEO Engagement Priorities Coordination .....	116
GEOSS Data, Information and Knowledge Resources .....	118
GEOSS Infrastructure Development .....	120
GEO Work Programme Support .....	123
GEO Secretariat Operations .....	125
<b>Table of Acronyms.....</b>	<b>127</b>



## Status of Activities

**Table A – Disposition of Activities from the 2017-2019 GEO Work Programme**

GEO Work Programme Activity	Category	Disposition
GEO Biodiversity Observation Network	GEO Flagship	Retained as a GEO Flagship
GEO Global Agricultural Monitoring	GEO Flagship	Retained as a GEO Flagship
Global Forest Observation Initiative	GEO Flagship	Retained as a GEO Flagship
Global Observation System for Mercury	GEO Flagship	Retained as a GEO Flagship
AfriGEOSS: Reinforcing Regional African Engagement	GEO Initiative	Retained as a Regional GEO
AmeriGEOSS	GEO Initiative	Retained as a Regional GEO
Aquawatch	GEO Initiative	Retained as a GEO Initiative
Asia-Oceania GEOSS	GEO Initiative	Retained as a Regional GEO
Climate Change Impact Observation on Africa's Coastal Zones	GEO Initiative	Did not submit a plan for 2020-2022
Data Access for Risk Management	GEO Initiative	Retained as a GEO Initiative
Earth Observations for Ecosystem Accounting	GEO Initiative	Retained as a GEO Initiative
Earth Observations in the Service of the 2020 Agenda for Sustainable Development	GEO Initiative	Retained as a GEO Initiative
EuroGEOSS	GEO Initiative	Retained as a Regional GEO
GEO Carbon and GHG Initiative	GEO Initiative	Did not submit a plan for 2020-2022
GEO Cold Regions Initiative	GEO Initiative	Did not submit a plan for 2020-2022
GEO Capacity Building in North Africa, Middle East, Balkans and the Black Sea	GEO Initiative	Retained as a GEO Initiative
GEO Geohazard Supersites and Natural Laboratories	GEO Initiative	Retained as a GEO Initiative
GEO Global Ecosystems Initiative	GEO Initiative	Re-categorized as a GEO Community Activity
GEO Global Network for Observation and Information in Mountain Environments	GEO Initiative	Retained as a GEO Initiative
GEO Global Water Sustainability	GEO Initiative	Retained as a GEO Initiative
GEO Human Planet Initiative	GEO Initiative	Retained as a GEO Initiative
GEO Land Degradation Neutrality Initiative	GEO Initiative	Retained as a GEO Initiative
GEOSS-Evolve	GEO Initiative	Included in the GEOSS Infrastructure Development Foundational Task
GEO Vision for Energy	GEO Initiative	Retained as a GEO Initiative
GEO Wetlands Initiative	GEO Initiative	Retained as a GEO Initiative
Global Drought Information System	GEO Initiative	Retained as a GEO Initiative

GEO Work Programme Activity	Category	Disposition
Global Observation System for Persistent Organic Pollutants	GEO Initiative	Retained as a GEO Initiative
Global Urban Observation and Information	GEO Initiative	Retained as a GEO Initiative
Global Wildfire Information System	GEO Initiative	Retained as a GEO Initiative
Oceans and Society: Blue Planet	GEO Initiative	Retained as a GEO Initiative
Access to Climate Data in GEOSS	GEO Community Activity	Retained as a GEO Community Activity (as Climate Observation, Simulation and Impacts)
Advancing Communications Networks	GEO Community Activity	Retained as a GEO Community Activity
AirNow International	GEO Community Activity	Did not submit a plan for 2020-2022
Arctic GEOSS	GEO Community Activity	Retained as a GEO Community Activity
Chinese Tsunami Mitigation System	GEO Community Activity	Did not submit a plan for 2020-2022
Copernicus Atmospheric Monitoring Service	GEO Community Activity	Retained as a GEO Community Activity
Copernicus Climate Change Service	GEO Community Activity	Retained as a GEO Community Activity
Data Integration and Analysis System	GEO Community Activity	Re-categorized as a GEO Initiative
Digital Earth Africa	GEO Community Activity	Retained as a GEO Community Activity
Digital Geomuseum	GEO Community Activity	Did not submit a plan for 2020-2022
Earth Observations and Citizen Science	GEO Community Activity	Retained as a GEO Community Activity
Earth Observations for Disaster Risk Management	GEO Community Activity	Retained as a GEO Community Activity
Earth Observations for Geohazards, Land Degradation and Environmental Monitoring	GEO Community Activity	Merged with Earth Observations for Managing Mineral Resources
Earth Observations for Health	GEO Community Activity	Re-categorized as a GEO Initiative
Earth Observations for Managing Mineral Resources	GEO Community Activity	Retained as a GEO Community Activity
Earth Observations for the Water-Energy-Food Nexus	GEO Community Activity	Retained as a GEO Community Activity
Forest Biodiversity in Asia and the Pacific Region	GEO Community Activity	Merged with Global Forest Observation Initiative
Geodata for Agriculture and Water	GEO Community Activity	Did not submit a plan for 2020-2022
Global Agricultural Drought Monitoring	GEO Community Activity	Retained as a GEO Community Activity
Global Ecosystems and Environmental Observation Analysis Report Cooperation	GEO Community Activity	Retained as a GEO Community Activity
Global Flood Awareness System	GEO Community Activity	Retained as a GEO Community Activity
Global Flood Risk Monitoring	GEO Community Activity	Retained as a GEO Community Activity
Global Framework for Climate Services – GEO Collaboration	GEO Community Activity	To be addressed within the framework of collaboration between the GEO Secretariat and the WMO Secretariat
Global Mangrove Monitoring	GEO Community Activity	Merged with GEO Wetlands
Global Marine Ecosystem Monitoring	GEO Community Activity	Merged with GEO Biodiversity Observation Network

GEO Work Programme Activity	Category	Disposition
Global Wheat Pest and Disease Habitat Monitoring and Risk Forecasting	GEO Community Activity	Retained as a GEO Community Activity
Himalayan GEOSS	GEO Community Activity	Merged with Asia-Oceania GEO
In Situ Observations and Practices for the Water Cycle	GEO Community Activity	Merged with GEO Global Water Sustainability
Integrated City-Region Systems Modelling	GEO Community Activity	Did not submit a plan for 2020-2022
Land Cover and Land Cover Change	GEO Community Activity	Merged with GEO Land Cover
Multi-Source Synergized Quantitative Remote Sensing Products and Services	GEO Community Activity	Retained as a GEO Community Activity
Research Data Science Summer Schools	GEO Community Activity	Did not submit a plan for 2020-2022
Socio-Economic Benefits of Earth Observations	GEO Community Activity	Retained as a GEO Community Activity (as Understanding the Impacts and Value of Earth Observations)
Space and Security	GEO Community Activity	Retained as a GEO Community Activity
Thorpex Interactive Grand Global Ensemble Evolution into a Global Interactive Forecast System	GEO Community Activity	Retained as a GEO Community Activity
Capacity Building Coordination	GEO Foundational Task	Included in the GEO Work Programme Support Foundational Task
Advancing GEOSS Data Sharing Principles	GEO Foundational Task	Included in the GEOSS Data, Information and Knowledge Resources Foundational Task
GEONETCast Development and Operations	GEO Foundational Task	Included in the GEOSS Infrastructure Development Foundational Task
GEOSS Platform	GEO Foundational Task	Included in the GEOSS Infrastructure Development Foundational Task
GEOSS In situ Earth Observation Resources	GEO Foundational Task	Included in the GEOSS Data, Information and Knowledge Resources Foundational Task
GEOSS Satellite Earth Observation Resources	GEO Foundational Task	Included in the GEOSS Data, Information and Knowledge Resources Foundational Task
User Needs and Gap Analysis	GEO Foundational Task	Included in the GEOSS Data, Information and Knowledge Resources Foundational Task
Communication and Engagement	GEO Foundational Task	Included in the GEO Engagement Priorities Coordination Foundational Task
Management and Support	GEO Foundational Task	Included in the GEO Secretariat Operations Foundational Task
Monitoring and Evaluation	GEO Foundational Task	Included in the GEO Work Programme Support and GEO Secretariat Operations Foundational Tasks

**Table B – Disposition of New Proposed GEO Work Programme Activities**

GEO Work Programme Activity	Proposed Category	Disposition
Earth Observations for the Atlantic Region	GEO Initiative	Accepted as a GEO Community Activity
GEO Essential Variables	GEO Initiative	Accepted as a GEO Community Activity
Space Climate Observatory	GEO Initiative	Accepted as a GEO Community Activity
Construction and Services of Chinese High-Resolution Satellite Data Resources	GEO Community Activity	Accepted as a GEO Community Activity
Dengue Model Satellite-based Forecasting System for South-east Asia	GEO Community Activity	Merged with Earth Observations for Health
Earth Observation and Copernicus in Support of Sendai Monitoring	GEO Community Activity	Accepted as a GEO Community Activity
Earth Observation Industrial Innovation Platform	GEO Community Activity	Accepted as a GEO Community Activity
GEO Satellite-based Climate Data Records Production and Service	GEO Community Activity	Proposal withdrawn.
Geodesy for the Sendai Framework	GEO Community Activity	Accepted as a GEO Community Activity
Geohazards Lab and Thematic Exploitation Platform	GEO Community Activity	Proposal withdrawn.
Global Land Cover	GEO Community Activity	Accepted as a GEO Community Activity
Global Observation of Deltas and Estuaries	GEO Community Activity	Accepted as a GEO Community Activity
In Situ Observations and Applications for Typical Ecosystem Status of China and Central Asia	GEO Community Activity	Accepted as a GEO Community Activity
Minimizing the Risk of Tailings Dam Failures through the use of Remote Sensing Data	GEO Community Activity	Merged with Earth Observations for Managing Mineral Resources
Next Generation Earth Observation Services	GEO Community Activity	Accepted as a GEO Community Activity
Night-time Light Remote Sensing for the Sustainable Development Goals	GEO Community Activity	Accepted as a GEO Community Activity

# Introduction to the GEO Work Programme

The GEO Work Programme is the primary instrument used by GEO to facilitate collaboration among its Members, Participating Organizations, GEO Associates, and other partners on activities to realize GEO's Mission and Vision.

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 by defined sets of users.

GEO Work Programme activities are largely funded through in-kind contributions from GEO Members and Participating Organizations on a voluntary, best-efforts basis, supplemented by financial contributions where possible. A small number of activities, the GEO Foundational Tasks, are implemented in part by the GEO Secretariat through resources contributed by GEO Members to the GEO Trust Fund.

Each new GEO Work Programme covers a fixed three-year period. The present document applies to the years 2020 to 2022, on a calendar year basis. Updates to the GEO Work Programme may be made in the intervening years. Both the original GEO Work Programme and any updates must be approved by the GEO Plenary at an annual meeting.

## Components of the GEO Work Programme

The GEO Work Programme includes five categories of activities, collectively known as GEO Implementation Mechanisms. Each of these categories is described below.

### **GEO Initiatives**

GEO Initiatives, together with GEO Flagships, form the core of the GEO Work Programme. Within their defined domains, GEO Initiatives help to transition innovative results and prototypes from the research community into Earth observation-based products and services to support a wide range of users. GEO Initiatives also build communities of stakeholders that work together to identify needs and gaps and develop capacity with these communities to maximize the value of the products and services being developed. GEO Flagships and Initiatives are expected to interact closely with the GEO Secretariat and the GEO community and, in return, receive a greater degree of visibility, support and guidance from GEO.

### **GEO Flagships**

GEO Flagships are Initiatives that exemplify the kind of impact and support to global, national, and local decision making that GEO aims to encourage and replicate. GEO Flagships have developed and continue to implement reliable, continuing services in response to defined policy mandates from international organizations, conventions, agreements or other bodies. In doing so, GEO Flagships serve as models and guides for other GEO Work Programme activities.

## **Regional GEOs**

Regional GEOs are a new category of activity in the GEO Work Programme although they emerged from GEO Initiatives. Regional GEOs were officially recognized at the GEO-XV Plenary as distinct components of the GEO governance structure. Regional GEOs act as the implementing arms of the GEO Caucuses, which are groups of GEO Member countries within five defined regions of the world. The roles of Regional GEOs include: engagement of countries and organizations within their region, including those which may not yet be GEO Members or actively involved; coordination of GEO activities within their region, including subsets of global Initiatives and Flagships; and initiation of new activities to serve regional needs.

## **GEO Community Activities**

GEO Community Activities range from communities of practice, to early-stage projects or pilots, to well-established services. GEO Community Activities offer an opportunity for GEO Members and Participating Organizations to collaborate and to contribute to realizing GEO's Vision and Mission with minimal requirements or structure. GEO Community Activities serve as an entry point for new activities which may go on to become GEO Initiatives. They may also include established services that find benefit from collaboration with other Work Programme activities, but which may not require the closer interaction typical of GEO Initiatives.

## **GEO Foundational Tasks**

GEO Foundational Tasks are the means by which GEO implements certain critical activities needed to ensure coordination across the GEO Work Programme, provide selected technical services to the GEO community, and to support GEO governance bodies and routine operations. Many of the activities within the Foundational Tasks are implemented by the GEO Secretariat, although others may be undertaken by collaborative teams drawn from across the GEO community.

## **Process of Development**

Development of GEO Work Programmes is led by the GEO Programme Board, with the support of the GEO Secretariat.

The development process is initiated by a call for new and revised implementation plans for GEO Work Programme activities to GEO Members, Participating Organizations and the broader community of stakeholders with which GEO interacts. As these plans are received, they are reviewed by teams of Programme Board members (in the case of candidate Flagships, Initiatives and Regional GEOs) or by the GEO Secretariat (in the case of candidate Community Activities). An iterative process of review and revision to the plans continues as needed, up to the time of preparation of the version of the Work Programme that is provided to the GEO Plenary for approval.

A total of four versions of the GEO Work Programme Summary Document will be prepared:

- Version 1 was distributed on 16 May 2019 via the GEO website to the broad GEO community for consultation;
- Version 2 was distributed on 19 July 2019 to GEO Principals of GEO Members and Participating Organizations by email and to the broad GEO community via the GEO website;

- Version 3 is distributed to GEO Principals as part of the package of documents for decision at the GEO-XVI Plenary and is also made available via the GEO website; and
- Version 4 is posted on the GEO website following the GEO-XVI Plenary, reflecting any adjustments or additions made at the Plenary meeting.

Each version is prepared and distributed by the GEO Secretariat, based on the decisions of the Programme Board. Version 4 will be the official version as approved by the GEO Plenary, although it will be subject to annual updates and revisions in 2020 and 2021.

## **Becoming Involved in the GEO Work Programme**

GEO is a voluntary organization and depends on the interest and energy of the international Earth observations and geospatial communities to reach its goals. There are many ways in which nations, organizations and individuals can contribute to the success of GEO and to the implementation of the GEO Work Programme. Some ways to start are listed below.

### **Contact the GEO Secretariat**

Secretariat staff would be pleased to explain the various opportunities available and help you to find the best match for your interests. You can reach the Secretariat by email at [secretariat@geosec.org](mailto:secretariat@geosec.org) or by telephone at +41 22 730 8505.

### **Contact a Member of the GEO Programme Board**

The Programme Board is a GEO governance body made up of 32 GEO Members and Participating Organizations appointed by the GEO Plenary. Programme Board members, through their representatives, collectively oversee the development and implementation of the GEO Work Programme. Contact information for Programme Board member representatives may be found on the GEO website [http://www.earthobservations.org/geo\\_pb.php](http://www.earthobservations.org/geo_pb.php).

### **Contact your GEO Principal**

If you live in a GEO Member country or work in a GEO Participating Organization, you are invited to contact the GEO Principal, their Alternate, or other contact persons to find out more about GEO activities in that country or organization. Contact details may be obtained from the GEO Secretariat.

### **Contact your Regional GEO**

You may also become involved in activities in your region. Regional GEOs are set up to engage regional stakeholders in GEO activities and coordinate implementation of GEO activities within their region. Points of contact for each of the four current Regional GEOs may be found in the Regional GEO section of this document.

### **Contribute to a GEO Flagship, Initiative or Community Activity**

All GEO Work Programme activities are open to new participants. While experience in relevant topics is welcomed, it is not necessary to be an expert to become involved. Most GEO Work Programme activities also seek to engage actual and potential users of the products and services being developed, as well as other stakeholders, to ensure that the activity truly addresses the needs of those it aims to benefit. You are invited to email the Points of Contact for the Flagships, Initiatives or Community Activities in which you are interested, as listed in this document.

### **Join a Foundational Task Working Group**

There are four Working Groups proposed in this document to participate in implementing the GEO Foundational Tasks; they address Capacity Development, Climate, Disaster Risk Reduction, and Data Sharing and Data Management. On approval of their terms of reference by the GEO Executive Committee, these Working Groups will be seeking new members to help realize their challenging mandates. Points of Contact may be found in the terms of reference of each Working Group (follow the links on the Foundational Task pages) or through the Points of Contact for the Foundational Tasks.

### **Propose a new GEO Community Activity**

GEO welcomes proposals for new Community Activities at any time, not only during the development of a new three-year Work Programme. The key criteria to be met are:

- The activity must include contributions from more than one GEO Member or Participating Organization;
- The targeted user need(s) and potential products or services to be explored must be identified;
- The concept must be plausible and not duplicate existing services;
- The team has sufficient expertise and experience to bring the concept to a practical demonstration; and
- The expected tasks are reasonable in relation to the identified objectives and resources.

Those interested in preparing a proposal should contact the GEO Secretariat to obtain the current templates and guidance documents.

## Brief History of the Group on Earth Observations

The need for strengthened cooperation and coordination among global observing systems and research programmes in order to provide integrated global observations for the achievement of sustainable development was widely recognized at the World Summit on Sustainable Development (WSSD) held in Johannesburg in 2002. Subsequent Earth Observation Summits (Washington D.C., 2003; Tokyo, 2004) underscored the importance of comprehensive, coordinated and sustained Earth observations—exchanged fully and openly—as a basis for informed decision making, and, building on existing systems, called for the establishment of a “system of systems” approach to deliver those observations.

The political will and commitment demonstrated at these Summits, confirmed by the G-8 endorsement of strengthened international cooperation on global observation of the environment (Evian, 2003), reached their culmination at the Third Earth Observation Summit (Brussels, 2005) when GEO was formally launched as a partnership of Member governments and Participating Organizations working together to implement the Global Earth Observation System of Systems (GEOSS). GEOSS was designed to deliver the data and information necessary for bringing qualitative improvements in understanding the Earth system so that global policy- and decision-making abilities that promote the environment, human health, safety, and welfare would be enhanced. In particular, GEO’s initial GEOSS 10-Year Implementation Plan (2005-2015) foresaw GEOSS as a step towards addressing the challenges articulated by the United Nations Millennium Declaration (including the Millennium Development Goals), as well as the 2002 WSSD and implementation of other international environmental treaty obligations.

Beyond addressing major policy initiatives, and building on existing local, national, regional, and international initiatives, GEO also promotes the benefits of GEOSS through enhancing capacity; engaging globally with a broad range of user communities, from managers, policy makers and scientific researchers and engineers, to civil society, governmental and non-governmental organizations, international bodies and the commercial sector; and providing Earth observations data and information yielding advances in knowledge across Societal Benefit Areas (SBAs), as defined by purpose and scope. Political support for full and open access to Earth observation data and information was affirmed by the Cape Town Declaration (2007) which called for implementation of the GEOSS Data Sharing Principles and improvements in interoperability of data systems. The Beijing Declaration (2010) took the commitment to sharing of Earth observation data and information a step further by establishing the GEOSS Data Collection of Open Resources for Everyone (GEOSS Data CORE), while urging governments to take the measures necessary to sustain and enhance both in situ and space-based observation systems. In 2014, GEO’s mandate was renewed for another decade with the Geneva Declaration, which also called for both strengthening engagement with developing countries, and broadening engagement with diverse stakeholders, including non-governmental and non-profit organizations and the commercial sector, while taking into account commitments to UN sustainable development themes.

With the Mexico City Ministerial Summit (2015) endorsement of the *GEO Strategic Plan 2016-2025: Implementing GEOSS*, the threads of support for sustainable development continues to be woven into the fabric of GEO’s existence. Indeed, the Strategic Plan references historical events that have transpired since the first decade of GEO’s existence, including the advent of the UN Sustainable Development Goals (SDGs) as a response to mounting global societal challenges. Since the SDGs contain quantifiable targets and indicators to serve as benchmarks against which

progress towards achievement of the SDGs may be ascertained, the Strategic Plan specifically calls for the provision of open, timely and reliable Earth observation data and information to supplement statistical analyses used in assessing that progress. Similarly, the 2015 GEO Mexico City Declaration both affirmed that “GEO and its Earth observations and information will support the implementation of, inter alia, the 2030 Global Goals for Sustainable Development...” and called on GEO to “...launch a GEO initiative to leverage Earth observations to support the implementation, monitoring and evaluation of the 2030 Global Goals for Sustainable Development, building on the recent success of GEO’s engagement with the United Nations on this issue.” To follow these calls with concerted action, at the GEO-XIII Plenary meeting (Saint Petersburg, 2016), the GEO Engagement Priorities for 2017-2019 identified several global policy initiatives as candidates for demonstrating that GEO is “the reference global initiative that facilitates evidence-based environmental decision-making by unlocking the potential of Earth observations.” The Plenary approved three of the policy initiatives (out of five) as initial priorities for GEO, including the 2030 Agenda for Sustainable Development (and associated SDGs), as well as the Paris Agreement on climate and the Sendai Framework for Disaster Risk Reduction.

## GEO Engagement Priorities

The *GEO Strategic Plan 2016-2025: Implementing GEOSS* recognized the potential of Earth observations in supporting key international policy priorities, stating:

*Earth observations are an indispensable component to measure and monitor our progress in addressing societal challenges.*

The Strategic Plan specifically pointed to the role of Earth observations in supplementing data from national statistical offices in supporting the Sustainable Development Goals. Similarly, Earth observations were also seen as relevant to follow-up and review frameworks of other international treaties and conventions.

The GEO XIII Plenary in 2016 took up this direction, approving an Engagement Strategy and selecting three key policy priorities to guide GEO's efforts over the medium term:

- United Nations 2030 Agenda for Sustainable Development;
- Climate Change, with specific emphasis on the Paris Agreement; and
- Sendai Framework for Disaster Risk Reduction.

While engagement efforts are led by the GEO Secretariat with the support of GEO Members and Participating Organizations, the detailed support and interaction mostly comes from GEO Flagships, Initiatives and Community Activities. This support is often based on existing services that have been developed to meet other users and needs, but which may be re-purposed to address specific needs associated with the engagement priorities. In other cases, GEO Work Programme activities engage directly with the relevant UN agencies, national governments, and other stakeholders to develop new products and services tailored specifically to address the requirements of the key policy drivers.

The three tables that appear on the following pages are based on the information provided in GEO Work Programme activity implementation plans for 2020-2022 regarding specific components of the engagement priorities that they are supporting. This information is a snapshot and should be expected to change over time, but it does provide at least an indication of how the GEO Work Programme is currently organizing its activities to respond to the engagement priorities.

The GEO Programme Board, along with the Secretariat, the GEO Engagement Priorities Coordination Foundational Task and the Working Groups addressing specific priorities, will continue to coordinate and encourage expansion of these efforts.

## GEO Work Programme Linkages to the UN 2030 Agenda



	1 NO POVERTY	2 ZERO HUNGER	3 GOOD HEALTH AND WELL-BEING	6 CLEAN WATER AND SANITATION	7 AFFORDABLE AND CLEAN ENERGY	8 DECENT WORK AND ECONOMIC GROWTH	9 INDUSTRY, INNOVATION AND INFRASTRUCTURE	11 SUSTAINABLE CITIES AND COMMUNITIES	12 RESPONSIBLE CONSUMPTION AND PRODUCTION	13 CLIMATE ACTION	14 LIFE BELOW WATER	15 LIFE ON LAND	17 PARTNERSHIPS FOR THE GOALS
GEO-BON													
GEOGLAM													
GFOI													
GOS4M													
AQUAWATCH													
BLUE-PLANET													
DIAS													
EO4EA													
EO4HEALTH													
EO4SDG													
GDIS													
GEO-DARMA													
GEO-GNOME													
GEO-LDN													
GEO-VENER													
GEO-WETLANDS													
GEO-CRADLE													
GEOGLOWS													
GOS4POPS													
GSNL													
GUOI													
GWIS													
HUMAN-PLANET													

## GEO Work Programme Linkages to the Paris Agreement



	Adaptation	Loss and Damage	Capacity Development / Technology Transfer	National Reporting / Global Stocktake	Mitigation
<b>FLAGSHIPS</b>					
GEO-BON					
GEOGLAM					
GFOI					
GOS4M					
<b>INITIATIVES</b>					
AQUAWATCH					
BLUE-PLANET					
DIAS					
EO4EA					
EO4HEALTH					
EO4SDG					
GDIS					
GEO-DARMA					
GEO-GNOME					
GEO-LDN					
GEO VENER					
GEO-WETLANDS					
GEO-CRADLE					
GEOGLOWS					
GOS4POPS					
GSNL					
GUOI					
GWIS					
HUMAN-PLANET					
<b>COMMUNITY ACTIVITIES (SELECTED)</b>					
ARCTIC-GEOSS					
C3S					
CAMS					
CLIMDATA-ACCESS					
SCO					

## GEO Work Programme Linkages to the Sendai Framework



	A	B	C	D	E	F	G	
<b>FLAGSHIPS</b>								
GEO-BON								
GEOGLAM								
GFOI								
GOS4M								
<b>INITIATIVES</b>								
AQUAWATCH								
BLUE-PLANET								
DIAS								Target A: Substantially reduce global disaster mortality
EO4EA								Target B: Substantially reduce the number of affected people globally
EO4HEALTH								Target C: Reduce direct disaster economic loss
EO4SDG								Target D: Substantially reduce disaster damage to critical infrastructure and disruption of basic services
GDIS								
GEO-DARMA								
GEO-GNOME								Target E: Substantially increase the number of countries with national and local disaster risk reduction Strategies
GEO-LDN								
GEO-VENER								Target F: Substantially enhance international cooperation to developing countries
GEO-WETLANDS								
GEO-CRADLE								Target G: increase the availability of and access to multi-hazard early warning systems and disaster risk information and assessments
GEOGLOWS								
GOS4POPS								
GSNL								
GUOI								
GWIS								
HUMAN-PLANET								
<b>COMMUNITY ACTIVITIES (SELECTED)</b>								
EO4DRM								
EO4MINERALS								
EO4SENDAI								
GFRM								
GLOFAS								

# GEO Flagships

## GEO Biodiversity Observation Network ([GEO-BON](#))

### Overview

Since its inception in 2008, GEO-BON has developed a global social network and community of practice for enhanced biodiversity observations in service for improved decision-making. This network includes many world leaders in biodiversity observation as well as major partner organizations in that field. In its third and present phase, GEO-BON has reorganized its structure in order to better sustain its targeted and integrated effort to further refine and apply a framework for biodiversity observations through targeted and continued development of Essential Biodiversity Variables (EBVs) and application of the EBV concept at multiple scales in partnership with national, regional and global partners. This approach will advance the theory and practice of efficient, user driven biodiversity observation design, leading to improved biodiversity observation data in support of decision-making.

GEO-BON is committed to become, by 2025, a resource to governments, industry, researchers, and the public around the world, providing sustained and interoperable data, information, and knowledge on ecosystem services that derive from diverse communities of living organisms. GEO-BON will be actively used by governments and their advisors, by the Convention on Biological Diversity (CBD), the Science Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Ramsar Convention. The data, information and knowledge will also be used to assess the progress in achieving the CBD's Aichi Targets by 2020 and the UN's Sustainable Development Goals (SDGs). The observations derived from this network contribute to the development of effective conservation actions, mitigation, and adaptation strategies that help ensure the sustainable use of resources. The scientific approach to observation contributes to the implementation of sustainable use management practices and policies regarding the world's biodiversity and the ecosystem services it provides.

### Planned Activities

The activities of GEO-BON can be summarized according to the two core areas of focus of the network.

The first is the development of the EBVs, which are a minimum set of variables that capture the major dimensions of biodiversity change. EBVs provide guidance to observation systems at all scales by helping to prioritize observations and identify standard methods for data collection and processing. The EBVs are being developed within the different GEO-BON Working Groups, and they are organized around the different levels of organization of biodiversity: Genetic Composition, Species Populations, Species Traits, Community Composition, Ecosystem Structure and Ecosystem Functions. Similarly, the working group dedicated to Ecosystem Services is working towards the development of the Essential Ecosystem Services Variables.

The second area of focus is the reinforcement of existing or the development of new Biodiversity Observation Networks, or BONs. The role of the BONs is to develop, apply and test the concepts, methods and tools to implement and enhance operational networks; collecting observations and providing data to the community and users. The BONs can be organized at the national or

regional level, or be thematic in scope, for example, Marine BON (MBON). The BONs produce, test and apply tools and applications, as well as produce EBV-relevant data that can be upscaled and downscaled to underpin more informed sustainable development and conservation decisions. Activities and outputs of BONs may also include the identification of research and development gaps and needs, the establishment of Technical Readiness Levels to help track progress towards the development of EBVs (particularly within thematic/biome scales), research papers, books, white papers, web apps, data collection and analysis (e.g. modelling) tools. To support the work of the existing BONs and the development of new networks, the GEO-BON secretariat is developing, in partnership with the Alexander von Humboldt Institute in Colombia, an online platform for capacity building and knowledge exchange called “BON-in-a-Box”.

Going hand in hand with supporting the development of the EBVs and the BONs, GEO-BON is dedicated to improving the delivery of information to its various users, and has developed several online platforms to serve this purpose. The GEO-BON secretariat has developed, in partnership with the University of Marburg, an EBV Data Portal to facilitate the visualization, sharing and analysis of EBV products and potentially, EBV-derived indicators.

Finally, a common trait of most activities of the GEO-BON working groups, BONs, and task forces is the policy relevance of their outputs. In this regard, GEO-BON will continue to work on both identifying and supporting the needs of its users, from the scientific community to policy bodies such as the IPBES and CBD.

### **Contributors**

**GEO Members:** Argentina, Australia, Belgium, Canada, China, Colombia, Denmark, European Commission, Finland, France, Germany, Japan, Netherlands, New Zealand, Portugal, South Africa, Sweden, Switzerland, United States.

**GEO Participating Organizations:** European Space Agency (ESA), Global Biodiversity Information Facility (GBIF).

**Other Contributors:** Association of Southeast Asian Nations (ASEAN) Centre for Biodiversity, Consortium for the Barcode of Life (iBOL), Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), International Union for the Conservation of Nature (IUCN).

### **Related GEO Work Programme Activities**

GFOI, EO<sub>4</sub>EA, EO<sub>4</sub>SDG, BLUE-PLANET, GEO-LDN, GEO-WETLANDS, GEO-ECO, AFRIGEO, AMERIGEO, AOGEO, EUROGEO.

### **Points of Contact**

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## GEO Global Agricultural Monitoring ([GEOGLAM](#))

### Overview

GEO Global Agricultural Monitoring (GEOGLAM) was initially launched by the Group of Twenty (G20) Agriculture Ministers in Paris, June 2011 during the French G20 Presidency and forms part of the G20 Action Plan on Food Price Volatility. The purpose of GEOGLAM is to increase market transparency and improve food security by producing and disseminating relevant, timely, and actionable information on agricultural conditions and outlooks of production at national, regional, and global scales. It achieves this by strengthening the international community's capacity to utilize coordinated, comprehensive, and sustained Earth observations.

GEOGLAM participants include representatives from most G20 nations, many additional countries including from food insecure regions, and several intergovernmental and non-governmental organizations. The GEOGLAM Crop Monitor for the Agricultural Monitoring Information System (Crop Monitor for AMIS) encompasses over 80% of global production, consumption and trade volumes of targeted crops (maize, rice, wheat and soybean) and has over 40 contributing institutions feeding in information on a monthly basis. The Crop Monitor for Early Warning monitors crops that are important in countries and regions that are susceptible to food insecurity. Over a dozen international food security organizations feed into the monthly monitors and also benefit from the published results. In 2019 at the request of the United Nations Office for Coordination of Humanitarian Affairs, GEOGLAM developed the capability to produce mid-month reports in areas of emerging concern.

Both Crop Monitor publications are internationally recognized as reliable sources of information on global crop conditions and are used by a range of ministries and multi-national and international organizations to inform decisions. In recent years, the early warning focus has moved to engaging national organizations. These national monitors are run by mandated agencies within nations to support policy and program decision makers and have resulted in rapid deployment of proactive policies and programs to mitigate disasters and mobilization of resources in response to emerging food emergencies.

Currently, capacity development is spread across several GEOGLAM activities. A Thematic Coordination Team on Capacity Development (CapDev Team) will be developed to better coordinate and harmonize activities across the contributing initiatives. The CapDev Team will have the role of promoting a community research and operationalization agenda, developing a strategic vision for capacity development for GEOGLAM, documenting and promoting good practices around capacity development, coordinating the transfer of research-to-operations, and working with scientific leads.

### Planned Activities

#### *GEOGLAM Core (Implemented)*

[Crop Monitor for AMIS](#): Monthly updates about crop supply in major producer countries, including the G20 countries plus eight other large producers. These updates, which summarize the conditions of four major commodity crops (wheat, soybean, maize, and rice), have been included in the monthly AMIS Market Monitor publication since 2013.

[Crop Monitor for Early Warning](#): AMIS crop monitor methods were adapted and applied to countries at risk of food production shortfalls. These countries, which represent nearly the inverse

of the large market producers, are monitored and reported on in the Crop Monitor for Early Warning reports

[Joint Experiment for Crop Assessment and Monitoring \(JECAM\)](#): JECAM is a global research network created by the GEO Agriculture Monitoring Community of Practice with the intent to enhance international collaboration around agricultural monitoring towards the development of a “systems of systems” to address issues associated with food security and a sustainable and profitable agricultural sector worldwide.

### ***GEOGLAM Regional***

GEOGLAM Latino America: Regional coordination of GEOGLAM activities in Latin America

AsiaRice: Regional coordination of GEOGLAM rice monitoring activities in Asia

AFRIGLAM: Regional coordination of GEOGLAM activities in Southern Africa

### ***GEOGLAM Partner Contributed***

China CropWatch: Assesses national and global crop production and related information using remote sensing and ground-based indicators. Each quarter, the group’s findings are published in the CropWatch bulletin, which is issued in both English and Chinese. CropWatch contributes to the AMIS and early warning crop monitors for GEOGLAM, and CropWatch Cloud platform provides a suite of cloud-based tools for customized crop condition analysis.

[Sen2Agri](#): The Sen2-Agri system is an operational standalone processing system generating agricultural products from Sentinel-2 (A&B) and Landsat 8 time series along the growing season.

[Harvest](#): NASA Harvest is a multidisciplinary consortium commissioned by the United States National Aeronautics and Space Administration (NASA) and led by the University of Maryland to enhance the use of satellite data in decision making related to food security and agriculture domestically and globally

[Monitoring Agricultural Resources \(MARS\) Crop Yield Forecasting System](#): Monitors European crops and forecasted crop yields and production since 1993. The main findings of the crop monitoring activities are collected in monthly MARS Bulletins published on the European Commission Joint Research Centre (JRC) website. Much of the MARS Crop Yield Forecasting System data and software is made freely available for access and reuse

[Anomaly Hotspots of Agricultural Production](#): An online decision support system for early warning about hotspots of agricultural production anomaly (crop and rangeland), developed by the JRC for food security crises prevention and response planning anticipation. As part of its agricultural monitoring for food security activities, the JRC, in collaboration with external partners, has developed several open access desktop applications available for download.

Essential Agricultural Variables-CEOS Working Group: Leading the development of Essential Agricultural Variables (EAVs) for GEOGLAM and Liaison with the Committee on Earth Observation Satellites (CEOS) to address data requirements, including Analysis-Ready Data (ARD).

Capacity Development Working Group: Development of GEOGLAM capacity development strategy and coordination of capacity development activities.

GeoRice-Regional: Demonstration of national-scale rice monitoring in Vietnam, Laos, Cambodia, Thailand and Myanmar using the 12 days revisit of Sentinel-1 satellite data. The project also addresses the research priority within Asia-RICE, a component of the GEOGLAM initiative.

**Sen4Stat:** The SEN4Stat project facilitates the uptake of Earth observation information in National Statistical Offices supporting the monitoring and reporting agricultural statistics. Special attention is given to develop and demonstrate Earth observation products and best practices for agriculture monitoring in support of the Sustainable Development Goal 2 (Zero Hunger) and research and development requirements of the GEOGLAM national monitoring systems.

**E-shape GEOGLAM Project:** Building on existing operational tools and modifying them to meet the specific user needs of the GEOGLAM community. Integrating the above-mentioned datasets with the Copernicus Data and Information Access Services (DIAS) storage and processing power. This will allow the monitoring of several essential agriculture variables (e.g. Leaf Area Index) and the development of agricultural metrics that are more quantitative and look beyond the current growing season as requested by the GEOGLAM community represented by the GEOGLAM secretariat.

### **Contributors**

***GEO Members:*** Argentina, Australia, Bangladesh, Belgium, Brazil, Canada, Chile, China, Egypt, European Commission, France, Germany, India, Indonesia, Italy, Japan, Kenya, Republic of Korea, Malaysia, Mali, Mexico, Morocco, United States, Uruguay, Vietnam, Zimbabwe.

***GEO Participating Organizations:*** European Space Agency (ESA), International Institute for Applied Systems Analysis (IIASA), International Institute for Geo-Information Science and Earth Observation (ITC).

***Other Contributors:*** Lao People's Democratic Republic, Association of Southeast Asian Nations (ASEAN), Bill and Melinda Gates Foundation.

### **Related GEO Work Programme Activities**

GFOI, EO4SDG, GEO-LDN, AFRICULTURES, GEO-EV, AGRI-DROUGHT-MONITORING.

### **Point of Contact**

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## **Global Forest Observations Initiative ([GFOI](#))**

### **Overview**

While the land sector is a significant source of global greenhouse gas (GHG) emissions, it also offers significant potential for reducing emissions and removing GHGs from the atmosphere. Many developing countries are working to establish self-sustained National Forest Monitoring Systems (NFMS) and associated emissions Measurement, Reporting and Verification (MRV) procedures to inform national policy development, improve international reporting, and transparently track progress towards their GHG emissions reduction commitments. The need for NFMSs is emphasized by the Paris Climate Change Agreement and associated decisions on guidance, transparency and MRV taken during the recent United Nations Framework Convention on Climate Change's (UNFCCC) 24<sup>th</sup> Conference of the Parties (COP 24) in Katowice, Poland.

The Global Forest Observations Initiative (GFOI) was established under the Group on Earth Observations (GEO) in 2011 as a forum to coordinate forest monitoring activities through the use of earth observation data. In 2015, GFOI was endorsed as one of the first GEO Flagships.

In 2016, GFOI partners commissioned a holistic external review of the Initiative. The review found that while GFOI had succeeded in achieving many of its initial goals, it needed to evolve to meet the changing global context, including supporting the implementation of the Paris Agreement, the United Nations Sustainable Development Goals, and the rapidly evolving information needs of developing countries. Subsequently, a second phase of GFOI was developed which reprioritizes the Initiative, expands its memberships and seeks to improve collaboration for the benefit of forested developing countries. GFOI Phase II is now in the early stages of implementation and is scheduled to run for the foreseeable future, including the period the GEO Work Programme 2020-2022 period.

GFOI constitutes an informal partnership of countries and institutions who collaboratively and consistently assist developing countries to operationalize or improve their NFMS. Together, GFOI provides a larger and more detailed package of support than any one partner could provide alone. GFOI's collaborative efforts seek to help developing countries to address multiple different needs, including establishing MRV procedures for REDD+, monitoring progress towards Nationally Determined Contributions (NDCs), the Global Stock Take process under the UNFCCC, confidence in performance based emissions reduction finances, supporting the Global Forest Resource Assessment (FRA), and informing national policy development and GHG inventories.

### **Planned Activities**

GFOI is the product of the collaborative actions of its partners. Under its second phase, GFOI will facilitate the following key activities, which seek to help developing countries to accelerate progress in their NFMS:

- Collaborative assessment of countries' needs, gaps and priorities;
- Coordinated work planning to address priority country needs for improving or operationalizing NFMS and support their application to relevant reporting frameworks, including UNFCCC;
- Facilitation of collaborative implementation of forest monitoring support;
- Complementary or consistent capacity building assistance delivered directly to developing countries;

- Development and dissemination of user-friendly guidance for REDD+ that is Intergovernmental Panel on Climate Change (IPCC) and UNFCCC compliant, and consistent with other international reporting requirements;
- Coordination of, and influence on, the availability, accessibility and capacity to use remote sensing and other key datasets and tools;
- Coordination of research and development activities to fill knowledge gaps, overcome obstacles to progress, align the work of the research community with country needs, and enable continuous improvements; and
- Other joint resources and mutually beneficial collaboration that provide targeted support and deliver tangible benefits to developing countries.

GFOI is guided by a Leads Group, currently comprising of the Governments of Australia, Germany, Norway, the United Kingdom and the United States as well as the Committee on Earth Observation Satellites (CEOS), the European Space Agency (ESA), the Food and Agriculture Organization of the United Nations (FAO), and the World Bank. It is implemented in close collaboration with developing countries and many other partners including the Intergovernmental Panel on Climate Change (IPCC) and UNFCCC Secretariats, non-governmental organizations, academia, the private sector, individual experts and others.

GFOI partners coordinate the delivery of their forest monitoring assistance across four interlinked components (i) capacity building, (ii) methods and guidance documentation (MGD), (iii) data and tool coordination and; (iv) research and development coordination. Furthermore, through the work of CEOS as a leading partner of the GFOI's Data Component, GFOI also works to provide assured availability of annual coverage of all the world's forested regions with remote sensing data.

### **Contributors**

***GEO Members:*** Australia, Germany, Norway, Spain, United Kingdom, United States.

***GEO Participating Organizations:*** Committee on Earth Observation Satellites (CEOS), European Space Agency (ESA), United National Food and Agriculture Organization (FAO), The World Bank.

### **Related GEO Work Programme Activities**

GEOGLAM.

### **Point of Contact**

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## Global Observation System for Mercury ([GOS4M](#))

### Overview

GOS4M aims to support all interested Parties in the implementation of the Minamata Convention. The core objective of GOS4M is to support nations, the Minamata Convention Secretariat, UN Environment and other interested Parties and stakeholders to contribute to fulfil the decisions and requests of the Minamata Convention Conference of the Parties related to, but not limited by, capacity-building and technical assistance to developing country Parties (Article 15), research, development and monitoring (Article 19) and effectiveness evaluation of the Convention (Article 22).

GOS4M promotes actions intended to provide comparable global monitoring mercury data and validated modelling frameworks. To achieve this objective, GOS4M promotes the establishment of a federation of existing regional and global monitoring networks that would enable provision of global comparable monitoring data for the purpose of the Minamata Convention on Mercury. The availability of comparable mercury monitoring data would support the validation of numerical and statistical models used to assess the fate of mercury from local to global scales with changing emission regimes and climate, and source-receptor relationships. GOS4M also supports nations and all interested Parties in developing their own national or/and regional monitoring programmes by providing technical assistance and promoting capacity building initiatives for setting up new monitoring sites in areas where no mercury monitoring facilities and expertise are available.

### Planned Activities

- Increase the availability and quality of Earth observation data acquired by in-situ, off-shore and satellite sensors that may contribute to improving the capability to track mercury releases, establish source-receptor relationships, assess their fate and impact with changing emission regimes and climate;
- Promote the establishment of a federation of existing mercury monitoring networks and programs to facilitate the access to available data and knowledge on mercury levels in different environmental matrixes by the scientific community, policy makers and stakeholders;
- Promote the harmonization of Standard Operating Procedures (SOPs) used by existing monitoring networks measuring the concentrations of mercury species in ambient air and precipitation samples as well as in biota;
- Harmonize the metadata description, archiving and data sharing methodologies used by existing mercury monitoring networks and programs;
- Contribute to improving the global coverage of currently available mercury monitoring data by promoting the establishment of new monitoring sites in areas that do not have monitoring capabilities and facilities;
- Promote intercomparison and validation of existing modelling frameworks and tools used to assess the fate of mercury within and between atmospheric and terrestrial compartments;
- Contribute to the development of downstream services designed to perform cost-benefit analysis of different policy measures aiming to reduce the level of mercury in environmental media and human exposure; and

- Develop advanced web services aiming to facilitate the access and use of state-of-the-art scientific information and data by policy makers and stakeholders.

### **Contributors**

***GEO Members:*** Argentina, Australia, China, Cote d'Ivoire, Czech Republic, Denmark, European Commission, Finland, France, Germany, Greece, Italy, Russian Federation, Slovenia, South Africa, Sweden, Ukraine, United Kingdom, United States.

### **Related GEO Work Programme Activities**

GOS4POPS.

### **Point of Contact**

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# GEO Initiatives

## AquaWatch ([AQUAWATCH](#))

### Overview

Water quality is essential for human, ecosystem and economic health. Degradation of water quality can result in human exposure to disease and harmful chemicals, reduction in productivity and diversity of ecosystems, and damage to aquaculture, agriculture and other water-related industries. Water quality monitoring is a large, multi-faceted field that is directly related to several GEO Societal Benefit Areas as well as a variety of policy and Sustainable Development Goals. While there are many available data products, offered by data service providers funded through a variety of regional, national, and international sources, minimum quality standards and best practices are often lacking.

The overall goal of AquaWatch is to develop and build the global capacity and utility of Earth Observation-derived water quality data, products and information to support effective monitoring, management and decision making. The objectives to achieve this goal are:

- Facilitate effective partnerships between the producers, providers and users of water quality data, products and information;
- Improve the quality, analysis, and integration of in situ and remote sensing water quality data;
- Develop and deliver best practices, minimum quality standards, and independent tools for users to assess fit-for-purpose water quality products and information services;
- Support technology transfer and access to water quality data products and information; and
- Advocate for increased education and capacity for the use of water quality information for decision making.

### Planned Activities

Activities to achieve the Initiative's objectives will be conducted by five working groups of experts that will focus on transforming water quality data to information and decision-support tools based on user needs.

**Working Group 1 – Outreach and User Engagement** will be responsible for facilitating effective partnerships between the producers, providers and users of water quality data, products and information. Activities of this working group will include the generation of a communication strategy for AquaWatch and information from other GEO water quality-related activities as well as the development of the AquaWatch website ([www.geoaquawatch.org](http://www.geoaquawatch.org)) into a knowledge hub for water-quality related activities (within and outside of GEO). This group will also work to identify current and potential users and create partnerships with providers and users.

**Working Group 2 – Observations and Data** will be responsible for improving analysis and integration of in situ and remote sensing water quality data. Activities of this group will include identifying and linking key data sets from remote sensing and in situ data sources and identifying data and observation gaps.

**Working Group 3 – Products and Information** will be responsible for developing and delivering fit-for-purpose water quality products and information services. The group will be tasked with generating and evaluating products derived from complementary remote sensing and in situ data sets, as well as supporting modelling and data assimilation activities for regional and global water quality nowcasts, forecasts and predictions.

**Working Group 4 – Distribution, Access, and Visualization** will be responsible for supporting technology transfer and access to water quality data products and information. The group will be tasked with distributing scientific, technical and other outputs to applicable end users and facilitating access to making products and derived information.

**Working Group 5 – Education and Capacity Building** will be responsible for advocating increased capacity and use of water quality information for decision making. The group will be tasked with generating educational content for policy makers, decision makers, and the environmental managers. This group will also support, identify and lead capacity building efforts in developed and developing nations to expand the effective and timely utilization of Earth observations for societal benefits.

AquaWatch is working towards building a single network that integrates existing water quality monitoring efforts for the benefit of the global community. This effort is termed the Global Water Quality Information Service (WQIS). This multifaceted project requires the concerted effort of all five AquaWatch working groups and their collective efforts contribute to the components required for the construction of the WQIS, as well as other activities aligned with the AquaWatch objectives.

### **Contributors**

**GEO Members:** Australia, Bangladesh, Belgium, Brazil, Canada, China, Estonia, France, Germany, Ghana, India, Japan, Netherlands, Nigeria, South Africa, Switzerland, United Kingdom, United States.

**GEO Participating Organizations:** United Nations Educational, Scientific and Cultural Organization (UNESCO).

**Other Contributors:** Singapore.

### **Related GEO Work Programme Activities**

EO4HEALTH, BLUE-PLANET, GEOGLOWS.

### **Point of Contact**

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## Data Access for Risk Management ([GEO-DARMA](#))

### Overview

Increased severity of weather events and rapid urbanization have led to growing economic and human losses from disasters, which in turn have led international organizations to focus much more on improved disaster risk reduction policies and programmes. As part of this effort, space agencies are fostering the use of Earth observation data to support disaster risk reduction and raising the awareness of policy and decision-makers and major stakeholders of the benefits of using satellite Earth observations in all phases of disaster risk management.

GEO-DARMA aims to support operational risk reduction activities through the implementation of end-user priorities in line with the Sendai Framework for Disaster Risk Reduction, on a trial basis in regions of the developing world. The main goal is to address critical issues related to disaster risk reduction affecting most of the countries in a region (e.g. South-East Asia or South America) through a series of projects (first demonstrators) that rely on the use of multiple sources of observational data (including space-based, in-situ, socio-economic, and model outputs). These data are either open and freely accessible, or accessible free of charge under license from the relevant space agency. Each project will involve data providers, data & information practitioners, regional institutions, governmental agencies, local decision makers, and scientists. The main information products from each project will be defined and generated with the objective of improving the quality and accuracy of information made available to national and local political and socio-economic decision-makers to implement disaster risk reduction and resilience measures, during all disaster risk management phases, whenever those products and services require satellite Earth observations combined with other sources of data (in-situ ground observations, socio-economic, model outputs).

The ultimate goal is to establish an inclusive, comprehensive process to address local disaster risk reduction requirements by using Earth observation technologies efficiently. The long-term expected outcomes of GEO-DARMA are to foster the use of Earth observation data and Earth observations-based risk information by end users and to increase awareness within donor agencies of the promise of Earth observations solutions.

### Planned Activities

GEO-DARMA will bring together relevant stakeholders from governments, intergovernmental organizations, the UN system and civil society. For its success, GEO-DARMA requires strong involvement of the end user community with identified needs and vetted for local application by relevant regional institutions. In order to address this, user groups are requested to participate actively in the formulation of GEO-DARMA project proposals, and outputs are considered from a decision-making point of view.

As a first step, GEO-DARMA seeks independent identification of disaster risk management priorities at regional level by authoritative Regional Institutions, in line with the priorities from the “Sendai Framework for Disaster Risk Reduction 2015-2030. These priorities could include, for example, the most prevalent hazards and most severe impact or hurdles in implementing effective disaster risk reduction and resilience measures in the region. There is no limitation on the types of hazards and issues that may be addressed in GEO-DARMA. This process results in the production of regional assessments. The first two regional assessments were completed in Asia and Africa in 2018. The final regional assessment was conducted in Latin America and the Caribbean in 2019 and is expected to be approved in late 2019.

In order to coordinate their actions, the partners identify and assess the critical needs of the participating disaster management communities and establish priorities. The identification of user needs takes place at a local level, but establishing priorities requires the active involvement of regional entities and organizations with a stake in disaster risk reduction and/or in Earth observations, as encouraged by the Sendai Framework. Given the limited resources available, GEO-DARMA began by selecting a few priority themes, building on strong elements from existing initiatives and choosing those elements most likely to be scalable at a regional and global level. Once the usefulness of the implemented prototypes has been demonstrated in a few countries, the extension to neighbouring areas could be envisaged whenever applicable. This process is expected to take several years.

GEO-DARMA uses an incremental approach with three main stages. During the “Concept” phase the projects and user needs to be addressed are identified. Then, in the “Prototyping” phase, specific risk information products and services and capacity building elements are developed with the active cooperation of partners. A limited number of early-adopter countries from different regions may serve as National Demonstrators. These demonstration initiatives will serve to develop and test approaches and methodologies and may involve some or all of the partners and attract additional regional and local partners.

The Prototyping phase will be limited in time. Before the end of the Prototyping phase, each project will be assessed to determine whether the project should stop or transition to the “Operational” phase. Transition to operations is dependent on both an explicit and strong request from the user community and availability of sustained funding.

At this time, only one GEO-DARMA project has been approved for implementation: SERVIR Mekong GEO-DARMA. This project is focussed on improving access to flood-related information for decision making in Myanmar.

### **Contributors**

***GEO Members:*** Canada, France, Italy, Netherlands, United States.

***GEO Participating Organizations:*** Asian Disaster Preparedness Center (ADPC), European Space Agency (ESA), Regional Centre for Mapping of Resources for Development (RCMRD), The World Bank, United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), United Nations Economic and Social Commission for Western Asia (UNESCWA).

***Other Contributors:*** Andean Commission, Caribbean Disaster and Emergency Management Agency, Centro de coordinación para la prevención de los desastres (CEPREDANAC), Intergovernmental Authority on Development, Myanmar, Singapore.

### **Related GEO Work Programme Activities**

AMERIGEO.

### **Point of Contact**

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## Data Integration and Analysis System ([DIAS](#))

### Overview

The Data Integration and Analysis System (DIAS) encompasses the previous GEO Community Activities: DIAS, Water Cycle Integrator (WCI), Asian Water Cycle Initiative (AWCI), and African Water Cycle Coordination Initiative (AfWCCI) and will coordinate their activities in line with the GEOSS Water Strategy recommendations. At the same time, DIAS will continue to use the Integrated Global Water Cycle Observations (IGWCO) Community of Practice for coordination with other Water SBA activities.

DIAS is an advanced, GEOSS-compliant e-infrastructure that addresses the challenges of a large increase in the volume of Earth observation data by developing a core system for data integration and analysis. In the arena of water, DIAS has been developing the Water Cycle Integrator (WCI) function, which enables a holistic approach towards solutions to water-related issues by (i) harmonization of data collection and management and improvement of data interoperability, and (ii) providing tools for integrating observations, modeling, research, analyses, and management systems across Societal Benefit Areas. The WCI efforts have incorporated experiences from the Asian Water Cycle Initiative (AWCI) and responded to the community requirements in the data and science integration field. The AWCI community has exploited the DIAS and WCI capabilities and demonstrated extensively their potential. The WCI function has also been recognized by the African Water Cycle Coordination Initiative (AfWCCI) community as a powerful tool for implementing Integrated Water Resources Management in transboundary basins and plans have been outlined for pilot projects.

In addition, DIAS is committed to contributing to adaptation policies at various time scales for climate change and weather events. For long-term climate change of several decades, DIAS contributes to sustainable policy decision (for example, disaster prevention and agriculture) at a local government level by downscaling the global climate change model and predicting local meteorological phenomena (rainfall, temperature, sunshine). In addition, phenomena (such as drought, infectious disease, etc.) that are correlated with the global climate change cycle of a medium term of several months to several years will be predicted by DIAS. This can provide necessary information for local governments and institutions (such as for stockpiling of water resources, medicines etc.). Furthermore, for extreme phenomena such as torrential rain after several hours, DIAS is useful for supporting evacuation planning by performing flood and inundation prediction in real time.

### Planned Activities

The goal of DIAS is to enable effective and efficient exploitation of Earth observation for truly informed decisions in water resources management and disaster risk reduction. This requires a variety of activities:

- Continue to improve data management covering the full data life cycle, while taking account of “big data” characteristics and, in particular, expand water-cycle relevant data acquisition and increase its availability and use for research and operations;
- Advance development of the WCI component of DIAS with new tools and functions for interdisciplinary and transdisciplinary collaboration, reflecting on user community requirements and opportunities arising from new earth observation capabilities and technologies;

- Improve understanding of water-related disaster risks and resilience and identify changes in these risks and resilience through research activities exploiting Earth observations and novel capabilities of WCI;
- Provide improved decision and policy-making support including flood early warning systems, drought monitoring and warning systems, and climate change assessment and adaptation planning tools, and promote and facilitate implementation of these systems in operational use;
- Human resource capacity building for water issues using inter- and transdisciplinary approach of WCI;
- Foster regional collaboration and enhance user engagement through AWCI and AfWCCI frameworks and expand collaboration with other regional and global frameworks and donor organizations;
- Collect and organize data on traffic, economic activities, industrial location, land use, etc. for Japan or other countries with the goal of making it possible to quantitatively estimate the impacts the estimated hazard (such as flood) will have on the local society, economy and life of the residents;
- Downscale the long-term climate change model to the regional level of Japan and/or other countries enabling predictions over several decades at a local scale, thereby contributing to disaster prevention and mitigation measures at a local government level;
- Use a hydraulic model based on topographic and infrastructure information of large cities, and use real-time data input functions such as rainfall radar on DIAS and high-speed arithmetic processing to predict the inundation risk of large cities several hours ahead; and
- Using correlation models of medium-period meteorological cycles (La Nina, etc.) and ecosystems (mosquito occurrence, etc.) develop a model that predicts infectious disease (malaria, dengue fever, etc.) outbreak from global meteorological forecasts.

## Contributors

*GEO Members:* Brazil, Indonesia, Iran, Japan, Philippines.

*GEO Participating Organizations:* AGRHYMET Regional Centre, Asia-Pacific Network for Global Change Research (APN), United Nations Educational, Scientific and Cultural Organization (UNESCO), World Meteorological Organization (WMO).

## Related GEO Work Programme Activities

GEOGLOWS, AOGEO.

## Points of Contact

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## Earth Observations for Ecosystem Accounting ([EO4EA](#))

### Overview

The purpose of EO4EA is to further the development and use of Earth observations for natural capital accounting, consistent with the set of standards and guidelines put forth by the UN System of Environmental-Economic Accounting (SEEA) and specifically the Ecosystem Accounts.

Ecosystem Accounts rely on spatial data in order to systematically assess the health and status of ecosystems and the benefits of ecosystem flows to human well-being and the economy. Through partnership, research, and practical application, EO4EA will advance the application of the science of Earth observation to the practice of ecosystem accounting. EO4EA envisions a future where Earth observation systems enable environmental transparency and the value of ecosystems is incorporated into conventional economic accounts and decision making, leading to an important shift in the valuation of natural resources and the use of that information for policy and programmatic decision making.

There is a significant global demand for ecosystem accounting, with the UN Statistical Commission identifying over 70 countries that have indicated their desire to develop these accounts. However, data for many of these countries is unavailable or is not available in time series that allow analyses of trends as well as status. Our mission is to document, pioneer, develop, and test the methods and tools that will allow Earth observation technology to more effectively enable the widespread adoption of ecosystem accounting. EO4EA advances GEO principles by facilitating the exchange of experiences and joint product development, creating a strong connection to users via the SEEA, breaking down barriers to data and method integration, aligning with other international efforts in earth observation but particularly within the GEO community, and explicitly increasing the use of Earth observations for decision making. The unique advantages of GEO can help countries standardize and repeat their assessment of natural capital, and their progress towards the Sustainable Development Goals.

### Planned Activities

Four work streams have been identified:

- **Case Studies and Synthesis:** Compilation of the use of Earth observation data in current ecosystem accounting efforts and preparation of an inventory of the extent and types of Earth observations being used.
- **Ecosystem Extent and Condition:** Assessment and further development of how Earth observations can contribute to monitoring and assessment of ecosystems extent and condition.
- **Ecosystem Services and their Contribution to the Economy:** Assessment and further development of how Earth observations can contribute to the identification, measurement and monitoring of ecosystem services.
- **Implementation and Capacity Building:** Development of pilots to test improved data and methods of using Earth observations for ecosystem accounting and provision of appropriate training with findings from all work streams.

### Contributors

**GEO Members:** Canada, Mexico, Netherlands, United States.

***GEO Participating Organizations:*** Conservation International, European Environment Agency (EEA), European Space Agency (ESA), United Nations Food and Agriculture Organization (FAO), The World Bank.

***Other Contributors:*** United Nations Statistics Division (UNSD).

### **Related GEO Work Programme Activities**

GEO-BON, EO<sub>4</sub>SDG, GEO-ECO, AFRIGEO, AMERIGEO, AOGEO, EUROGEO.

### **Points of Contact**

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## Earth Observations for Health ([EO4HEALTH](#))

### Overview

Earth Observations for Health (EO4Health) serves as a global network of governments, organizations, and observers who seek to use Earth observations data to improve health decision-making at the international, regional, country, and district levels. The overall goal is to support the systematic collection, analysis, and application of relevant information about areas of impending risk that inform the development of strategic responses to anticipate risks and opportunities and their evolution and communicate options to critical actors for the purposes of decision-making and response.

To achieve this goal, EO4Health will:

- Engage with end-user communities to better understand and identify their needs and requirements;
- Develop and implement activities that address the needs and requirements of end-user communities;
- Improve the use of, and clarify future needs for, Earth observations for health;
- Examine effectiveness and provide feedback on future Earth observations actions for health; and
- Participate with other individuals, GEO communities of practice, and institutions to produce an outcome greater than that achievable otherwise.

As a GEO Initiative, EO4Health helps foster the development of integrated information systems (IISs) that improve the capacity to predict, respond to, and reduce environment-related health risks. These systems combine Earth observations monitoring and prediction; social, demographic, and health information; interdisciplinary research; application and assessment; communication; education; and training in order to enhance preparedness and resilience. Three initial focus areas are weather and climate extremes (e.g. heat), water-related illness (e.g. cholera), and vector-borne disease (e.g. dengue, malaria).

### Planned Activities

EO4Health has supported the GEO Health Community of Practice (CoP) in the development and elaboration of the CoP Work Plan. Previous work within the GEO Health CoP has been focused on health early warning systems for air quality, heat, infectious disease, water-related illness, and ecosystem-related health impacts. Major foci included air quality, cholera, dengue, harmful algal blooms, leptospirosis, malaria, and meningitis. The GEO Health CoP will expand on this previous work and focus on developing IISs that sustain engagement between scientists and decision makers to provide useful Earth observations data that protect health and build resilience. The GEO Health CoP also seeks to build partnerships across public and private sectors, and to stimulate innovative and open approaches to gathering and providing useful risk assessment, monitoring, prediction, and forecasting information.

The CoP Work Plan is aligned with the EO4Health objectives and includes working groups on seven specific topics:

***Predict and Prevent Heat-related Health Risks across Time Scales.*** Build a globally relevant capacity to use Earth observations to understand, predict, and reduce health risks from heat across time scales. Initial efforts will centre on building a global mapping capability that conveys

heat risk and identifies the most critical used or needed heat data, forecast or other Earth observation information along with land cover and social vulnerability data.

***Predict and Prevent Environmentally-sensitive Infectious Diseases.*** Improve prediction and prevention systems for environmentally-sensitive infectious diseases to help reduce risks for human health by application of Earth observations to decision-relevant risk monitoring, with particular focus on underserved communities.

***Air Quality, Wildfires, Respiratory Health.*** Identify components and a modelling framework that would enable development of space-time specific assessments, monitoring, and forecasts quantifying the levels of exposure of populations to wildfire-related pollutants and aeroallergens associated with those levels of risk for various population groups.

***Food Security and Safety.*** Strengthen Earth observation applications to address food- and water-borne diseases that undermine health and food safety and security. Develop an IIS for the monitoring and prediction of pathogen and toxin (*Vibrio* spp. and harmful algal blooms) risk in marine and coastal environments, coupled with critical Earth observation-derived coastal and inland water quality.

***Health Care Infrastructure.*** Develop a partnership with UN agencies and governmental agencies that share an interest in better identifying health care facilities at risk from environmental stressors and extreme weather events. Integrate Earth observation datasets in order to develop an informational resource that can assess the vulnerability of health care infrastructures to local environmental stressors. Develop methods to assess the adequacy of these infrastructures under regional extreme catastrophes.

***Cross-Cutting Issues: Regional Foci, Vulnerable Populations, Data/Access.*** Increase awareness of using Earth observations with other data to prevent and respond to health-related problems.

***Integrating Earth Observation-based Population and Data Disaggregation Techniques in One Health Tools and Projects.*** Identify authoritative reference data, missing information, and assessment of capacity of GEO to provide human and animal data and methods to answer needs of the health community.

## **Contributors**

***GEO Members:*** Australia, Canada, Costa Rica, Germany, Italy, South Africa, Switzerland, United Kingdom, United States.

***GEO Participating Organizations:*** World Health Organization (WHO), World Meteorological Organization (WMO).

## **Related GEO Work Programme Activities**

GEO-BON, GEOGLAM, GOS4M, AQUAWATCH, BLUE-PLANET, CAMS, AFRIGEO, AMERIGEO, AOGEO.

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## Earth Observations for the Sustainable Development Goals (EO4SDG)

### Overview

The 2030 Agenda for Sustainable Development calls for new data acquisition and integration approaches to improve the quality, coverage, and availability of data to support the implementation of the development agenda at all levels. This presents a unique opportunity for Earth observations and geospatial information to be integrated into national information systems and monitoring frameworks, as well as real-world applications that can reduce and mitigate environmental risk and disasters, creating more sustainable and resilient societies.

The Earth Observations for Sustainable Development Goals (EO4SDG) Initiative organizes and realizes the potential of Earth observations and geospatial information to advance the 2030 Agenda and enable societal benefits through achievement of the Sustainable Development Goals (SDGs). EO4SDG works with GEO Members, Participating Organizations and other GEO Initiatives and Flagships to integrate Earth observations in local, national and global SDG processes. Beyond broadening interest and awareness of Earth observation support to the SDGs, and increasing skills and capabilities in countries to use Earth observations for the SDGs and their broader benefits, the Initiative focuses on developing examples and use cases where countries have adopted and integrated Earth observations into SDG processes, especially in hopes of encouraging more countries and UN agencies involved in the SDG process to follow suit.

In addition, EO4SDG, in partnership with CEOS, engages in efforts that advance the provision, access, discoverability, and applicability of Earth observations and geospatial information for use with the SDGs. This element draws on GEO's efforts to characterize user needs, especially in the collection of information from SDG user organizations, to help refine approaches to enable greater use of Earth observations for the SDGs. EO4SDG also serves to "federate" all of GEO's Community Activities, Initiatives and Flagships that include an SDG element to increase SDG-related knowledge sharing across the GEO Work Programme. The Initiative provides technical and other guidance for projects developed under other GEO activities, serving a coordination role to GEO's overall service to the SDG.

The prime users of EO4SDG are National Statistical Offices, National Mapping Agencies, line ministries, international statistical agencies, UN custodian agencies, and other major groups and stakeholders. The Initiative promotes the emergence and scaling-up of joint efforts and collaboration between these users and the geospatial and Earth observation communities to demonstrate effective uses of Earth observation data in complementing traditional data systems such as census data, administrative data, household survey data, and vital statistics, to help achieve the SDG.

EO4SDG, in collaboration with thematic GEO Work Programme elements, works closely with custodian agencies responsible for specific Indicators relevant to their thematic expertise and mandate on SDG indicator method development, testing, refinement, adoption, and widespread, sustained use. These efforts have led to proposals within the UN system to elevate the readiness status of global methodologies related to fresh water, terrestrial ecosystems, and sustainable urbanization, with Earth observations integrated as notable inputs.

In addition, EO4SDG works with the United Nations (UN) Inter-Agency Expert Group on Sustainable Development Goals (IAEG-SDG) Working Group on Geospatial Information (WGGI), a working group responsible for reviewing the Global Indicator Framework through a "geographic

location lens” and identifying how geospatial information, including Earth observations, can contribute toward addressing the SDG.

Overall, EO4SDG enables countries and organizations to leverage Earth observations to support the implementation, planning, measuring, monitoring, reporting, and evaluation of the SDG and their normative societal benefits via country pilot projects for method development, distribution, and adoption; a portfolio of capacity development activities to support institutions and individuals in the development and implementation of methods; and other efforts to advance the provision, access, and applicability of Earth observations for use with the SDG (for example, GEO survey on data characteristics, usability, and user needs; developing a framework for moving from Earth observation observable themes to information products for specific indicators to decisions). EO4SDG plans to package reproducible Earth observation integrated methodologies and guidelines, in partnership with its end-users, encompassing all relevant Earth observation datasets, available tools and platforms, training material, as well as use cases and national experiences per SDG target and indicator supported by Earth observations. These comprehensive methodologies will be presented in an openly accessible way and be made available via the [EO4SDG website](#). These can also be linked to the GEO Knowledge Hub, and will be accompanied by capacity development efforts through functional tools and trainings.

### **Contributors**

**GEO Members:** Australia, Belgium, China, Colombia, Ecuador, Germany, Greece, Hungary, Japan, Mexico, Netherlands, Norway, South Africa, Sweden, Switzerland, United Arab Emirates, United Kingdom, United States.

**GEO Participating Organizations:** Belmont Forum, Committee on Earth Observation Satellites (CEOS), European Association of Remote Sensing Companies (EARSC), European Space Agency (ESA), Future Earth, Global Partnership for Sustainable Development Data (GPSDD), Institute of Electrical and Electronics Engineers (IEEE), Inter-Balkan Environment Centre (iBEC), International Science Council (ISC), International Institute for Applied Systems Analysis (IIASA), International Society for Photogrammetry and Remote Sensing (ISPRS), Partnership for Observation of the Global Ocean (POGO), United Nations Environment Programme (UN Environment), United Nations Institute for Training and Research (UNITAR), United Nations Office for Outer Space Affairs (UNOOSA), World Health Organization (WHO).

**Other Contributors:** Ecological Sequestration Trust, United Nations Committee of Experts on Global Geospatial Information Management (UN-GGIM).

### **Related GEO Work Programme Activities**

GEOGLAM, AQUAWATCH, BLUE-PLANET, GEO-CRADLE, GEO-LDN, GEO-WETLANDS, HUMAN-PLANET, AMERIGEO.

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## **GEO Capacity Building in the North Africa, Middle East, Balkans, and Black Sea Region ([GEO-CRADLE](#))**

### **Overview**

The GEO-CRADLE Initiative is intended to sustain, and extend geographically, the results achieved during the implementation of previous GEO-CRADLE Community Activity. It is informed by the lessons learned during that period, and by the outcomes of various exchanges between the project and key stakeholders.

The expected short-term outcomes of GEO-CRADLE are:

- Enhanced participation of the complete Earth observations ecosystem in capacity building, research / development / innovation collaboration and awareness raising, with focus on continuous engagement of users;
- Progressive increase of Earth observations maturity in the region through the assessment of gaps and challenges, the design and implementation of tailored pilot activities, and their subsequent operationalization;
- Improved dialogue between the Earth observations demand and supply sides by fostering co-design approaches (maintaining the GEO-CRADLE user requirements registry) and involving private sector to provide operational services; and
- Increased number of regional datasets linked to GEOSS Platform.

Over the medium to long term, GEO-CRADLE aims to achieve:

- Sustained uptake of GEO/GEOSS and Copernicus in the region, and better leveraging of existing and future investments;
- Matching of top-down (that is, programme level whether this is GEO or Copernicus) with the bottom-up (that is, national and sector-specific) perspectives, informed by the GEO-CRADLE Roadmap which promotes multi-actor, cross-border and interdisciplinary collaboration among Earth observations stakeholders in the region for the delivery of Earth observations-based benefits to society and economy; and
- Improved uptake of Earth observations-derived benefits in a region with strong interest for Europe and solid foundations for cooperation.

### **Planned Activities**

During the 2020-2022 period, GEO-CRADLE intends to:

- Promote the coordination of Earth observation activities within the North Africa, Middle East, and Balkans region through the sustained operation of the GEO-CRADLE networking platform (currently with 268 actors from 29 countries), the organization of additional regional workshops, and the interfacing with key initiatives (including Regional GEOs like EuroGEO and AfriGEO as well as collaborative efforts such as Partnership for Research and Innovation in the Mediterranean Area (PRIMA) and the European Space Agency's Earth Observations for Sustainable Development (EO4SD) initiative;
- Assess the maturity of Earth observations activities at the national level to inform targeted capacity building, by applying the novel methodology which was pioneered by GEO-CRADLE and which has been applied to date in 11 countries. The methodology uses an extensive set of 32 maturity indicators across three main fields: Capacities, Cooperation, and National Uptake and Awareness;

- Foster the progressive operationalization of Earth observations-based services, building on the results of the four GEO-CRADLE pilots (Adaptation to Climate Change, Improved Food Security – Water Extremes Management, Access to Raw Materials, and Access to Solar Energy), linking to the GEO priorities and the national needs for achievement of the Sustainable Development Goals and involving the private sector; and
- Further promote the effective implementation of the GEOSS Data Sharing Principles in the region and the registration of national datasets to GEOSS Platform, through the GEO-CRADLE Regional Data Hub, which is set up 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 (more than 25 million datasets are now available by accessing through the Regional Data Hub to GEOSS and regional / local portals, including the data available through the GEO-CRADLE project pilots).

### **Contributors**

GEO Members: Greece.

***GEO Participating Organizations:*** European Association of Remote Sensing Companies (EARSC), Inter-Balkan Environment Centre (iBEC).

### **Related GEO Work Programme Activities**

GEOGLAM, EO4SDG, GEO-VENER, CAMS, C3S, AFRIGEO, EUROGEO.

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## GEO Global Water Sustainability ([GEOGLOWS](#))

### Overview

GEOGloWS is a user-driven initiative that brings together water and Earth observation activities around the world to guide the decision-making process. GEOGloWS provides coordination, knowledge, data, and products on diverse freshwater activities within and outside GEO, to address user needs. By bringing together global partners to improve and test much-needed tools and resources, GEOGloWS is contributing to global and local water management, disaster risk reduction, and water sustainability.

GEOGloWS activities include a comprehensive perspective on observations and services for water sustainability. Within GEOGloWS, the term “sustainability” encompasses humanity’s goal of balancing social, economic, and environmental well-being, and as such, water sustainability, including water quality as an essential part of these broader sustainability goals. GEOGloWS uses these three dimensions of sustainability to determine the direction of the Initiative and as a requirement in all GEOGloWS activities. GEOGloWS is working to provide relevant, actionable information about water that promotes the use of earth observations and the strengthening of observational networks. GEOGloWS provides a space for self-organizing International Water Cycle observations, and its applications to forecasting (including water cycle extremes), water accounting, drought (and water stress), climate change detection, adaptation and impact mitigation, and many other freshwater activities. GEOGloWS also provides a forum for government to government collaboration and engagement with the academic, non-profit organizations, and private sectors. In addition, this voluntary forum leverages and coordinates its activities among historical intergovernmental mechanisms of the UN, and among multiple partners within and outside the UN system. With an operational focus, GEOGloWS allows for engagement and greater integration with transboundary organizations (for example, the European Centre for Medium-Range Weather Forecasts (ECMWF)) and others that are not hydrometeorological services (such as CEMADEN-Brazil and SICA-Central America).

### Planned Activities

- **Global streamflow forecasting service:** GEOGloWS will continue, through strategic partnerships, to assist organizations with hydrological forecast responsibility to implement this unique service to complement their national and local efforts. GEOGloWS expects to expand the service to make multiple forecasts accessible.
- **Essential Water Variables (EWVs):** A plan will be submitted by 2019 for coordinating the definition of EWVs in support of the Sustainable Development Goals, Sendai, and other priority policies. By 2020, the plan will expand to leverage existing programs and organizations for the implementation of data acquisition, analysis, exchange, and distribution systems for the accepted EWVs. By 2021, it will include system development and governance that will provide all nations with consistent access to EWV estimates and related processing tools at preferred resolutions.
- **Regional capacity:** GEOGloWS will work to increase regional capacity to acquire, share, store, maintain and utilize water data and information by leveraging data-exchange efforts of the Regional GEOs and will establish a web presence through these Regional efforts.

- **Water Accounting Framework:** Starting in 2019 and through a partnership with the AmeriGEO Platform, GEOGloWS will pursue the development of a “Water Accounting Framework” to support sustainability in the Americas.
- **H2020 TWIGA project:** GEOGloWS will develop new sensors, improve and extend in situ networks, and provide actionable information for water management and flood risk reduction in sub-Saharan Africa.
- **Agriculture Drought Monitoring and Prediction:** In partnership with the Asian Water Cycle Initiative (AWCI), GEOGloWS will explore collaboration in the area of "agriculture drought monitoring and prediction", contributing to the food-water nexus.
- **Data discoverability and interoperability:** GEOGloWS will develop tests to ensure that its data are easily discoverable in the GEOSS Platform, as well as develop a set of principles for countries and agencies to ensure the development of a coherent interoperable data system for water.
- GEOGloWS will develop a collaborative platform (Tethys) where solutions to transform data into knowledge can be shared and reused.
- **Integrated water resources management and climate change adaptation:** In collaboration with the Space Climate Observatory and national agencies and basin organizations, GEOGloWS will provide useful information about water quantity and quality derived from space observations over the main African basins. The work has started over the Congo basin and will be pursued over the Niger, Chad and Senegal basins. It will support also in situ measurements to validate and calibrate satellite products and to optimize the complementarity between space and ground measurements. The ultimate goal is to define adaptation scenarios and risk mitigation.
- Joint collaboration between GEOGloWS and the Multi-sectoral Working Group of the Santa Eulalia sub-basin /Global Water Partnership-Peru to promote projects of natural Infrastructure on communities in the Americas and around the world.
- Integration of the “In-Situ Observations and Practices for the Water Cycle” Community Activity within GEOGloWS. A plan to leverage the potential of this community into current GEOGloWS activities is being developed.

## Contributors

**GEO Members:** China, Colombia, France, Germany, Italy, Japan, Netherlands, Peru, Switzerland, United States.

**GEO Participating Organizations:** Conservation International, Central American Commission for the Environment and Development (SICA/CCAD), European Centre for Medium-Range Weather Forecasts (ECMWF), The World Bank, World Meteorological Organization (WMO).

## Related GEO Work Programme Activities

AQUAWATCH, GEO-WETLANDS.

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## GEO Human Planet ([HUMAN-PLANET](#))

### Overview

GEO Human Planet is committed to develop a new generation of measurements and information products that provide new scientific evidence and more integrated understanding of the human presence on planet Earth in support of global policy processes with agreed, actionable and goal-driven metrics. The goal is to generate the global-scale data and knowledge needed to advance our understanding of societal processes and their impact on Earth systems, and to generate useful indicators to inform policy.

An immediate objective of GEO Human Planet is to support several key post-2015 international frameworks: the UN Third Conference on Housing and Sustainable Urban Development (Habitat III, 2016), the 2030 Agenda for Sustainable Development (SDGs), the UN Framework Convention on Climate Change (UNFCCC), and the Sendai Framework for Disaster Risk Reduction. These international frameworks are accompanied by targets that are further elaborated by indicators focused on measurable outcomes. These indicators are action oriented, global in nature, and universally applicable.

GEO Human Planet relies on a core set of partners committed to producing global spatial baseline data for human settlements and population, and an enlarged community of supporting partners. The core partners and co-leads are the European Commission, Directorate General Joint Research Centre and the Centre for International Earth Science Information Network (CIESIN) at Columbia University. The extended partnership involves more than 200 individual scientists and policy makers from 120 different organizations including academic organizations, national governmental and international institutions, and the private sector.

### Planned Activities

Global historical baseline data on population and built-up areas

Built-up areas from global historical records of Landsat platform in the epochs 1975, 1990, 2000, and 2014 will be continued in the 2020-2022 time frame to assure continuity and updates.

#### ***Global spatial baseline data on built-up areas from Sentinel sensors (10m)***

Global built-up areas detection and characterization using Sentinel 2 data of the EU Copernicus program. 10-m of spatial resolution, yearly updates starting from 2019.

#### ***Global spatial baseline data on built-up areas based on integrating different sensors***

Global built-up areas detection and characterization using Sentinel 1 and 2 data of the EU Copernicus program, with 10-m of spatial resolution, yearly updates starting from 2019. This work package may include the processing of other high resolution imagery.

#### ***Global settlement classification schema and indicators***

Harmonized definition of the spatial extent of global human settlements based on density of population and built-up infrastructures. Rural-urban continuous. City-level aggregation of exposure, impact, and accessibility indicators.

#### ***Global high-resolution age-structured population maps***

GEO Human Planet will participate in the [WorldPop project](#), a multi-organization international collaboration to construct global population distribution maps for the 2000-2020 period. Modelling methods for multi-temporal census count disaggregation from administrative units to

100x100m grid squares previously developed will be scaled up to construct global, age-structured population distribution datasets for the 2000-2020 period.

#### ***Global settlement classification schema and indicators***

Harmonized definition of the spatial extension the global human settlements based on density of population and built-up infrastructures. City-level aggregation of exposure, impact, and accessibility indicators.

#### ***Regional and national show cases***

Processing of national image archive for national based built-up areas.

#### ***Human Planet web platform***

GEO Human Planet will implement a communications web platform to promote the exchange of data and access to GEO Human Planet products by partners, scientist, expert groups, and decision makers.

#### ***Human Planet Atlas releases***

Periodic publication of the Human Planet Atlas where the core evidence and derived indicators produced by the initiative are presented. The Atlas includes a facts-and-figures section, a cross-cutting thematic section, and an executive summary delivering periodic key messages and narratives based on the core evidences and derived indicators.

### **Contributors**

***GEO Members:*** Australia, Austria, Belgium, Brazil, China, Colombia, European Commission, Germany, Greece, Ireland, Italy, Japan, Netherlands, South Africa, Turkey, United Kingdom, United States.

***GEO Participating Organizations:*** European Space Agency (ESA), International Institute for Applied Systems Analysis (IIASA), The World Bank, United Nations Environment Programme (UN Environment), World Health Organization (WHO), World Resources Institute (WRI).

***Other Contributors:*** Bill and Melinda Gates Foundation, United Nations Development Programme (UNDP), United Nations Economic Commission for Europe (UNECE), United Nations Human Settlement Programme (UN-Habitat).

### **Related GEO Work Programme Activities**

EO4HEALTH, EO4SDG, GEO-DARMA, GEO-GNOME, GFRM, GUOI, AFRIGEO, AMERIGEO, EUROGEO.

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## **GEO Land Degradation Neutrality ([GEO-LDN](#))**

### **Overview**

In order to halt and reverse the current trends in land degradation, there is an urgent need to enhance national capacities to measure and map degraded lands and identify the most appropriate interventions. The UN Sustainable Development Goal (SDG) Indicator 15.3.1 (“the proportion of land that is degraded over total land area”), for which the United Nations Convention to Combat Desertification (UNCCD) is the custodian agency, utilizes three sub-indicators: land cover, land productivity and carbon stocks, which can be calculated from Earth observation and other geospatial information in accordance with the Good Practice Guidance for SDG Indicator 15.3.1.

The UNCCD’s Land Degradation Neutrality (LDN) target-setting and implementation programmes use SDG indicator 15.3.1 and its sub-indicators in a decision support framework to encourage countries to stabilize or reduce their extent of degraded lands through conservation, sustainable management and restoration activities. A coordinated response is needed from the Earth observation and geospatial community to assist countries and other actors, particularly those with limited Earth observation capacities, to carry out assessments and implement LDN activities.

Increased access to large Earth observation datasets, targeted data products, improved analytical capacity and practical tools are needed to help countries set and implement LDN targets, including to support policy, planning and investment decisions. The data, products, tools, platforms and reporting protocols developed within the GEO-LDN Initiative would be accessible in the Global Earth Observation System of Systems (GEOSS) Platform and available for use by other GEO Initiatives, including GEO-BON, GEOGLAM and EO4EA. GEO-LDN aims to facilitate the provision of space-based information and in situ measurements for improved land management and planning which are fundamentally linked to many other areas of the GEO Work Programme, including its Strategic Plan 2016-2025, and global priorities on sustainable development, climate action and disaster risk reduction.

### **Planned Activities**

The strategic activities of the GEO-LDN Initiative are aimed at:

- Building capacity at the country and regional level to ensure national ownership of Earth observations and in-situ measurements will entail the preparation of curriculum and training on the use of new data products and practical tools to support countries in accessing, interpreting and validating this data for (a) UNCCD national reports and action plans which in turn will inform reporting on SDG indicator 15.3.1 at the regional and global level, and (b) land use and spatial planning frameworks required to effectively implement measures to achieve LDN. The curriculum will also include reference to other target monitoring systems and reporting obligations at national level to maximize synergies and avoid duplication of efforts.
- Developing minimum data quality standards and protocols and explore the development of federated collaborative platforms with high computing capacities and big data analytics tools (e.g., data cubes) that would allow countries to easily select, access, process, analyze, interpret and quality control large datasets associated with Earth observations and geospatial information.

The GEO-LDN Initiative will be global in scope, but may also support regional activities in capacity building, data collection and validation, including activities aligned with other regional GEO Initiatives and priorities. GEO-LDN strategic activities will be coordinated via three Working Groups:

Working Group 1: Capacity Building, which will establish networks and facilitate the provision of training,

Working Group 2: Data Quality Standards, which will develop minimum data quality standards and specifications for the indicators, and

Working Group 3: Data Analytics, which will facilitate and support the development of data products and analytical tools that assist countries and other stakeholders to monitor land degradation.

### **Contributors**

**GEO Members:** Australia, Burkina Faso, Germany, Ghana, Japan, Netherlands, South Africa, Sweden, United States.

**GEO Participating Organizations:** African Association of Remote Sensing of the Environment (AARSE), Committee on Earth Observation Satellites (CEOS), Conservation International, European Space Agency (ESA), United Nations Food and Agriculture Organization (FAO), Secretariat of the United Nations Convention to Combat Desertification (UNCCD), United Nations Environment Programme (UN Environment), United Nations University, Institute for Environment and Human Security (UNU-EHS).

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### **Related GEO Work Programme Activities**

GEOGLAM, GFOI, EO4SDG, EO4EA, AFRIGEO.

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## GEO Vision for Energy (GEO-VENER)

### Overview

The GEO-VENER initiative was launched in September 2016 to ensure a more efficient link between the renewable energy community and the GEO community and to stress the benefits of Earth observation data for decision-making in the development of renewable energies.

GEO-VENER built on the community portal [webservice-energy.org](http://webservice-energy.org), to serve the development of renewable energies by providing easy, interoperable, and GEOSS-compliant access to documented, precise, trustable (or bankable) data, observation, information, knowledge and services related to renewable energies.

As analyzed by the International Renewable Energy Agency (IRENA), renewable energy is central for human development, sustainable growth and environmental sustainability and contribute to all SDGs of the 2030 Agenda for Sustainable Development. As the 2018 report from IRENA shows, renewable energies and energy efficiency can, in combination, provide over 90% of the necessary energy-related CO<sub>2</sub> emission reductions. Keeping the global temperature rise below 2 degrees Celsius is technically feasible and GEO-VENER will contribute to the 2015 Paris Agreement on climate change objectives. However, the global energy system must undergo a profound transformation, replacing the present system that is largely based on fossil-fuels. The total share of renewable energies must rise from around 18% of total final energy consumption (in 2015) to around two-thirds by 2050. Over the same period, the share of renewables in the power sector would increase from around one-quarter to 85%, mostly through growth in solar and wind power generation.

### Planned Activities

- **Stakeholder engagement, governance, and funding for GEO-VENER.** This includes redefining priorities based on stakeholder input and participant interest, as well as defining governance structures based on consensus. GEO-VENER should as a set of processes on ownership, governance, information management, communication and funding to establish. As the previous activities were based on users, they were more built on opportunities. The first objective of GEO-VENER is to define and then share its objectives and planned activities and outputs with the broader energy services and Earth observations community and to define the pathways to success. Means of engaging with the broader community will also be identified but will begin with a robust and sustainable Community of Practice (CoP).
- **Essential Renewable Energy Variables (EREVs).** These are key elements for providing data, observation, information, knowledge and services related to renewable energies. The H2020 ConnectinGEO project is an attempt to define EREVs. A set of EREVs has been proposed for solar, wind and marine renewable energies. The definition of EREVs for other renewable energies will be pursued in GEO-VENER by interacting with the whole community and by engaging with the public and private sectors.
- **Gap analysis is key within the renewable energies domain.** No specific Earth observations system or program dedicated to renewable energies exists, but the renewable energies domain is using Earth observations systems and programs dedicated to others' domains to extract relevant renewable energies information. Based on the EREVs and on the practices of the renewable energies stakeholders, the gap analysis will be conducted through various approaches.

- **Development of in-situ meta-networks for renewable energies.** In situ observations for renewable energies (such as global horizontal solar radiation) are not yet accessible through a single, dedicated community network. The definition and development of a renewable energy “meta-network” will continue in order to attract institutional users and subject matter experts in the solar domain. Interactions with end-users will help engage the solar community. Based on this experience and on its results, a promotion oriented to other renewable energy communities will be considered. This first work will be pursued and adapted in close cooperation with the newly hired in situ data management specialist of the GEO Secretariat. Given that the industry is investing to increase data relevant to solar production, there may be a need to consistent standards and a global approach to this could be useful. There are currently existing portals that could be assessed for these purposes, including the Australian Renewable Energy Mapping Infrastructure.
- **Webservice-energy.org.** This is a community portal dedicated to renewable energies, offering access to renewable energies observations, data, information and services for the benefits of energy users. It is recognized as a GEOSS Community Portal. The webservice-energy.org platform hosts a collection of web services offering data and applications in renewable energy and environment. The exploitation of renewable energy sources such as solar and wind energy requires accurate knowledge of the resources and their availability--in space and time--as well as accurate forecasts in the different phases of an energy system life cycle. Within GEO-VENER, the webservice-energy.org community portal will be used as a focal point and will evolve to ensure the link with the energy community of practice; to cover all renewable energies (solar, wind marine, biomass, geothermal, hydro) and to offer the one-stop portal for the renewable energies community.
- Draw connections and synergies between GEO-VENER and other GEO work groups and thematic areas including regional GEO initiatives such as AMERIGEO, EUROGEO, AOGEO and AFRIGEO, and thematic areas such as resilience, disasters, and risk. Energy has reach into all sustainable SDGs and all regions therefore strengthening the connections between GEO-VENER and other initiatives will make it a more sustainable and engaging work program.

## Contributors

**GEO Members:** Denmark, European Commission, France, Germany, United States.

**GEO Participating Organizations:** European Space Agency (ESA).

## Related GEO Work Programme Activities

EO4SDG, BLUE-PLANET, GEO-CRADLE, CAMS, C<sub>3</sub>S, GEO-CITSCI, EO4MIN, EO4WEF, TIGGE, AFRIGEO, EUROGEO.

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## GEO Wetlands ([GEO-WETLANDS](#))

### Overview

Wetlands are hot spots of biodiversity and provide a wide range of valuable ecosystem services, such as water purification, hydrological buffering against floods and droughts, coastal protection and climate regulation. Despite their disproportionate importance for people and nature, wetlands are one of the fastest declining ecosystem types worldwide. Information on wetland ecosystems and their services is often scattered, difficult to find, and hard to integrate into decision making.

To improve this situation, the Ramsar Convention on Wetlands has been supporting the conceptualization of a Global Wetlands Observing System (GWOS) since 2007. GEO Wetlands took over this task by implementing a community portal that supports users with reporting on the status and trends of wetland ecosystems on different spatial scales. GEO Wetlands is designed to directly support the Ramsar Convention on wetlands by providing Ramsar Contracting Parties with the necessary Earth observation data, methods and tools to better fulfil their commitments and obligations towards the Ramsar Convention.

GEO Wetlands also contributes directly to the development and implementation of best monitoring practices for the UN Sustainable Development Goals (SDGs), in particular, Target 6.6 “By 2020 protect and restore water-related ecosystems, including mountains, forests, wetlands, rivers, aquifers and lakes”, and supporting the development of methodological approaches and tools for SDG indicator 6.6.1 “percentage of change in water-related ecosystems extent over time”. Furthermore, it provides tools that can be used by country governments to set quantitative targets for their wetland resources. This directly serves countries with the monitoring and reporting regarding Sustainable Development Goal 6.6 Indicator 6.6.1 on water-related ecosystems. These activities are coordinated with the two custodian agencies of this indicator, UN Environment and the Ramsar Convention.

GEO Wetlands strengthens the cross-cutting coordination of global wetlands observation by involving key stakeholders at different levels, from different regions, and from all sectors (science, industry, policy) in a user-needs driven framework. This ensures that activities in GEO Wetlands are in line with the needs of these broad communities and carried out in an efficient and targeted approach to facilitate the user uptake. It also allows flexible and open involvement of the full user and developer spectrum, based on a co-design and co-creation approach with the major wetland stakeholders.

GEO Wetlands aims to ensure long-term sustainability by converting the ownership and governance structure from the current project and best-effort level to a more sustainable longer-term common governance structure using available project results to demonstrate the added value GEO Wetlands provides to users on different levels.

### Planned Activities

- The GEO Wetlands knowledge-base and community portal, that are operational but still under development, will reach a mature and fully operational stage where users can freely access and interact with both tools to find, access and use data, products, tools, guidelines, training materials, case studies, recommended practice documents and other relevant information sources.

- New research and innovation projects will be launched (subject to available funding) focusing on improving existing methods and tools as well as the underlying research and introducing new functionalities for the knowledge-base and community portal based on user feedback.
- Different pilot projects (e.g. national implementation projects) will demonstrate the capabilities of the available tools to support policy implementation (e.g. SDG monitoring) and support their further dissemination and visibility.
- A more permanent and substantial resource situation will be established for GEO-Wetlands through strengthened engagement with key stakeholders and in cooperation with members and participating organizations of GEO as well as with parties of the Ramsar Convention.
- Subject to the available funding, more substantial and permanent governance and management structures for GEO Wetlands will be established to allow long-term planning, community management, infrastructure maintenance and working towards policy mandate for the initiative.
- Several working groups that reached a semi-operational stage during the 2017-2019 period (e.g. mangroves; capacity building; wetland inventory) will emerge into fully operational working groups with defined membership, objectives, work plans and outputs.

### **Contributors**

**GEO Members:** Austria, Denmark, France, Germany, Greece, Japan, Netherlands, Spain, Sweden, United Kingdom, United States.

**GEO Participating Organizations:** European Space Agency (ESA), International Water Management Institute (IWMI).

### **Related GEO Work Programme Activities**

GEO-BON, AQUAWATCH, EO4SDG, GEOGLOWS, GEO-ECO, AFRIGEO, AMERIGEO, AOGEO, EUROGEO.

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## Geohazard Supersites and Natural Laboratories ([GSNL](#))

### Overview

The Geohazard Supersites and Natural Laboratories initiative (GSNL) is a voluntary international partnership aiming to improve, through an Open Science approach, geophysical scientific research and geohazard assessment in support of disaster risk reduction.

This goal is pursued by promoting broad international scientific collaboration and open access to a variety of space- and ground-based data, focusing on Supersites, i.e. areas of strong interest to the geohazard community in which single or multiple geological hazards pose a threat to people and/or critical facilities. Supersites are virtual workshops where focused collaborative investigations aim to improve the scientific understanding of the geological and geophysical processes causing the hazards, eventually enabling reduction of the uncertainties in risk assessment.

At each Supersite, GSNL and the local and international communities:

- Make openly available data from all disciplines, and sensors from both in-situ and satellite systems, through easy-to-access data infrastructures;
- Support collaborative research activities of a broad international community, favouring an Open Science approach;
- Promote testing and adoption of innovative technologies for geophysical monitoring, data sharing, scientific collaboration, and communication to the stakeholders;
- Are part of the GSNL network, in which they may be asked to contribute expertise, capacities, infrastructures, training, to support the needs of other Supersites; and
- Are coordinated by local scientific institutes which have an official mandate for supporting the national risk and emergency management agencies with monitoring and scientific products.

At each Supersite there is a clear definition of roles: the space agencies provide satellite imagery at no cost for scientific monitoring, the local observatories and institutes provide access to ground-based data, and the scientific community employs these data to generate new scientific results which are eventually delivered to the local decision makers.

The decision-making processes to achieve effective disaster risk reduction occur at national and local scales and involve a variety of public bodies. To be well-received and effectively support decisions, scientific information generated at the international scale must reach the appropriate stakeholders in the proper way and form. For this reason, the Supersites are coordinated by local geohazard scientific institutions which have a mandate, in the respective national risk management frameworks, to provide authoritative information to public decision makers and the population. This ensures a rapid uptake of the information by stakeholders, benefiting hazard assessment, disaster monitoring and response actions.

### Planned Activities

To reach its goals, in the period 2020-2022 GSNL will expand the network partnership, increasing the number of Supersites from 11 to 14, with a focus on less-developed countries. Some other specific activities are listed below:

**Management.** Reform of the GSNL governance structure. Manage satellite data access for Supersite scientists, with the Committee on Earth Observations Satellites. Pursue the establishment of a South-east Asia Natural Laboratory (or Supersite). Coordinate the

communication and the provision of data/processing services to the scientific community. Improve knowledge exchange and sharing of research results in digital format.

**Networking.** Improve communication and collaboration with other international initiatives on disaster risk reduction and open data/processing infrastructures. Contact development funding agencies to explore the possibility of supporting Supersites in less developed countries. Improve collaboration with other scientific, user-oriented initiatives, such as the Global Earthquake Model and the Global Volcano Model.

**Capacity Building.** Implement capacity building actions in collaboration with Supersite partners and existing initiatives in GEO and in the CEOS. Promote sharing of scientific codes for data processing and provide remote processing services.

**Data Provision.** Collect Earth observation data needs from the Supersite scientific community and request image quota allocation to the CEOS space agencies. Promote within the Supersite community data access services developed by existing data sharing infrastructures. Promote the use of GEOSS for data and product dissemination.

**Monitoring and Research.** Continue to implement continuous monitoring activities, early warning and research at each Supersite, using the in situ and satellite data. Generate new scientific results and monitoring products, and disseminate them to the Supersite national end-users. Exchange and disseminate scientific information.

## **Contributors**

**GEO Members:** Canada, Chile, Ecuador, European Commission, France, Germany, Iceland, Italy, New Zealand, Switzerland, Turkey, United States.

**GEO Participating Organizations:** European Plate Observing System (EPOS).

**Other Contributors:** Democratic Republic of the Congo.

## **Related GEO Work Programme Activities**

GEO-DARMA.

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## Global Drought Information System ([GDIS](#))

### Overview

The Global Drought Information System (GDIS) aims to develop new observational systems, or better integration of existing systems, to improve drought management in areas lacking comprehensive meteorological and hydrological grids. GDIS assesses and proposes improvements in global infrastructure required to better monitor and predict droughts and heat waves for early warning and disaster prevention, while also providing the capability to monitor changes in the extremes of drought and heat waves as global warming and global climate change intensifies.

Drought monitoring and prediction is transnational and even transregional, encompassing atmospheric and ocean conditions, such as the El Niño Southern Oscillation that extend over vast distances over the globe. However, it retains local factors such as hydrological factors of low river water level, anomalously low soil moisture, or diminished glacial meltwater. A key contribution of GDIS has been to recommend a set of defensible, consistent drought-monitoring criteria and standards that could be uniformly applied globally, across different national drought management systems, and that are grounded upon measurable physical processes.

### Planned Activities

#### *Upgrading the global precipitation monitoring data processing stream*

GDIS will test whether global drought monitoring is improved by moving beyond purely land-based Global Precipitation Climatology Centre (GPCC) precipitation station observations to a new space-based global precipitation satellite blended with GPCC's land stations. Many regions of the globe do not meet World Meteorological Organization (WMO) recommendations for minimum density of meteorological stations. As a result of this scarcity of precipitation measurement points, GPCC must extrapolate precipitation fields from a sparse number of sampling locations. The new system would include space-based observations to improve measurement of the distribution of precipitation during the monsoon seasons.

As a second example, much Regional Drought Centre drought vegetation coverage is based upon moderate-scale MODIS imagery which is too coarse to map small farm plots in Sub-Saharan Africa, Southeast Asia, Central America, and elsewhere. GDIS will test whether incremental improvement is made by deploying nanosatellite coverage for vegetation drought monitoring, relative to that provided by the commonly used vegetation mappings currently employed.

GDIS will also test additional drought monitoring benefit from deploying evapotranspiration-based drought monitoring. The mappings are derived from global radiation observations, many from geostationary satellites. The combined precipitation and evapotranspiration global maps provide the ancillary benefit of independently validating statistics collected by each country pursuant to the Water Sustainable Development Goal (SDG) mapping of global water stress.

#### *Upgrades to the GDIS Portal*

A major overhaul of the current portal will be undertaken to improve its usability as a “one-stop shop” for the status of droughts across the globe. Besides Standardized Precipitation Index (SPI) mapping, mapping is being prepared for other processes capable of identifying drought onset, intensification, and dissipation. Agricultural drought maps need to be introduced, as well as other products, such as maps of low water and declining groundwater.

GDIS provides global drought coverage within the United States National Integrated Drought Information System (NIDIS). Improvements will be made to the interactive mapping within the NIDIS portal, the geographic information system interface, and the ability to replot maps from other regional centres onto the GDIS interactive map.

#### ***Development of global drought forecasting data processing software***

A processing chain will be set up using the Copernicus European Centre for Medium-Range Weather Forecasts (ECMWF) seasonal model forecasts, and this will be linked to the data processing stream used for National Oceanic and Atmospheric Administration Climate Prediction Center Morphed (CMORPH) and the Global Precipitation Measurement (GPM) global precipitation SPI mapping. A counterpart stream will be prepared for the North American Multi-Model Ensemble. Within the experimental environment the two systems will be mapped separately, and then co-mapped to a common grid and common ensemble start times.

Drought forecast skill will be tested using the hindcast history for each system over domains falling within the jurisdiction of the regional partners. If results are deemed plausible, then forecasts can be examined under controlled conditions within some of the regional drought centres willing to participate. A lengthy validation period may be required before the system is routinely released within a production environment. Some possible experimental pilot partners include the Drought Management Centre for Southeast Europe, the South American regional climate centres, the Asian Pacific Climate Center, and the African regional climate centres.

#### ***Drought training and drought education***

New portal sections will be set up for drought education and download of drought tools, some of which will mesh with what is available through the WMO drought management website.

### **Contributors**

***GEO Members:*** Argentina, Australia, Austria, Brazil, China, European Commission, Japan, Mexico, Pakistan, Paraguay, Republic of Korea, Slovenia, United Kingdom, United States.

***GEO Participating Organizations:*** AGRHYMET Regional Centre, International Research Centre on El Niño (CIIFEN), European Centre for Medium-Range Weather Forecasts (ECMWF), World Meteorological Organization (WMO).

***Other Contributors:*** Sri Lanka, Asian Pacific Climate Centre (APCC), Intergovernmental Authority on Development Climate Prediction and Application Centre (ICPAC), Southern Africa Development Community (SADC).

### **Related GEO Work Programme Activities**

GEOGLAM.

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## Global Network for Observations and Information in Mountain Environments ([GEO-GNOME](#))

### Overview

GEO-GNOME, which was launched in 2016, aims at bringing together research institutions and mountain observation networks to collate and make available transboundary and inter- and transdisciplinary environmental and social-ecological data and information on global change in mountains. This is expected to facilitate access to key data and information to the research community for studies applicable to global assessments such as those by the Intergovernmental Panel on Climate Change (IPCC), as well as information for local, national and regional decision-makers, ensuring that 'mountains' as a topic is incorporated in the process of global agendas such as the 2030 UN Agenda and its Sustainable Development Goals (SDGs), on climate change through the IPCC and the United National Framework Convention on Climate Changes (UNFCCC), as well as Sendai Framework for Disaster Risk Reduction.

### Planned Activities

#### *Accurately delineate mountain regions using best available data.*

- Explore option to add one further layer with information on socio-ecological systems superimposed on mountain delineations. A publication is envisaged to document the process and the result.
- Make Global Mountain Explorer accessible via GEOSS and linked via the GEO-GNOME Community Portal.
- Offer a series of webinars to enhance communication, exchange and engagement with the GEO-GNOME community of interested scientists, data providers, and data users to present GEO-GNOME developments with the GEO-GNOME Community Portal and seek feedback on its utility and improvements.

#### *Identify data providers and user knowledge needs.*

- Update an existing database on data providers, including GEO Flagships, Initiatives, and Community Activities relevant to GEO-GNOME.
- Engage and contact data stewards and researchers for other additional relevant data. Create a registry of relevant data providers that could connect to and contribute to GEO-GNOME goals and objectives. Prepare a gap analysis to identify and map data availability and their protocols, relative to what is required for observations in mountain environments
- Identify user needs in the specification of data and information needs, in line with GEO's strategy and global policy processes focus. Conduct surveys and/or consultations to gather insights and inputs on specific user needs.

#### *Improve monitoring and understanding of mountain processes.*

- Support the development of the Uniform High-Elevation Observing Platform (UHOP) to improve high-elevation climate data, from elevation-dependent warming to Elevation-Dependent Climate Change. Identify suitable regions/areas for UHOPs and document the existing capacities and infrastructure available to monitor and gather observation data as per needs / specific relevance for mountain environments.
- Convene a workshop on essential climate variables (ECVs) for mountains. The workshop is intended to identify ECVs for climate and environmental transformations and changes

in mountains and along altitudinal gradients, as well as to start identifying all other mountain-relevant variables for socio-ecological high-elevation systems. The workshop is also intended to highlight the high value of combining in-situ observations, satellite data and modelling.

- Convene a workshop to identify essential mountain variables for social- ecological systems. The workshop will be planned to occur in conjunction with the ECV workshop. A position paper (gap analysis) and inventory is envisaged as output.
- Convene a workshop on elevational transects to derive foundational work and information on suitable locations for elevational transects and identify key local stakeholders/observatories.
- Explore and establish links with paleoclimate research communities. Understanding the past evolution of the Earth's climate system in highly sensitive regions such as the mountain areas is crucial to better understand current conditions and to predict possible future scenarios of change, assess their impacts and develop appropriate strategies for supporting sustainable development and adaptation. At the same time, the availability of reliable observations of ECVs in mountains is essential to calibrate natural and documentary proxies from mountains. Given this two-fold advantage, this task aims at exploring a new link between GEO-GNOME and the existing paleoclimate communities, such as PAGES (Past Global Changes) or other smaller initiatives. As a first step, GEO-GNOME will connect to the paleo-communities through Mountain Research Initiative-facilitated webinars to explore ways for cooperation. Based on the outcomes of these preliminary links, the possibility to organize a dedicated workshop will be explored.

***Communicate, link, and develop reporting capacity that responds to policy needs.***

- Communicate milestones and tasks results, and showcase products at key GEO events and at relevant global policy events.
- List, and connect with, other regional and national programmes relevant to Earth observations in mountain environments, as well as international networks.

**Contributors**

***GEO Members:*** Ecuador, Italy, Germany, Switzerland, United Kingdom, United States.

***GEO Participating Organizations:*** European Space Agency (ESA), Future Earth, Mountain Research Initiative (MRI).

**Related GEO Work Programme Activities**

GEO-BON, EO<sub>4</sub>EA, GSNL, GEO-ECO.

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## **Global Observation System for Persistent Organic Pollutants (GOS4POPS)**

### **Overview**

GOS4POPS is intended to further develop a global observation system for persistent organic pollutants (POPs) to support the Stockholm Convention and the UN Economic Commission for Europe Convention on Long-range Transboundary Air Pollution (LRTAP) and ongoing international programs, including the Global Monitoring Plan (GMP) of the Stockholm Convention on POPs and the European Monitoring and Evaluation Programme (EMEP).

The objectives of GOS4POPs are to provide:

- Increased availability and quality of Earth observation data and information needed to track these chemical pollutants and anticipated changes in the environment on the basis of chemical production and use restrictions;
- Harmonization of metadata production, archiving and sharing among networks; and
- Development of advanced services in support of the policy mandate and effectiveness evaluation of the Stockholm Convention on Persistent Organic Pollutants.

To attain these objectives, GOS4POPS will further the development and adoption of advanced sensors for monitoring pollutants; advocate better preparation, archiving and sharing of metadata; create advanced web services for using and discovering information from metadata and data; and update web services for policy makers.

### **Planned Activities**

GOS4POPS aligns its internal planning to the six-year evaluation cycles of the Stockholm Convention. The 2020-2022 GEO Work Programme period represents the second half of the current six-year plan. The major focus will be on supporting the third collection of global data, and providing advanced services to the Regional Organization Groups (ROGs) and the Global Coordination Group (GCG) in their tasks of producing regional and global reports in support of the effectiveness evaluation of the Stockholm Convention measures.

Specific tasks for the 2020-2022 period include:

- Analysis of current monitoring programmes, data infrastructures and archived information on POPs, with a special attention to newly listed POPs;
- Increasing the availability and quality of data by supporting further development of monitoring programmes, harmonization of applied sensors, standardization of the analytical procedures, joint interpretation of available information and production of metadata following standards;
- Upgrading the GMP DWH to include new POPs;
- Design, development and implementation of core services supporting adopted procedures of the 3rd Global Monitoring Report (harmonized data collection);
- Design, development and implementation of tools supporting data accessibility, presentation and interpretation; and
- Testing and updating of services and tools.

The first task will analyze the state of the art of POPs monitoring programmes and data infrastructures to discover data gaps, strengths and weaknesses that will affect further development of the GMP Portal (carried out in the third task). The second task will provide harmonized information and metadata to be exported to GEOSS. The remaining tasks will

support implementation of the 3rd Global Monitoring Report for effectiveness evaluation of the Stockholm Convention on POPs. The fourth task will support harmonized data collection enabling analyses and reports on trends of POPs in the environment and human tissues. The fifth task will create specific tools allowing policy makers and stakeholders to explore and use key information. The sixth task will serve to test and update services and tools to satisfy emerging needs of the effectiveness evaluation of the Stockholm Convention (new POPs, matrices, global reports) through the end of the GEO Work Programme period.

Three to five years are necessary to make the GMP data warehouse fully operational and ready to support the third global data collection campaign. The remaining time will serve to make adjustments and to better calibrate services on policy maker and stakeholders requirements and needs.

### **Contributors**

**GEO Members:** Australia, Brazil, Cameroun, Canada, China, Costa Rica, Czech Republic, Denmark, European Commission, Fiji Islands, Germany, Greece, Italy, Japan, Kenya, Morocco, Norway, Russian Federation, Slovenia, Spain, Sweden, Uruguay.

**GEO Participating Organizations:** UN Environment, World Health Organization (WHO).

**Other Contributors:** Northern Macedonia, Arctic Monitoring and Assessment Programme (AMAP), European Monitoring and Evaluation Programme (EMEP), Global Environment Facility.

### **Related GEO Work Programme Activities**

GOS4M.

### **Points of Contact**

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## Global Urban Observation and Information ([GUOI](#))

### Overview

The Global Urban Observation and Information (GUOI) Initiative intends to improve urban monitoring and assessment by developing a series of satellite-based essential urban variables and indicators of sustainable cities through international cooperation and collaboration. This information is expected to provide datasets, information, technologies to pertinent urban users in the World Bank, United Nations organizations, Africa, South America, and planning and environmental management agencies in other developing countries, as well as to support the UN Sustainable Development Goal (SDG) 11: Make cities inclusive, safe, resilient and sustainable.

The government agencies most likely to use GUOI datasets include city authorities and urban resilience offices, departments of urban and regional planning, environmental management, natural resources, metropolitan transit authorities, and offices of sustainability and regional statistics. These agencies are expected to use the datasets to obtain information about urban land use and land cover, urban form and growth patterns, infrastructure and transport needs, ecosystems and biodiversity, human health, thermal comfort, food security, and socioeconomic development. Further, the World Bank Platform for Urban Mapping and Analysis may also benefit from the datasets, products, and services that this initiative offers. For the scientific community, GUOI will provide new knowledge on global urbanization process and innovations in urban observation.

Contributions from multiple organizations and countries are coalesced into a single GEO initiative through collaborative and affiliated projects, annual symposia, international summer school, joint field works, publications, and coordinated user engagement efforts. GUOI will generate various data products of global urban areas using Earth observation data, provide Earth observation-based urban data services through various systems and tools, develop new models and algorithms to assess and monitor urban environments, create a better knowledge of cities and to develop essential urban variables and indicators for sustainable cities for SDG 11.

### Planned Activities

- Develop a series of satellite-based essential urban variables and indicators of sustainable cities to support UN SDG Goal 11 through international cooperation and collaboration.
- Establish a Global Institute of Sustainable Cities to explore Earth observations as an enabling technology for development of sustainable cities. It would also support GEO's objectives on urban resilience and coastal resilience by providing Earth observation methods and technologies, objective information on the footprint of global urbanization, and assisting in the development of indicators for sustainable cities to support the SDGs.
- Megacities Observation and Monitoring: this set of projects will focus on global urbanization of megacities and provide data sets for megacity municipalities worldwide.
- Continued generation of global human settlement layers at various international and national levels and seek synergies among them.
- Implement a virtual global urban remote sensing laboratory to develop an online tool for acquiring, processing, visualizing, and sharing of urban data sets.
- Continue joint projects on impervious surface mapping in tropical and subtropical cities in Asia, Africa, and South America.
- Organize the annual GEO Global Urban Observation Symposium.

- Create an annual international summer school to train and educate students and young researchers worldwide.
- Collaborate with the Institute of Electrical and Electronics Engineers (IEEE), the Geoscience and Remote Sensing Society (GRSS), and the International Society for Photogrammetry and Remote Sensing (ISPRS) on capacity building and to showcase and disseminate research results.
- Seek synergies with other GEO Flagships and Initiatives.

### **Contributors**

*GEO Members:* Austria, Brazil, Canada, China, Germany, Greece, India, Italy, Japan, Pakistan, South Africa, Spain, Sweden, United States.

### **Related GEO Work Programme Activities**

HUMAN-PLANET.

### **Points of Contact**

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## Global Wildfire Information System ([GWIS](#))

### Overview

Wildfires cause enormous environmental damage and economic losses and continue to present a major risk in many countries. Wildfires, as opposed to controlled fires for agricultural and fuel reduction purposes, are a major threat to humans and the environment. Recent episodes show that wildfires are far from diminishing in their size or intensity, and may be exacerbated by the already noticeable effects of climate change. It is estimated that about 450 million ha of natural areas are burned every year, causing significant environmental and economic damage and contributing to the increase of carbon emissions worldwide.

Several national and supranational organizations have established systems aiming at providing early warning for large fire events, and thereby to minimize the effects of catastrophic fires, to monitor active fire distribution, and to support post-fire accounting of burned areas. Comprehensive and accurate ground-based inventories of wildfires at the global level do not exist, nor is there yet a global system that is able to provide synthesized information on the evolution of fire regimes and fire impacts at national, regional and global levels. Different definitions of forests or wildfires, different methods in the collection of information, and different systems at the national or sub-national level, prevent the construction of a global system through the aggregation of ground-collected information.

The use of remote sensing provides an alternative way to collect wildfire information essential to understand fire management from the local to national to regional to global scale. Earth observations and information, derived both from space and surface networks, have demonstrated not only their maturity, but their critical role in supporting fire managers, first responders and risk managers by providing effective tools to predict severe fire danger conditions, rapidly map natural hazards, and assess impacts.

GWIS aims to provide harmonized information on wildfires that could be used at different scales, from national to global. At the global level, where information on wildfires is scattered and not harmonized, GWIS is a unique source of information for global initiatives and policies, while supporting the analysis of wildfire regimes at this scale. The calibration of the system and the validation of the different modules requires close collaboration with regional and national partners. In countries that currently do not have a wildfire information system, GWIS will fill this gap and help countries engage in international collaboration. For countries and regions where wildfire information systems exist, GWIS provides a complementary and independent source of harmonized information adding to the national/regional information sources.

GWIS builds on the experience, achievements and networks established with the European Forest Fire Information System (EFFIS) and the Global Observation of Forest Cover Global Observation of Land Dynamics (GOFC-GOLD) Fire Implementation Team and Fire Regional Networks. Engagement with wildfire managers at national and local scale is channelled through the EFFIS network in Europe, Middle East and North Africa, and through the GOFC Fire IT networks in the rest of the world.

### Planned Activities

- Maintain and further develop GWIS, providing harmonized fire information including fire danger, active fires, burned areas, emissions, as well as reports on wildfire regimes and statistics at national, regional and global level.

- Integrate NASA-supported project results into operations, including: global active fire monitoring from geostationary satellites; fire danger prediction specific calibration for regional scales; and national/regional/global GWIS services for fire managers and fire administrations.
- Integrate global wildfire products from all sources, including, for example, results of the European Space Agency Fire Climate Change Initiative products and Copernicus products from different services.
- Promote networking among major national and regional fire information providers through an annual workshop convening key international organizations and initiatives and national / regional providers.
- Maintain established operational links with other wildfire communities dealing with wildfire aspects at global scale (for example, for burned area assessment and emission estimation) and develop new links with other wildfire-related communities.
- Further develop GWIS by integrating and harmonizing as much as possible regional wildfire data and information sources.
- Develop, implement and promote the establishment of mechanisms for interoperability and communication among national, regional and global wildfire information systems following OGC standards and guidelines, and the GEOSS Data Sharing Principles.
- Develop methods for the global assessment of wildfire risk and implementation of this assessment at the global scale through collaboration with UN Office for Disaster Risk Reduction (UNDRR) on the Global Assessment Report and the Global Risk Assessment Framework.
- Coordinate and promote capacity building and training activities in close cooperation with the GOFC-GOLD Fire Implementation Team regional networks and the EFFIS network.
- Promote dissemination of information and training on the use of GWIS methods and tools to the wildfire community and the general public, in cooperation with the National Aeronautics and Space Administration, Copernicus Communication Services, and the GEO Secretariat.

### **Contributors**

***GEO Members:*** Australia, Brazil, Canada, China, Netherlands, New Zealand, South Africa, Spain, United Kingdom, United States.

***GEO Participating Organizations:*** European Space Agency (ESA).

***Other Contributors:*** Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD).

### **Related GEO Work Programme Activities**

GEO-BON, GFOI, GDIS, GEO-DARMA, HUMAN-PLANET, GEO-ECO, GLOFAS, AFRIGEO, AMERIGEO, EUROGEO.

### **Point of Contact**

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## Oceans and Society: Blue Planet ([BLUE-PLANET](#))

### Overview

We live on a blue planet, and Earth's waters benefit many sectors of society. The future of our Blue Planet is increasingly reliant on the services delivered by marine, coastal and inland waters and on the advancement of effective, evidence-based decisions on sustainable development. Blue Planet is a network of ocean and coastal-observers, social scientists and end-user representatives from a variety of stakeholder groups, including international and regional organizations, NGOs, national institutes, universities and government agencies. GEO Blue Planet aims to ensure the sustained development and use of ocean and coastal observations for the benefit of society.

Blue Planet's mission is to:

- Advance and exploit synergies among the many observational programmes devoted to ocean and coastal waters;
- Improve engagement with a variety of stakeholders for enhancing the timeliness, quality and range of services delivered; and
- Raise awareness of the societal benefits of ocean observations at the public and policy levels.

### Planned Activities

Blue Planet has three standing working groups that implement cross-cutting activities:

- The ***Working Group on Stakeholders and Societal Awareness*** works to promote communication between those who need better knowledge of the ocean and coasts with those who are capable of producing that knowledge using ocean and coastal observation technologies.
- The ***Working Group on Capacity Development*** works to link and build on existing capacity development efforts related to sustained ocean and coastal observations, products and services. Best practices will be shared broadly with the GEO community.
- The ***Working Group on Data Discovery, Access and Utilization*** is working to share best practices and support activities to increase data discoverability and integration of data sets. The working group is particularly focused on supporting the advent of systematic and regular provision of analysis ready quality assured data.

There are also six working groups that address one of Blue Planet's thematic areas:

- The ***Understanding Flooding on Reef-lined Island Coasts (UFORIC) Working Group*** works to develop action plans that can be used globally, regionally, and nationally to help guide research and development activities related to understanding and predicting flooding along tropical coral reef-lined shorelines over the coming years.
- The ***Multi-hazard Information and Alert System for the Wider Caribbean Project*** is being implemented in partnership with the Intergovernmental Oceanographic Commission's Sub-Commission for the Caribbean and Adjacent Region (IOCARIBE) and its Regional Alliance with the Global Ocean Observing System IOCARIBE-GOOS, along with other stakeholders to develop a multi-hazard information system for the Caribbean and Adjacent Regions. The project will first focus on Sargassum and oil spills and expand to include additional hazards.

- The **Working Group on Earth Observations for Water-Associated Diseases** aims to identify benefits, best practices and feasibility of incorporating Earth observation measurements into early-warning systems for water-associated diseases.
- The **Marine Debris Working Group** is a collaboration between GEO Blue Planet and other partners focusing on the mounting global challenge of plastic pollution.
- The **Fisheries Working Group** will work with countries to identify needs and gaps in data availability and knowledge sharing for the fisheries community across local, regional and global levels and different types of fisheries and support the implementation of an open knowledge platform to empower decision makers.
- The **Coral Reef Working Group** will work with existing Coral Reef monitoring information systems to increase the discovery and accessibility of available data worldwide and encourage the registration of data in shared platforms.

### Contributors

**GEO Members:** Argentina, Australia, Belgium, Brazil, Canada, Chile, China, Denmark, European Commission, France, Germany, Greece, India, Ireland, Italy, Japan, Mexico, Netherlands, New Zealand, Norway, Philippines, Poland, Portugal, Seychelles, South Africa, Spain, Sweden, Switzerland, United Kingdom, United States.

**GEO Participating Organizations:** Committee on Earth Observation Satellites (CEOS), Global Climate Observing System (GCOS), Global Ocean Observing System (GOOS), Institute of Electrical and Electronics Engineers (IEEE), Integrated Carbon Observation System (ICOS), Intergovernmental Oceanographic Commission (IOC), International Union of Geodesy and Geophysics (IUGG), Partnership for Observation of the Global Ocean (POGO), UN Environment, United Nations Educational, Scientific and Cultural Organization (UNESCO).

**Other Contributors:** Tanzania, Central Caribbean Marine Institute (CCMI) of Cayman Islands, Coastal Dynamics Limited, Pacific Islands Forum Fisheries Agency, Organization of Eastern Caribbean States (OECS), University of the West Indies (UWI), World Wildlife Fund.

### Related GEO Work Programme Activities

GEO-BON, AQUAWATCH, EO<sub>4</sub>HEALTH, EO<sub>4</sub>EA, EO<sub>4</sub>SDG, GEO-DARMA, GEO-ECO, AOGEO.

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# Regional GEOs

## Africa Group on Earth Observations ([AFRIGEO](#))

### Overview

The development and uptake of Earth observation data, information and knowledge is critical to improving the socio-economic status of the African continent. The GEO Member States and Participating Organizations in Africa, comprising of 27 countries and nine regional institutions, recognize the need to improve and coordinate observation systems across Africa. Strong advocacy of open data-sharing policies and practices, as well as for increased use of Earth observations data and information, are the foundation of moving forward in these vital areas. Similarly, focusing significant effort on building human, institutional and technological capacities and capabilities will ensure that all parts of the African continent benefit from better access, understanding and use of Earth observations data, products and services. From these products and services information can be derived to better inform policy and decisions.

AfriGEO is an initiative of the African community in GEO aimed at providing a coordination framework and platform for Africa's participation in GEO. In addition, it is a:

- Pan African initiative to raise awareness and develop capacity on Earth observations for governments, research organizations and the commercial sector;
- Framework for strengthening partnerships and collaborations within Africa;
- Gateway into Africa for international partners; and
- Support mechanism for the implementation of GEO objectives and programmes in Africa.

For nearly a decade, several GEO programmes, initiatives and projects have focused on or included Africa in their scope. These activities included response to societal benefit requirements as well as access to Earth observation data, tools and products. Part way into the next decade of GEO, GEO initiatives need strengthened connections and to support the continuously growing African Earth observation community and the ongoing national and regional programmes in Africa. AfriGEO, aims to support GEO activities to strengthen linkages between current GEO activities and existing capabilities and initiatives in Africa. The initiative will provide the necessary framework for African countries and organizations to contribute to the GEO Work Programme. In addition, AfriGEO, through the decision of the 26th African Union Summit, will support the development and implementation of the African space programme and contribute to relevant environmental, socio-economic, science and technology African agendas.

The Secretariat has recently been moved to the Regional Centre for Mapping of Resources for Development (RCMRD) based in Nairobi. RCMRD was established in 1975 under the auspices of the United Nations Economic Commission for Africa (UNECA) and the African Union as a non-profit intergovernmental organization hosted in Kenya and presently has 20 contracting member States in Eastern and Southern Africa. RCMRD's mission is to strengthen the member States and our stakeholders' capacity through generation, application and dissemination of geo-information and allied technologies for sustainable development.

### Planned Activities

There are seven key areas of activity planned for 2020-2022:

- **Food security:** This includes coordination of GEOGLAM activities through AfriGAM to ensure countries have access to food security information allowing for evidence-based decision making by African governments.
- **Water resource management:** The AfriGEO Water Resource Management (AfriWRM) initiative aims at ensuring connections with GEO water activities such as GEOGloWS, GloFAS, Digital Earth Africa water service, and GEO-DARMA.
- **Sustainable Urban Growth:** This activity will assess the spatial extent of selected major African cities and map the key patterns of urbanization using Earth observations. It will promote sharing of methods and tools for building and geo-visualizing geographic urban infrastructure, extracting key urban features; and detecting patterns and trends.
- **Land Cover for Africa:** This activity will contribute to the development of a land cover programme which includes monitoring land cover change and land degradation for Africa at medium and high resolution.
- **Sustainable Forest Management:** This activity will identify and connect all sub-regional forest organizations into a network to facilitate sharing of best practices and challenges.
- **Climate Services and Adaptation:** This activity will provide climate information to governments for decision making purposes.
- **Data and Infrastructure:** This activity complements the GEOSS Platform and the GEO Knowledge Hub to provide end users with access to data, information, products and services.

## Contributors

**GEO Members:** Canada, China, Republic of the Congo, Egypt, European Commission, Gabon, Ghana, Kenya, Madagascar, Morocco, Nigeria, Senegal, South Africa, Spain, Switzerland, Uganda, United States, Zimbabwe.

**GEO Participating Organizations:** African Association of Remote Sensing of the Environment (AARSE), AGRHYMET Regional Centre, African Regional Centre for Space Science and Technology Education (ARSSTEE), Arab States Research and Education Network (ASREN), Central African Forests Commission (COMIFAC), Regional Center for Remote Sensing North Africa States (CRTEAN), Environmental Information Systems – Africa (EIS-AFRICA), Geoscience and Remote Sensing Society (GRSS), Sahara and Sahel Observatory (OSS), Regional Centre for Mapping of Resources for Development (RCMRD), United Nations Economic Commission for Africa (UNECA), UN Environment.

**Other Contributors:** Botswana, Namibia, Swaziland.

## Related GEO Work Programme Activities

GEOGLAM, GFOI, GEO-DARMA, GEOGLOWS, GLOFAS, DE-AFRICA.

## Points of Contact

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## Americas Group on Earth Observations ([AMERIGEO](#))

### Overview

AmeriGEO, formerly called AmeriGEOSS, was established in 2014 by the GEO members in the Americas and is a continuation of activities conducted in the framework of “GEOSS in the Americas” since the first GEOSS in the Americas Symposium was convened by Brazil in 2007.

AmeriGEO provides a framework for cooperation among countries in the Americas in the use of Earth observations, for the benefit of society. Of the 35 sovereign states in the Americas, of those, 16 countries have become formal members of GEO while two others are observers. AmeriGEO’s regional approach seeks to both take advantage of existing institutional and technical capabilities of its member countries and leverage resources of other GEO initiatives. AmeriGEO focuses its activities in the four priority areas selected at the 2014 Americas Caucus meeting: agriculture, biodiversity & ecosystems, disaster risk reduction, and water.

To provide strategic direction for cooperation and to advocate for the local and national interests, AmeriGEO members participate in regional and priority area working groups and other collaborations established through high-level cooperation agreements between and among countries in the Americas. AmeriGEO also seeks to increase institutional and personal capacity through cooperation, acquisition and sharing of technology, training, and through the engagement of experts, stakeholders, and decision-makers in the process of decision-making and implementation of sound policies. AmeriGEO facilitates a regional perspective within GEO’s 2020-2022 Work Programme by reflecting the local, national, and regional interests for short and long-term planning, development, and implementation of GEO activities in the Americas. GEO strategic objectives of relevance to AmeriGEO are also outlined in this document.

### Planned Activities

While AmeriGEO has made great strides from 2014 to 2019, new activities are planned to broaden the initiative’s engagement in the Americas and further advance its core mission. AmeriGEO plans to continue the activities of the AmeriGEO Coordination Working Group and hosting of the annual AmeriGEO events. It is also anticipated that the work will continue to focus on the four priority areas identified for AmeriGEO in 2014.

Other activities, some of which are in collaboration with other GEO Work Programme activities, include:

- ***Earth Observations for Indigenous-led Land Management*** (EO4ILM). Improving sustainable land management in the Americas by strengthening the technical capacities of indigenous peoples’ organizations;
- ***GEOGLAM Latino-américa***: Regional instance of GEOGLAM
- ***Pole-to-Pole Marine Biodiversity Observation Network of the Americas*** (P2P-Americas) builds a community of practice at the continental scale serving information needs of multiple national and international stakeholders for the conservation of marine living resources, in collaboration with Marine BON (GEO-BON).
- ***Synthetic Aperture Radar Capacity Building Centre*** (SAR-CBC): This project is developing targeted educational material, webinars, and on-site trainings that build capacity in the use of SAR-based Earth observation data in decisions-making. To sustain the use of SAR resources long term, this project is developing innovative cloud-based

data processing solutions that enable SAR data analysis without requiring expensive computing infrastructure.

- **Needs Assessment Protocol:** Development of questions, strategy for collecting information to establish priority working areas for Agricultural Monitoring in the Americas (AMA).
- **Resources Inventory:** Collection, organization, storage, and access promotion to Earth observations-related resources relevant in the Americas
- Earth observations information for disaster risk management;
- Earth observations data to support disaster risk reduction decision (in collaboration with GEO-DARMA);
- **AmeriGEOSS Platform:** Earth observations to products and services for communities
- **Global Flood Risk Monitoring:** Global Earth observations integrated assessment of flood risk on global scale;
- Wildfire information (in collaboration with GWIS);
- Geophysical and geohazard assessment for disaster risk reduction (with GSNL); and
- Global monitoring drought and water scarcity (in collaboration with GDIS).

### **Contributors**

**GEO Members:** Argentina, Belize, Brazil, Canada, Chile, Colombia, Costa Rica, Ecuador, Honduras, Mexico, Paraguay, Peru, United States.

**GEO Participating Organizations:** Conservation International.

**Other Contributors:** Guatemala, Coralwave.

### **Related GEO Work Programme Activities**

GEO-BON, GEOGLAM, GFOI, GDIS, GEO-DARMA, GEOGLOWS, GSNL, GWIS, EO4DRM, GFRM.

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## Asia-Oceania Group on Earth Observations ([AOGEO](#))

### Overview

Recognizing that Earth observation data, information and derived knowledge are critical for identifying vulnerabilities, monitoring and assessing impacts and informing the decision-makers, and the uneven development of the Asia-Oceania region and complexity of the geographic scope, there is an urgent demand to develop an integrated, shareable, and sustained observation system and to foster its application capacity. AOGEO will engage regional stakeholders, including national agencies and regional intergovernmental organizations, in global GEO activities and coordinate implementation of GEO activities within the Asia-Oceania region.

### Planned Activities

AOGEO will focus on the three areas of GEO's Engagement Strategy, including 2030 Agenda for Sustainable Development (SDGs), Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC), and the Sendai Framework for Disaster Risk Reduction by implementing three types of activities: Regional Application Activities, Foundational Tasks and Integrated Pilot Studies.

#### *Regional Application Activities*

- Asian Water Cycle Initiative (AWCI)
- Asia-Pacific Biodiversity Observation Network (AP-BON)
- GEO Carbon and GHG Initiative
- Oceans, Coasts, and Islands (OCI)
- Agriculture and Food Security (AsiaRiCE)
- Drought monitoring and Evaluation
- Environmental Monitoring and Protection (EMP)
- Disaster Resilience
- Himalayan GEOSS

#### *Foundational Tasks*

- Data Sharing
- Data Hub and Cubes
- User Engagement and Communication

#### *Integrated Pilot Studies*

- Mekong River Basin
- Small Island States
- Himalayan Mountains.

### Contributors

**GEO Members:** Australia, Bangladesh, Cambodia, China, India, Indonesia, Japan, Malaysia, Mongolia, Nepal, New Zealand, Pakistan, Philippines, Republic of Korea, Thailand, Vietnam.

**GEO Participating Organizations:** United Nations Food and Agriculture Organization (FAO).

**Other Contributors:** Lao People's Democratic Republic, International Rice Research Institute (IRRI).

### **Related GEO Work Programme Activities**

GEO-BON, GEOGLAM, BLUE-PLANET, GEO-DARMA, GEOGLOWS, GEO-GNOME, GEOARC.

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## European Group on Earth Observations ([EUROGEO](#))

### Overview

The EuroGEO Initiative was launched in 2017 and provides a regional framework to promote coordination and cooperation among the members of the European GEO Caucus. EuroGEO will achieve a critical mass in Europe by combining existing European Earth observation assets and initiatives and delivering pilot applications supporting governments in their decisions, boosting innovation and improving lives in Europe. EuroGEO will also strengthen the coordinated European contributions to major Flagships, Initiatives, Community Activities and Foundational Tasks of GEO.

EuroGEO builds on two major European Union programmes: Copernicus and Horizon 2020. GEO relevant elements of these major European Union-level programmes will be combined with elements of other European-level activities of European GEO members and Participating Organizations such as European Space Agency (ESA) and European Organization for the Exploitation of Meteorological Satellites (EUMETSAT).

EuroGEO intends to make a major contribution to the implementation of GEOSS and to foster GEOSS uptake by users in Europe. The GEO implementation plan available at the link above is a high-level document and does not provide the details of the implementation that are folded in the relevant European initiatives (references to those detailed implementation plans are provided throughout the document). In this context, it is important to note that EuroGEO is positioned as an integrator in Europe enabling to fold different public Earth observation downstream activities in Europe under the same umbrella.

Emphasis is and will be further put on the following actions:

- Identifying existing Earth observation applications under development in Europe with high potential to respond to consolidated European user needs, but requiring further demonstration, incubation, up-scaling, deployment or replication;
- Up-scaling selected pilot applications by streamlining innovation instruments available in the EU and internationally, to actively promote synergies;
- Connecting EuroGEO pilot applications and related GEO activities to allow for appropriate scaling-up (from national, through European up to global scale) and scaling-down (from global to regional scale);
- Showcasing GEOSS benefits to European citizens, science and businesses and promoting the GEO vision in Europe to realize a future where decisions and actions are informed by coordinated, comprehensive and sustained Earth observations and information.
- Supporting the consolidation of national GEO structures across Europe.

EuroGEO builds upon, networks and promotes further incubation and scaling-up of the most promising user-driven applications conducted at national or European Union levels by the members of the European GEO Caucus. Particular emphasis is put on tackling as far as possible the 'last mile' of the innovation process, thus enabling pre-operational services that could extend/reinforce other GEO initiatives and flagships. This will accelerate the transformation of GEO from a data-centric to a user-driven partnership.

While especially Copernicus with its infrastructure, data and services builds a strong basis, European funded projects such as e-shape (EuroGEOSS Showcases: Applications powered by Europe), PARSEC (Promoting the international competitiveness of European Remote Sensing companies through Cross-cluster collaboration) and the upcoming new Coordination and

Support Action on commercial actors in the field of Earth observation are contributing to this endeavour downstream of Copernicus.

EuroGEO pilot applications will take full advantage of the infrastructure, data and information products delivered by Copernicus and the core Copernicus Services, the EU operational programme for Earth observation. The selected pilots are or will be of direct relevance to the GEO Engagement Priorities whilst leveraging global and European EO initiatives to improve/facilitate the implementation of European environmental policy.

After the initial start in 2017 and a number of preparatory steps in 2018, such as the setting-up of Action Groups, EuroGEO has entered the next stage with the launch of major European funded projects and the consolidation of the Copernicus infrastructure. The first outcomes of those projects will consolidate the specific demand for GEOSS solutions in Europe, facilitate interaction with and contribute to relevant GEO actions and stimulate the innovation process tackling unaddressed regional needs.

EuroGEO has a light governance structure to support greater engagement by the Members of the European GEO Caucus. The structure includes a Coordination Group, jointly chaired by the Commission (Directorate General Research and Innovation (DG RTD) and the Directorate General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW)) and implementation working groups bringing together existing relevant initiatives.

### **Planned Activities**

EuroGEO already has an impact on the Earth observation landscape in Europe since its inception in 2017. In the coming years, new activities are planned to continue and strengthen the initiative in Europe, and thus together with the Copernicus Programme, further strengthen the European contribution to GEO. This will be done in close cooperation with the EuroGEO Coordination Group and the Action Groups. Close interactions with the GEO Flagships, Initiatives, Community Activities and the Foundational Tasks have been and will be pursued.

The main spheres of activities to be conducted by the EuroGEO Initiative are as follows:

- Coordination of GEO-relevant activities undertaken in Europe to ensure a coherent European contribution to GEOSS;
- Combination or integration of activity outputs to provide added value and to reach maximize user uptake and engagement;
- Cooperation beyond individual programmes and user communities;
- Coordination with other Regional GEOs.

### **Points of Contact**

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# GEO Community Activities

## Advancing Communication Infrastructure and Services ([ACIS](#))

### Overview

The transmission and exchange of data used in GEO and geospatial research relies upon several communication layers and distribution systems. These layers and systems, controlled by different actors, when inter-mixed form a transparent underlying service otherwise known as the internet. In some respects, these layers are operated by various private (commercial), non-profit, governmental and non-governmental organizations to form a communications commons on which the GEO community relies for its systems and services to work. ACIS, through collaboration with existing and new contributors, will explore possibilities of making non-commodity communication infrastructure resources available and advocate for adequate resources to develop the communication infrastructure that will ensure wider and sustainable access to and use of Earth observations data and information.

### Planned Activities

- Continue engagement and support for AfriGEO, aligning to their strategic aims;
- Engage and align with AmeriGEO strategic aims to assist in outreach to Earth observations research organizations and data centres in Latin America;
- Engage with GEO Flagships and Initiatives to assess network requirements and possible improvements of data dissemination and federated identity management services;
- Support National Research and Education Networks (NRENs) to discuss existing communication infrastructure, requirements and developing activities in various world regions which are aligned to GEO Flagships and initiatives;
- Provide assistance to the GEO-Amazon Web Services Cloud Credits programme;
- Investigate state-of-the-art information technologies, such as trust and identity and cloud services, available through existing and potential contributing networks and how these may be applied to GEO Flagships, Initiatives and Community Activities;
- Engage with GEO community data providers to seek potential cooperation with and requirements to the GEO communication infrastructures and associated services;
- Investigate a potential trust and identity architecture which would allow GEO activities to interconnect with other trust and identity Authentication and Authorization Infrastructures (AAIs) and regional research collaborations, such as the European Open Science Cloud (EOSC).

### Contributors

**GEO Members:** South Africa.

**GEO Participating Organizations:** Arab States Research and Education Network (ASREN), GÉANT.

**Other Contributors:** West and Central African Research and Education Network (WACREN), UbuntuNet Alliance.

### **Points of Contact**

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## Arctic GEOSS ([ARCTIC-GEOSS](#))

### Overview

The rapid on-going changes in the Arctic present an urgent need to better observe, characterize and quantify processes and properties of the Arctic system. A full integration of ground-based and satellite segments of observing system is fundamental to achieve this overarching target.

Arctic GEOSS represents a collaboration between Sustaining Arctic Observing Networks (SAON) – a joint initiative of the Arctic Council and the International Arctic Science Committee (IASC) – and the GEO community to advance SAON’s Vision of a connected, collaborative, and comprehensive long-term pan-Arctic Observing System that serves societal needs.

The SAON process was established in 2011 via the Arctic Council Nuuk Declaration. This declaration recognizes the importance of the SAON process as a major legacy of the International Polar Year for enhancing scientific observations and data-sharing.

SAON’s Strategy is based on the following three goals:

- Create a roadmap to a well-integrated Arctic Observing System;
- Promote free and ethically open access to all Arctic observational data; and
- Ensure sustainability of Arctic observing.

With ArcticGEOSS, the SAON goals will extend to encompass policy relevant services as the link from the observing system to societal benefits. The need for this link has been identified in The International Arctic Observations Assessment Framework.

In the European Commission Work Programme 2018-2020, there is a call for “Supporting the implementation of GEOSS in the Arctic in collaboration with Copernicus”. The aim of the project is to advance “the operationalization of an integrated pan-Arctic Observing System in preparation for a possible future ArcticGEOSS initiative”. The ArcticGEOSS Community Activity will be supported through a project proposal to be submitted in a response to this call.

### Planned Activities

#### *Create a roadmap to a well-integrated Arctic Observing System*

To create and sustain an Arctic Observing System, it is essential for participating parties to adopt a community-endorsed framework. The International Arctic Observations Assessment Framework provides such a starting point. Arctic GEOSS can assist in further developing and implementing this framework to identify critical observations, products, and services that are relevant to the Arctic Observations value tree. A holistic benefit analysis can then be used to assess the responsiveness of current observing system and identify potential expansions. The results of this analysis will be central to the creation of a roadmap to well-integrated Arctic observing that is responsive to Societal Benefit Areas. This roadmap will also be used to identify funding sources to support infrastructure required for sustaining or adding new observational capabilities as well as technological innovations to improve observation capacity.

#### *Promote free and ethically open access to all Arctic observational data*

In various contexts it has been agreed that the key current challenges impeding development of a globally-connected, interoperable system are social and organizational rather than technical: supporting human networks, promoting standards, and aligning policy with implementation.

A review of relevant Arctic data management efforts and results have shown the need for an open, interconnected, international system for sharing data across disciplines, domains, and cultures. Requirements and characteristics of such a system include but are not limited to:

- A distributed design that connects different data repositories and other resources. This implies and requires interoperability that supports sharing data among various information systems in a useful and meaningful manner;
- Many linked catalogues fostering 'single window' search;
- High quality, ethically open data sustainably preserved over time;
- Data as a responsive, "live" service rather than simple download approach;
- Inclusive of Indigenous and local perspectives and information;
- Access to "big data" and powerful analytical tools (e.g. cloud platforms); and
- Cost effective, maximizing the investments made to develop and maintain the system.

In recognizing the elements of the envisioned system and the key challenges identified by the community, Arctic GEOSS will focus on improving connections and cooperation between actors. This will be achieved by working with the global Arctic data community, including data providers, data scientists, funders, users and beneficiaries within society. This effort will provide the necessary collaborative foundation needed to achieve the desired system.

### **Contributors**

***GEO Members:*** Canada, Finland, Iceland, Norway, United States.

***GEO Participating Organizations:*** Sustaining Arctic Observing Networks (SAON).

### **Point of Contact**

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## Chinese High-resolution Satellite Data Resources ([CSDR](#))

### Overview

Since the implementation of the [UN Global Mapping Project](#), Member States, including China, have been actively supporting and conducting related work benefitting the sustainable development of society and economy at domestic, regional and global levels. In recent years, the Chinese government proposed the Belt and Road (B&R) Initiative and started the co-construction with B&R countries to promote global commerce, investment and technical cooperation. The Ministry of Natural Resources (MNR) of the People's Republic of China – the former National Agency of Surveying, Mapping and Geo-information (NASG) – has launched a programme to serve the B&R region with the acquisition, processing, and application of geo-information to assist the geospatial industry, institutions, commercial sectors in the global co-construction and sharing of surveying, mapping and geo-information, where it has accumulated the sufficient international Earth observations achievements of products, resources and experience.

The Cloud Service Platform of Natural Resources Satellites Images (SatCloud) initiated by Land Satellite Remote Sensing Application Center, MNR (LASAC) is capable of meeting the demands of remote sensing data for natural resources management. SatCloud has a client management system and an instant push system as well, providing management services, distribution services and real-time push services for latest acquired images of China domestic high-resolution satellites. SatCloud with high-resolution satellite images has been applied to government agencies and other relevant organizations during the last 2 years. It provides data query, data purchase, data instant push, and other related services. At present, LASAC has the partners of 15 countries which have co-constructed 15 nodes in 4 continents of the network by bi-literal cooperation, while some of them are also the members of GEO. This network and mechanism are desired to take leveraging of GEO framework to strengthen and expand the network construction with more substantial outcomes. For CSDR, on one hand, partners of SatCloud will be in this CSDR programme continually to make joint efforts to promote the applications, research and engineering of Earth observation remote sensing satellites images for natural resources management. On the other hand, the construction of data sharing, data exchange, and other forms of cooperation of sharing satellite resources are implemented in CSDR network.

Through the service model and mechanism of CSDR, Chinese high-resolution satellite image data, mapping products and data processing technologies can be contributed to GEO members to support applications in developing countries, small islands, and south-south cooperation for the sustainable and harmonious development.

To accelerate the data applications, planned activities include construction and updates of the SatCloud and the multi-satellite radiation and geometric calibration will be conducted with the collaboration of Turkey, Jordan, Germany, Austria, France and others to guarantee data precision and the status of the satellites.

The CSDR high-resolution satellite image network architecture and application regulations will be established, in situ data cooperation and field investigation for geo-information will also be conducted in associated countries, such as in Zimbabwe and Laos.

### Planned Activities

In general, the activities have been and will be conducted through joint research, technical projects and activities; organization of seminars, workshops and training courses; development of

regional cooperation mechanism and infrastructure network; data sharing and results publishing of scientific studies and cooperative projects in the cooperation areas, which are listed as but not limited to the following:

- Construction of [SatCloud](#) to provide satellite data and services to partner countries;
- Node construction of SatCloud in associated countries and the expansion of the network;
- High-resolution remote sensing data processing, joint calibration and products verification;
- Generation and update of 1:25,000 and 1:50,000 geospatial information products based on natural resources satellite images, mainly on ZY-3;
- Geospatial information extraction and change detection based on remote sensing technology;
- Remote sensing and GIS applications in agriculture, forestry, water conservancy, land resource management, urban planning, ecological environment, disaster prevention and alleviation, and other areas.

In the year 2020, key activities are as below:

- Establish the CSDR administrative body, joint research centre and secretariat;
- Provide non-charge Chinese natural resources satellites data for co-constructing technical experiments and testing, while strengthening the service model and cooperation mechanism;
- Build more international nodes for partners in the on-going CSDR programme;
- Discuss the long-term development goals and short-time action plans;
- Conduct exchange visits and technical collaboration, and co-host workshop and training courses based on SatCloud network.

### **Contributors**

*GEO Members:* Australia, Austria, China, Germany, Ghana, Nepal, United Kingdom, Venezuela.

### **Points of Contact**

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## Climate Observation, Simulation and Impacts ([CLIMATE-OBS](#))

### Overview

Earth-orbiting satellites have enabled scientists to collect many different types of information about our planet and its climate on a global scale. This body of data, collected over many years, reveals the signals of a changing climate.

This Community Activity aims to enable the integration of GEOSS with the Earth System Grid Federation (ESGF) and other world-wide climate data systems to augment GEOSS's observation data with climate reanalysis data, and Earth system model simulation data to present the past, current, and future climate information. This enhanced climate data access capability in GEO will benefit studies in many domains, including biodiversity and ecosystem sustainability, disaster resilience, food security and sustainable agriculture, public health surveillance, and sustainable urban development.

Focusing on the impacts of changing climate, this community activity will further present how water, energy, transportation, wildlife, agriculture, ecosystems, and human health experiencing the effects of a changing climate. This is expected to raise public awareness of a changing climate by enabling access to the climate data, and by presenting its impacts.

### Planned Activities

- Leverage the Intergovernmental Panel on Climate Change (IPCC) / World Climate Research Programme (WCRP) Coupled Model Inter-comparison Project (CMIP) infrastructure for access to climate model outputs under the ESGF collaboration;
- Promote wider development and use of ESGF for climate simulations at all spatial and temporal scales and Earth system domains, including regional downscaling as in the Coordinated Regional Climate Downscaling Experiment (CORDEX), seasonal and decadal predictions, and WCRP Core Projects model development and inter-comparison initiatives;
- Advance GEO collaborations and linkages to NASA's Collaborative Reanalysis Technical Environment (CREATE) reanalysis clearinghouse and Reanalysis.org;
- Collaborate with the Decadal Forecast Exchange data; links with contributions from the Copernicus Climate Change Services; and
- Leverage GlobalChangeONE to enable a collaborative analysis paradigm for reanalyses, observational data and climate simulations.
- Collect, organize, and present the impacts of a changing climate on water, transportation, agriculture, ecosystems, and other areas in a dedicated GEO Climate community portal.

### Contributors

*GEO Members:* China.

*GEO Participating Organizations:* World Climate Research Programme (WCRP), World Meteorological Organization (WMO).

### Points of Contact

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## Copernicus Atmosphere Monitoring Service ([CAMS](#))

### Overview

The Copernicus Atmosphere Monitoring Service (CAMS) is one of the 6 core services of the European Union's flagship programme Copernicus. It provides consistent and quality-controlled information, based on Earth observation, related to air pollution and health, solar energy, greenhouse gases and climate forcing, anywhere in the world. All these CAMS information products are available to all, following a full, free, and open data policy.

CAMS has been operating in operational mode since 2015, building on a decade of research and development precursor projects and user consultation. CAMS is managed and partly implemented by European Centre for Medium-Range Weather Forecasts (ECMWF) and partly by means of contracts involving over 130 public and private entities from more than 28 European countries. The work programme of CAMS beyond 2021 will seek enhanced continuity and will depend upon the wider programmatic elements of the future Multi-Financial Framework of the European Commission and, in particular, the future space regulation.

### Planned Activities

CAMS will continue to deliver its portfolio of operational information products and services throughout the period.

In 2020, CAMS activities will include:

- Consolidation of the operational use of all the Sentinel-5p products available – ozone , nitrogen dioxide, carbon monoxide, sulphur dioxide, formaldehyde and methane – and of Sentinel-3 data – aerosol optical depth (AOD) and fire radiative power (FRP) as soon as available – in the CAMS global system;
- Promotion of the first CAMS reanalysis, covering 2003 to present (calculation to be completed to cover the entire year 2018 in 2019, and the year 2019 in 2020);
- Extension from seven to nine members of the operational regional air quality ensemble, expected to bring additional performance and resilience to issues;
- Upgrade to fully new emissions datasets for both global and regional systems operations;
- Completion of the migration of CAMS products onto the Atmosphere Data Store (ADS) and Data and Information Access Services (DIAS); and
- Continuation of efforts to consolidate the use of CAMS policy products at the European and international levels, as well as to increase their uptake at national level.

### Contributors

*GEO Participating Organizations:* European Centre for Medium-Range Weather Forecasts (ECMWF).

### Related GEO Work Programme Activities

EUROGEO.

### Point of Contact

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## Copernicus Climate Change Service ([C3S](#))

### Overview

The Copernicus Climate Change Service (C3S) routinely monitors and analyses more than 20 Essential Climate Variables (ECVs) to build a global picture of our climate, from the past to the future, and to develop customizable climate indicators for relevant economic sectors, such as energy, water management, agriculture, insurance, and health.

C3S complements the established range of national meteorological and environmental services. Strong involvement of current service providers and academic communities ensures that C3S fully benefits from existing infrastructure and knowledge. The C3S service elements are procured by competitive tender and are delivered by about 200 companies and organizations across Europe.

### Planned Activities

The current Delegation Agreement signed between the European Centre for Medium-Range Weather Forecasts (ECMWF) and the European Commission covers the period November 2014 until December 2020, although some provisions have been made to continue operations until mid-2021. Thus, the implementation plan only includes activities envisaged until the end of 2020 (assuming continuity of six months into 2021).

As C3S has just become “operational”, much effort during 2020 will be dedicated to the consolidation of the Service, in many aspects:

- Inclusion of additional climate datasets into the Climate Data Store;
- Continued production of climate data records for climate monitoring, including from global and regional reanalyses;
- Development of an optimal environment for downstream applications and use cases on the Climate Data Store toolbox in a wide variety of economic sectors;
- Quality assurance mechanisms and processes to ensure authoritativeness of the Service;
- Full deployment of a training strategy, including an ambitious train-the-trainer programme, focused towards Europe but also supporting third countries and programmes in need of climate information for their own services; and
- More generally, improvement of the quality of service, including user support, performance of the CDS, and documentation.

New prototype service elements will be consolidated in 2020, corresponding to important demands by the user community for an attribution service element and a decadal (5-10 year) prediction element.

### Contributors

**GEO Participating Organizations:** European Centre for Medium-Range Weather Forecasts (ECMWF).

### Related GEO Work Programme Activities

EUROGEO.

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## Digital Earth Africa ([DE-AFRICA](#))

### Overview

The United Nations Sustainable Development Goals (SDGs) are a global effort to address social, economic and environmental challenges across all countries by 2030. These ambitious goals require new approaches in using data, creating challenges and opportunities for earth observation. A massive continent with rich and diverse environments, Africa faces challenges of climate change and environmental degradation, illegal mining, land degradation, water quality decline, deforestation and food insecurity. These challenges are taking their toll on communities and ecosystems.

The Data Cube ([www.opendatacube.org](http://www.opendatacube.org)) was first developed and operationalized in Australia ([www.ga.gov.au/dea](http://www.ga.gov.au/dea)), where it is transforming the use of earth observations in government decision-making and private sector innovation. Digital Earth Africa (DE Africa) will develop a continental-scale Data Cube for Africa, providing a routine, reliable and operational service enabling African nations to track changes across countries in unprecedented detail. With a land area of over 30 million square kilometres, DE Africa will be the world's largest continental Data Cube. DE Africa products and services will enable policy makers, scientists, private sector and civil society to address social, environmental and economic changes on the African continent and develop an ecosystem for innovation.

Digital Earth Africa will process openly accessible and freely available data to produce these decision-ready products. DE Africa will be responsive to the information needs, challenges and priorities of the African continent. DE Africa will leverage and build on existing capacity to enable the use of Earth observations to address key challenges across the continent.

Digital Earth Africa will be developed and operated to deliver the following outcomes in Africa:

- Countries are empowered, with national data and information relating to challenges of land, water, the environment, resources, and human population.
- Lives are improved, through access to information that empowers governments, individuals and communities to make informed decisions and choices.
- Development activities are more effective, through access to and use of information that improves the understanding of issues and solutions. Continental assessments, reporting, and responses are advanced through access to continental scale data and information products relevant to Agenda 2030 and the Sustainable Development Goals.
- Digital transformation is advanced, through industry uptake and innovation using products and services from DE Africa.
- Economic development and job creation are increased, through access to data for commercial products and services development.

### Planned Activities

The key activities to be achieved for the 3 year establishment of DE Africa are outlined below.

#### *Setting the foundation (Year One):*

- Define the mission and vision, and develop and implement the governance framework;
- Establish institutional hosting arrangements and DE Africa Office, recruit staff;
- Deliver DE Africa Day and key events;
- Deliver a continental-wide beta water observations from space product;

- Develop key strategies for communications and stakeholder engagement, partnerships, and capacity building;
- Establish key partnerships with in-country enablers and others, and ensure alignment with relevant initiatives, programs and institutions;
- Develop a technical roadmap; and
- Build the DE Africa data and ODC infrastructure.

***Building capacity and uptake (Year Two):***

- First DE Africa Annual Users Meeting;
- Implement the technical roadmap;
- Deliver 3 continental-wide products;
- DE Africa Office operating and fully staffed;
- Regular training and capacity building program in place;
- Engage at the country level on uptake of DE Africa products;
- Increase the ability for African countries to exploit DE Africa products and services;
- Produce a study on the economic value of EO data for Africa;
- Increase comprehensive stakeholder engagement; and
- Secure co-investment from additional philanthropic/aid agencies.

***A developing ecosystem (Year Three):***

- Deliver 5 continental-wide products;
- Deliver case studies on the impact of EO data on decision making in Africa;
- Demonstrate a developing business case for direct country-level investment based on delivered value;
- Demonstrate cases of products and services from DE Africa being independently ingested into new, innovative applications; and
- Develop a sustainability plan for the continued operations of DE Africa.

**Contributors**

***GEO Members:*** Australia, Ethiopia, Ghana, Kenya, Niger, Nigeria, Senegal, Sierra-Leone, South Africa, United States.

***GEO Participating Organizations:*** African Regional Institute for Geospatial Information Science and Technology (AFRIGIST), AGHRYMET Regional Centre, Committee on Earth Observation Satellites (CEOS), Global Partnership for Sustainable Development Data (GPSDD), Regional Centre for Mapping of Resources for Development (RCMRD), United Nations Economic Commission for Africa (UNECA).

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**Related GEO Work Programme Activities**

AFRIGEO.

**Point of Contact**

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## Earth Observation and Copernicus in Support of Sendai Monitoring ([EO4SENDAI-MONITORING](#))

### Overview

The United Nations included seven global targets in the Sendai Framework for Disaster Risk Reduction 2015-2030 (Sendai Framework) and agreed on 38 indicators to measure the global progress in implementing the Framework. Monitoring the status and degree of target achievement uniformly across the globe requires the use of various data sources (e.g. official data, media reports, insurance data), which should be consistent and comparable in time and space. In the majority of states, however, the 38 Sendai indicators are currently not recorded in the way they should be reported to United Nations Office for Disaster Risk Reduction (UNDRR) and data gaps pose a challenge to the reporting mechanism. Data gaps could be closed by new technologies, such as satellite remote sensing information, such as provided by National Aeronautics and Space Administration (NASA) or the European Copernicus Earth observation programme – both provide open and free satellite data and various, value-added products relevant for disaster and risk management. In the aftermath of a disaster, satellite images of affected areas can identify the spatial extent of an event and identify the degree of destruction. Such information is of potential value to support the mandated national agencies with Sendai Framework implementation and monitoring. However, such progress must be incorporated into official procedures of these reporting agencies.

In order to foster the uptake of this technology, EO4SENDAI-MONITORING aims at exploring how Earth observations can support the implementation of the Sendai Framework, specifically by developing guidelines and good practices for deriving selected Sendai indicators. Through this activity, the use of Earth observations can be maximized to support national Sendai Focal Points in the Sendai reporting by providing better and more consistent methods and – where possible – valued added products from remote sensing to support the Sendai monitoring process. To this end, EO4SENDAI-MONITORING intends to improve and validate existing procedures and to develop new, EO based methods in order to derive data and services for the Sendai Framework monitoring. The activity will facilitate knowledge transfer, sharing good practice guidelines and methodologies, and cooperation among national focal points and data providers. By closing gaps in the data base, it is expected that the activity's outcomes will support Sendai Framework monitoring at national levels, strengthen the capacity of member countries to respond to the Sendai Framework, and eventually help increasing preparedness for disaster response and strengthen disaster resilience.

### Planned Activities

- Systematic assessing the feasibility of Earth observations to derive Sendai indicators through a comprehensive evaluation of available space-based data, methods, and products;
- Developing methodologies, products and procedures that can be implemented by Sendai Framework focal points in their national context;
- Convening workshops and strengthening capacity to facilitate knowledge transfer and cooperation between end-users (for example, national Sendai focal points) and data providers/space agencies; and
- Developing and publishing good-practice guidelines to facilitate uptake of Earth observation technology.

## **Contributors**

*GEO Members:* Germany.

## **Related GEO Work Programme Activities**

GEO-DARMA, EO4DRM.

## **Points of Contact**

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## Earth Observation Industrial Innovation Platform for Sustainable Development ([EO-IIP](#))

### Overview

Increasingly advanced Earth observation technologies are driving explosive growth in Earth observation data. However, the operational application solutions tend to lag behind the emerging techniques and data available. It turns out that the capacity of integrating all resources available to form solutions is very significant to the Earth observation industry and there is a great need for a platform to accommodate solution development and to facilitate capacity building, in particular for developing countries.

In order to enhance the integration capacity of Earth observation industry, and to enable prototyping of a cooperative platform for the development of application solutions based on cloud computing technology, an Earth Observation Industrial Innovation Platform for sustainable development (EO-IIP) is presented to incorporate the advantages of various practitioners and promote better application of Earth observation products and services, as well to foster the adoption of the innovative technologies. EO-IIP will enable easy access and sharing of a wide range of Earth observation resources and create an attractive and transparent forum for practitioners and stakeholders to communicate their concerns and interests to form a virtuous circle for the sustainable development of the Earth observation industry.

EO-IIP will also establish an operational application solutions pool of Earth observation for cooperation and integration. The platform is also open to academic communities and will jointly contribute to operational technologies and real-world problem solving. It will benefit industrial and academic communities, local governments, international organizations, enterprises, capacity building stakeholders, and others, thus the project can continuously serve and inform a wide range of areas for sustainable development, climate change and disaster risk reduction as well.

### Planned Activities

The key activities are generally planned in three categories:

- Organize and manage the systems of project in order to design the plans and maintain the development agenda on key issues;
- Build a forum to activate interactions with various stakeholders and review the needs and trends, and as well to organize high quality technical exhibitions and expert panels to attract practitioners;
- Prepare guidelines on the use and contribution of best practices and project resources, to pay efforts for capacity-building, to facilitate international collaboration and support appropriate GEO activities by providing industrial expertise.

### Contributors

GEO Members: China.

### Points of Contact

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## Earth Observations for Disaster Risk Management ([EO4DRM](#))

### Overview

The Sendai Framework for Disaster Risk Reduction 2015-2030 includes two articles with explicit references to satellite Earth observation and several articles that refer to topics for which satellite observations are needed (for example, geospatial information or risk maps). This activity aims at improving disaster risk management and reduction by providing timely risk information relevant to the full cycle of disaster management (mitigation, preparedness, warning, response and recovery) and will be used both directly by the end-user community including the decision makers that have to take appropriate resilience and Disaster Risk Reduction measures as well as Disaster Risk Management (DRM) more broadly, and by intermediate users such as science and research institutes that inform the actions of end users.

EO4DRM builds on existing CEOS thematic pilots and demonstrators already underway with a view to creating a broader community of users and ensuring better linkages to end user communities. CEOS has implemented four thematic pilots, three which were completed in 2017 (Floods, Seismic Hazards, and Volcanoes) and a fourth (Landslides) which will be completed by the end of 2020. These pilots were started under the 2012-2015 GEO Work Plan and have produced multiple risk products that have been taken up by civil protection agencies and other end users and have generated new science products based on Earth observation data. In the case of Volcanoes and Seismic Hazards, new demonstrators have begun, with a view to achieving broader user uptake and sustainable financing for long-term applications.

### Planned Activities

- Improve disaster risk management and reduction by providing timely remotely sensed and in situ information relevant to the full cycle of disaster management (mitigation, preparedness, warning, response, and recovery);
- Work in close coordination with International Charter: Space and Major Disasters, Sentinel Asia, Copernicus Emergency Management Services, and SERVIR to improve the full cycle of DRM;
- Implement the current strategy from the CEOS agencies to better contribute to all phases of DRM, in response to the needs of the user community;
- Promote timely and reliable access to in-situ data required in emergency events, and its coordination and integration with satellite-based products;
- Coordinate efforts towards a more-timely dissemination of information from globally coordinated systems for monitoring, predicting, risk assessment, early warning, mitigating, and responding to hazards at local, national, regional, and global levels;
- Demonstrate the validity of regional end-to-end systems through multi-actions single hazard Pilot demonstrators with an initial focus on Seismic Hazards and Volcanoes, with direct involvement of the user community;
- Demonstrate the validity of multi-hazard Pilots such as a possible Generic Recovery Observatory, a multi-year activity which aims to analyze recovery of severely damaged areas after the International Charter Space and Major Disasters data provision period ends;
- Integrate Early Haiti Recovery Observatory evaluation and concept work on Generic Recovery Observatory, to establish a new Recovery Demonstrator (multi-year activity which aims to analyze recovery of severely damaged areas after the International Charter

Space and Major Disasters data provision period ends) aimed at demonstrating the validity of multi-hazard analysis and increasing the use of satellite Earth observations for recovery;

- Improve the quality of risk information generated by the Pilots/Demonstrators by combining space data with relevant in situ data.

### **Contributors**

***GEO Members:*** Canada, China, European Commission, France, Germany, Italy, Japan, United States.

***GEO Participating Organizations:*** Committee on Earth Observation Satellites (CEOS), European Space Agency (ESA), UN Environment, United Nations Institute for Training and Research (UNITAR), The World Bank.

***Other Contributors:*** United Nations Development Programme (UNDP).

### **Related GEO Work Programme Activities**

GEO-DARMA, GSNL.

### **Points of Contact**

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## Earth Observations for Managing Mineral and Non-Renewable Energy Resources ([EO4MIN](#))

### Overview

In a global context where a tremendous demand for minerals and raw materials is expected to face the needs for a low-carbon society and renewable energy production, Earth observation data, including in-situ data, can contribute to the production of objective, reliable, affordable and authoritative products and information. These can be used to: i) assess mineral resources, and ii) educate, demonstrate, inform, alert and reassure the general public on the impacts of mining and enforce regulation, thereby contributing the UN Sustainable Development Goals.

The overarching goals of the EO4MIN Community Activity are to develop web-based platforms for Earth observations data collection, management and processing to make publicly accessible tools and services for the:

- Assessment, monitoring and forecasting of geological resources (including mineral and fossil resources, and raw materials); and
- Monitoring of environmental and societal impacts of mining operations, in particular, in a Social License to Operate perspective.

### Planned Activities

During 2020-2022, actual and planned activities will focus on the acquisition of data and knowledge that together will enable reaching these goals on a longer term. These include:

- Identification of essential variables relevant of the extractive industries that can serve for the assessment and monitoring of their footprint;
- Acquisition of soil reflectance reference spectra and the contribution to global and/or regional Soil Spectral Library made accessible through dedicated portal(s);
- Development, in the QGIS environment, of dedicated algorithms for global soil and mineral mapping applications that will be freely available from the web, worldwide; and
- Implementation of capacity building programmes to develop skills and expertise at the intersection between Earth observations data and stakeholders in the mining sector.

### Contributors

**GEO Members:** Australia, Austria, Czech, France, Germany, Ghana, Greece, Israel, Switzerland, United Kingdom.

**GEO Participating Organizations:** The Association of the Geological Surveys of the European Union (EuroGeoSurveys), UN Environment.

**Other Contributors:** EIT Raw Materials.

### Related GEO Work Programme Activities

GEO-CRADLE, GEO-VENER.

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## Earth Observations for the Atlantic Region ([ATLANTIC-EO](#))

### Overview

In 2015, UN members agreed on the 2030 Agenda for Sustainable Development, defining 17 Sustainable Development Goals to be achieved over the next 15 years. Implementing and monitoring progress toward many of these goals depend on comprehensive information on, and knowledge of, the oceans. Earth observation data and monitoring systems have proven to be an effective solution for a deepened understanding of the marine environment and, as a result, can support the development of better responses to emerging challenges. Atlantic-EO is an initiative proposed in the context of the Atlantic International Research Centre (AIR-Centre), focusing on an integrated approach for Earth observation-based services.

The goals of Atlantic-EO are: 1) to develop an integrated Earth observations framework that promotes collaboration and sustainable growth within the Atlantic countries, and 2) to engage with communities to identify and develop opportunities for Earth observations information and services, serving the region's societal needs.

Atlantic-EO is focused on marine, maritime and coastal application areas, such as monitoring marine biodiversity and protected areas, fishing and aquaculture, and marine spatial planning. Geographically, the initiative is based on the extension to the South Atlantic of the Galway Statement - the [Belém Statement](#), signed between the European Commission, South Africa and Brazil. The initiative comprises institutions from many Atlantic states from Europe, Africa and America to facilitate the creation of value-added services for federated users in support to decision-making processes.

The four pillars of the Atlantic-EO are:

- Federating user needs for the Atlantic leveraged mostly on the AIR-Centre's extensive network;
- Matching user needs with proven Earth observation technology and scientific players in Atlantic bordering countries;
- Engaging international and national funding institutions to support the initiatives with highest impact; and
- Promoting dedicated capacity building to ensure the local and widespread sustainability of the activities.

### Planned Activities

For 2019, the focus will be on the consolidation of the support for the Atlantic-EO initiative and engagement of stakeholders, particularly through the AIR-Centre network and meetings, and on the consolidation of the implementation plan, in coordination with the GEO Secretariat. A task will be set up to identify relevant initiatives, programmes and projects in the Atlantic area in order to develop synergies and avoid overlapping with existing activities. The resources for the Atlantic-EO initial setup in 2019 will be provided as in-kind contributions from the participants in the initiative. Funding for an initial batch of activities for 2020-2022 will also be pursued during this period through identified opportunities and with the coordination of the participants in Atlantic-EO.

Starting in 2020, the governance structure will be defined and set up, and the cycles of User Federation and Challenge Identification -- Preliminary Technical Assessment -- Funding Rounds

and Selection of Activities -- Implementation in Co-design -- Capacity Building -- Operations will be promoted for the activity areas identified by the federated users.

### **Contributors**

*GEO Members:* Brazil, Germany, Ghana, Norway, Portugal, South Africa, Spain, United Kingdom.

*Other Contributors:* Sao Tome and Principe, Atlantic International Research Centre (AIR-Centre).

### **Related GEO Work Programme Activities**

AQUAWATCH, BLUE-PLANET, EO4SDG, GEO-DARMA, GEOGLOWS, GSNL, GEO-ECO, AFRIGEO, AMERIGEO, EUROGEO.

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

### Overview

The EO4WEF Community Activity, with support from the Sustainable Water Future Program and Future Earth, is seeking to implement Water-Energy Food (W-E-F Nexus) data and information systems on appropriate spatial scales to provide advisory services to those decision-makers and policy advisors concerned with national or regional applications of the W-E-F Nexus principles. In addition, these systems will support contributions to global-scale knowledge systems and initiatives aimed at more broadly implementing W-E-F Nexus perspectives on resource management by promoting Nexus principles and integrating and merging them with environmental services and the Sustainable Development Goals in critical areas.

Integrated W-E-F Nexus planning and management are needed because most water, energy and food sector decisions are currently made in separate silos both within and outside government. The W-E-F Nexus data and information system service is intended to support joint planning and project evaluation and to help in identifying and achieving resource efficiencies and innovations in the many areas where the sectors interact.

W-E-F Nexus Data and Information systems would rely on in situ and satellite observations, biophysical and socio-economic data, biophysical models, and planning and analytical tools extending over the water, energy and food sectors. During this phase of EO4WEF, efforts will be focused on launching pilot projects in key agricultural regions. Specific opportunities and issues will be identified in conjunction with a W-E-F Nexus Community of Practice initiated for early promotion of the concept.

The W-E-F Nexus is supported by COMPASS, a project being undertaken by the Sustainable Water Future Programme (Water Future) of Future Earth along with several UN agencies, governments, academic institutions and other partners. COMPASS is currently developing a comprehensive assessment toolbox (called “COMPASS”) for water resource management. COMPASS is designed to provide robust baseline descriptions of past hydrological conditions complemented with the capabilities to extend the historical state of the water resources to near real-time, short-term forecasts (up to 3 months) and future projections. The historical and the near real-time hydrological assessments use the best available observational climate forcing data, complemented by hydrological observations where and when they are available and combined with state-of-the art hydrological modelling and data assimilation to provide the most reliable accounting of the availability of water resources. The World Bank is considering joining the COMPASS effort and incorporating COMPASS capabilities into their operational “Water Security Studies”, which provide high-level policymakers information on priority issues related to national water resources management and water service delivery, and their impacts on the economy, society, and the environment. As a pilot implementation, three South American countries (Argentina, Colombia and Peru) were selected to test COMPASS capabilities and outline the pathways whereby the World Bank and its regional partners could adopt COMPASS. With these developments COMPASS could become a platform for moving some aspects of the W-E-F Nexus implementation to national decision-makers.

### Planned Activities

Key activities during the 2020-2022 period include:

- Integration of COMPASS into the World Bank’s “water security studies” for nations around the world;
- Selection of several areas for W-E-F Nexus pilot projects and initiating coordination in these areas to obtain resources and facilitate the implementation of the pilot project, with the Lake Winnipeg Basin in central Canada one area currently under consideration;
- Clarification of the data and software needs for a data and information system, through meetings with user groups either generally or within specific basins;
- Development of a full implementation plan for the W-E-F Nexus based on a 2019 Future Earth report on the W-E-F Nexus; and
- Participation in scientific conferences and publication opportunities to encourage the engagement of the scientific community with W-E-F Nexus issues.

### **Contributors**

*GEO Members:* Germany, Norway, United States.

*GEO Participating Organizations:* Future Earth, The World Bank.

### **Related GEO Work Programme Activities**

GEOGLAM.

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## Enhancing Food Security in African Agricultural Systems with the Support of Remote Sensing ([AFRICULTURES](#))

### Overview

AfriCultuReS – Enhancing Food Security in AFRIcan AgriCULTUral Systems with the Support of REmote Sensing – aims to design, implement and demonstrate an integrated agricultural monitoring and early warning system that will support decision making in the field of food security. AfriCultuReS will deliver a broad range of climatic, production, biophysical and economic information, for various regions in Africa. AfriCultuReS will apply geospatial science to sustainable agricultural development, natural resource management, biodiversity conservation, and poverty alleviation in Africa.

AfriCultuReS will deliver services at the national, district/county/province and local level with a focus on the categories of climate, crop, drought, land, livestock, water and weather. The services will be delivered to the public sector, the agribusiness sector, the financial sector and the academic sector.

A sequence of definition of methodology, identification of users requirements, identification of services, definition of framework, development of services, internal test phase, pre-operational test phase, operational test phase and exploitation phase will result in technically mature services that can be prepared for market readiness at the end of 2021.

### Planned Activities

AfriCultuReS will push forward the services provided by current systems, with innovative fusion of data from multiple sources (remote sensing, in-situ, citizen-based crowdsourcing, climate services and weather, crop models) in a vertical manner. Crop yield and biomass prediction models will be enhanced through the fusion of Earth observations data and climate models, emphasizing the use of the complementary sensors of the EU Sentinels constellation.

Geospatial products will be combined in a spatial Decision Support System (DSS) to enrich decision making and risk assessment. The geospatial component of the DSS will be compliant with the GEO's interoperability standards, allowing its integration with the current services of the GEOSS Platform.

The African partners and collaborating networks will be essential for local training and promoting further use of the project tools. Social innovation will be used to increase the number of involved stakeholders and to boost the flow of information in a user-friendly manner. The final target will be to produce a web tool that will support early decision-making for the stakeholders of African food production.

Seven main service categories have been identified:

- **Climate:** improve climate predictions, seasonal climate early warning and climate adaptation advice;
- **Crops:** improve crop condition monitoring and yield forecasts;
- **Droughts:** improve drought early warning and forecasts;
- **Land:** provide advice on avoiding land degradation and to improve soil condition assessment;
- **Livestock:** improve grazing and rangeland monitoring, browsing capacity assessment and identification of available water sources for livestock;

- **Water:** improve monitoring of water availability and productivity, crop water requirements assessment and soil moisture monitoring.
- **Weather:** improve (local) weather forecasts and extreme weather early warning.

Although it is already technically complicated to develop these services, bringing solutions to market takes even more time; a period of ten years to do this is not uncommon. For this reason, AfriCultuReS partners began discussions with potential clients from the beginning. If solutions are created not only for, but also with clients, market readiness can be achieved quicker and more easily.

Developing services for and with regional governments, such as county, provincial or district governments is an interesting option. Fulfilling the agricultural potential is a priority for local government and by improving the analysis and prediction of potential yields and monitoring of actual yields, useful intelligence for improving agricultural policy can be delivered.

The private sector is another good partner. Working with input suppliers, buyers, sellers and the processing industry can lead to an interesting bundling of services that benefit farmers and that are economically feasible. With financial institutions products can be developed that reduce the risks of providing (micro-)credit, possibly coupled with the delivery of index insurance products that are based on satellite information.

The focus will be mainly on eight crops: maize, wheat, potatoes, sorghum, cassava, millet, rice and sugarcane. Grassland for livestock farming will also be included in the portfolio and room will be made for crops that are locally relevant.

## Contributors

**GEO Members:** Greece, Ethiopia, European Commission, Ghana, Italy, Kenya, Mozambique, Netherlands, Niger, Rwanda, South Africa, Spain, Sweden, Tunisia, United Kingdom.

**GEO Participating Organizations:** World Food Programme (WFP).

**Other Contributors:** African Development Bank, Global Monitoring for Environment and Security and Africa (GMES and Africa), New Partnership for Africa's Development (NEPAD).

## Related GEO Work Programme Activities

GEOGLAM, EO4SDG, GEOGLOWS.

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## **GEO Citizen Science ([GEO-CITSCI](#))**

### **Overview**

The widespread adoption of mobile devices and social media platforms, coupled with the development of low-cost sensors, has made it easier for the public to contribute to and engage in scientific and engineering research and monitoring. This collaborative exchange with the scientific community, in which members of the public actively join the co-creation of new scientific knowledge, is known as “citizen science”.

Citizen science observations, data and information can complement official, traditional in situ and remote sensing Earth observation data sources in many application areas relevant to GEO. Governmental entities around the globe, from Australia and Asia to Europe and North America, are supporting the development and integration of new sources of in situ Earth observations data collection at local, regional, and global scales through citizen science observatories and projects.

Building on these initiatives, this GEO Citizen Science will focus on the following goals:

- Demonstrate the value of citizen science data for advancing the GEOSS priorities in terms of research and informing policy;
- Facilitate the creation of a linked ecosystem of open citizen science data and supporting resources under GEOSS and the GEOSS Data Management Principles; and,
- Increase the use of citizen science in GEO by supporting global coordination and collaboration within and beyond GEO.

Overcoming institutional barriers, perceptions and technical issues will be addressed and resolved by the Initiative in terms of heterogeneity in data models, flavours and data formats formed by the long tail of citizen science projects. Furthermore, we will address data accessibility, metadata harvesting, data quality documentation, annotation and connectivity with the GEOSS platform.

### **Planned Activities**

Planned activities for 2020-2022 include:

- Support and elevate demonstration projects that showcase the use and value of scalable citizen science projects—e.g., citizen observatories, Earth Challenge 2020, Citizen Science Earth Observation Lab (CSEOL) pilot projects—particularly in the provision of in-situ data;
- Showcase the use of citizen science data sets (from the GEOSS-Data Core) in combination with other Earth Observation products and for validation and exploitation of Earth observations via the Earth Challenge 2020, the citizen observatories and other projects;
- Demonstrate new technologies such as machine learning trained by citizen science data (i.e., “human in the loop”), to improve calibration/validation of sensors, increase the speed and accuracy of image processing, provide in situ ground truth data, and/or augment and enhance validation and knowledge extraction;
- Identify and prioritize gaps in in situ observations for GEOSS, and then identify existing citizen science projects that could cover these gaps, for example through the SDG framework;
- Mobilize existing and newly emerging citizen science initiatives to make the data that they collect available through the GEOSS platform (e.g., Earth Challenge 2020 and the citizen observatories);

- Increase discovery and access of open science resources including citizen science data and complementary data sets; data collection tools (hardware and software); platforms for data analysis and visualization; educational resources such as lesson plans or other toolkits; and, publications;
- Showcase best practices for discovery and access of citizen-observed data through GEOSS, and the implementation of the GEOSS Data Management Principles;
- Provide guidelines for using and managing citizen science in GEOSS incorporating use of existing standards for data collection and management;
- Working with the Open Geospatial Consortium (OGC), conduct interoperability experiments and recommend how to offer access to citizen science through GEOSS;
- Conduct interoperability experiments about data access, single sign on mechanism and data quality, data annotation and user feedback;
- Generate “data profiles” and data collection protocols that can serve for scaling up citizen science;
- Based on the work described above, develop recommendations for the increased use of citizen science data for GEO, and for using products available through GEOSS in citizen science communities; and
- Working closely with the Citizen Science Global Partnership, leverage GEO’s role as a global convener to help keep track of and coordinate a range of complementary activities led by different communities.

### **Contributors**

*GEO Members:* European Commission, Netherlands, United States.

### **Related GEO Work Programme Activities**

GEO-BON, GEOGLAM.

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## GEO Essential Variables ([GEO-EV](#))

### Overview

The concept of “essential variables” (EVs) is increasingly used in Earth observation communities to identify those variables that have a high impact, high feasibility and relative low cost of implementation. The Global Climate Observing System (GCOS) was the first to develop a full set of Essential Climate Variables (ECV). Other examples of communities applying the same concept include oceans (Essential Ocean Variables: BLUE-PLANET), biosphere (Essential Biodiversity Variables: GEO-BON), and the water cycle (Essential Water Variables: GEOGLOWS). ConnectinGEO illustrated that EVs can be a useful approach to several indicators for monitor Sustainable Development Goals (SDGs).

GEO-EV proposes to review and extend the current EVs framework and assign priorities in designing, deploying and maintaining EVs in connection with the responsible observation networks. At the same time, essential variables should be promoted among all Societal Benefit Areas (SBAs) in GEO. GEO-EV aims to be a panel of experts to discuss the current status of EVs, exchange knowledge, experiences and methodologies in EVs definition, analyze the usefulness of EVs in creating SDG indicators, and the gaps to be solved in communities in the near future. This initiative does not have the intention to interfere in the ongoing communities already working on the definition of the EVs, but to become a common forum to share expertise and to have a single voice inside GEO regarding EVs.

### Planned Activities

- Meta-coordination in the elaboration of EVs among Societal Benefit Areas. Reduce overlaps between existing and future essential variables. Share knowledge and processes for EV definition.
- Gap analysis of EVs and observation networks.
- Convergence of the definition of EVs across SBAs.
- Expanding EVs to all relevant themes in Earth observation.
- Relationship between EVs and SDGs. Further analyze the approximation of SDGs indicator’s retrieval based on the use of essential variables as a proxy.

### Contributors

**GEO Members:** European Commission, Greece, Italy, Spain, Switzerland.

**GEO Participating Organizations:** International Institute for Applied Systems Analysis (IIASA).

### Related GEO Work Programme Activities

GEO-BON, GEOGLAM, GFOI, EO4SDG, GEOGLOWS, GEO-GNOME, GEO-VENER, GEO-ECO, AFRIGEO, AMERIGEO, AOGEO, EUROGEO.

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## **GEO Global Ecosystems ([GEO-ECO](#))**

### **Overview**

Terrestrial and marine ecosystems provide essential goods and services to human societies and are of crucial importance for the sustenance and development of our societies as well as achieving the Sustainable Development Goals (SDGs). In the last decades, however, anthropogenic pressures are causing serious threats to ecosystem integrity, functions, and processes, potentially leading to habitat degradation or loss for many species. Ecosystem degradation and loss of ecosystem services can seriously affect human wellbeing directly. In addition, the regulating contribution of ecosystems to climate services and carbon sequestration is increasingly under threat, potentially amplifying the negative effects of global change.

Knowledge-based conservation, management, and restoration policies are urgently needed in order to preserve biodiversity per se, but also to ensure delivery of ecosystem benefits in the face of increasing anthropogenic pressures. Fundamental to all these are effective monitoring, system understanding, and modelling of the state, trends, and evolutions in ecosystem functions and services. New monitoring methodologies have become available that combine approaches in geo- and bio-science, remote-sensing and in-situ monitoring with others of experimental nature investigating the potential of new methodologies in obtaining dynamic new and informative data sets providing additional information to support modelling efforts and supporting deeper understanding of system behaviours. Modern satellite missions, such as the European Sentinels, provide a large amount of high-quality data on the environment and ecosystem components. In situ data is being made available in open access data portals such as Global Biodiversity Information Facility (GBIF) and organized through international activities such as the International Long-Term Ecological Research (ILTER) network.

Based on these perspectives and building upon existing activities, the GEO-ECO Initiative intends to utilize existing Earth Observation data, results, and information in order to generate tools, information, and decision support elements that facilitate the management and well-being of protected areas and both staff and decision makers entrusted with their care. Such an ambition can be achieved through dialogs and co-development of tools and knowledge which is required to understand and communicate the complex interconnectivity of protected areas with the natural and anthropogenic environments at multiple levels, including researchers, management, protected area staff, and policy makers. This will support protected areas of continental and global relevance, extending the analysis to vulnerable, unprotected areas by adopting the view of ecosystems as "one physical system" with their environment. Furthermore, such efforts are enhanced by a strong consideration of geosphere-biosphere-anthroposphere interactions across multiple space and time scales. Both terrestrial and marine ecosystems are considered through this work, with a special focus on interactions and processes taking place in the layer at the surface of our planet (the Earth Living Skin) such as the Earth Critical Zone (ECZ). The knowledge on ecosystems acquired through the activities of GEO-ECO will be built together with the people in charge of the management of protected areas, ecosystems, and those with invested interest in the study thereof leading to the creation of an Ecosystem Community of Practice, encapsulating the users, researchers, decision-makers, and stewards of natural systems.

### **Planned Activities**

GEO-ECO has defined three overarching goals and associated objectives to realise its vision:

***Collate, generate, and synthesize knowledge on status and trends across different terrestrial and marine ecosystems***

- Determine the most suitable typology for monitoring ecosystems;
- Map existing monitoring initiative, with emphasis on critical zone observatories, Long-Term Ecosystem Research sites and other in-situ networks;
- Identify knowledge gaps and develop funding and research opportunities to fill them, including addressing novel conceptual developments and enhance understanding of fundamental ecosystem processes and geosphere-biosphere interactions; and
- Improve remote sensed methods and products to monitor ecosystems state, functioning and services at a global scale.

***Forecast climate and global change impacts on ecosystem status, functioning and services***

- Gain a better understanding of the current state and functioning of ecosystems with particular focus on their contribution to the maintenance of biodiversity, carbon sequestration, and resilience towards extreme climatic events;
- Project future changes of ecosystems based on General Circulation Models (GCMs) and Representative Concentration Pathways (RCPs) under consideration of big data on functional diversity, dispersal capabilities, and life cycles linking correlative and process-based models; and
- Identify the role of climatic fluctuations and non-linear ecosystem dynamics for state changes and quantifying sources of uncertainty in order to develop solid application-oriented approaches such as vulnerability estimates and risk assessments.

***Enable improved decision-making at local, regional, national, continental, and global scales***

- Develop a scientific basis and tools for better ecosystem management under deep uncertainties;
- Establish a Community of Practice with managers, decision-makers and Earth Observation scientists;
- Integrate data, products, models, and knowledge into Open Access hubs allowing dissemination and innovation powered by GEOSS; and
- Engage, communicate with, and train practitioners to use state-of-art science from ongoing monitoring and remote sensing.

**Contributors**

**GEO Members:** Austria, China, European Commission, Italy, Netherlands, Spain, United States.

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**Related GEO Work Programme Activities**

GEO-BON.

**Points of Contact**

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## Geodesy for the Sendai Framework ([GEODESY4SENDAI](#))

### Overview

This activity will establish the Geodesy4Sendai Community Activity with its first project: organizing the Global Navigation Satellite System (GNSS) Tsunami Shield Consortium of international organizations to enhance tsunami early warning systems with the unique powerful capabilities of GNSS real time positioning and ionospheric imaging for the GNSS enhancement for Tsunami Early Warning Systems (GTEWS). Through the Geodesy4Sendai activity, the Consortium will implement the recommendations of the GTEWS 2017 workshop as presented within the 2019 Global Assessment Report on Disaster Risk Reduction (GAR19) of the United Nations Office for Disaster Risk Reduction (UNDRR).

The GTEWS 2017 workshop was supported by the eleven nation GATEW working group of the Global Geodetic Observing System, the Association of Pacific Rim Universities (APRU), the International Research Institute of Disaster Science of Tohoku University, and United States National Aeronautics and Space Administration. The GTEWS 2017 report provides the rationale and strategy to implement Resolution #4 of the 2015 International Union of Geodesy and Geophysics (IUGG) General Assembly. As its first task, Geodesy4Sendai will bring together these supporting organizations, the GEO community and several national real time GNSS networks within the Indo-Pacific and Caribbean basins to establish a prototype GTEWS network to demonstrate the implementation of IUGG 2015 Resolution #4.

This activity was influenced by the objectives and approaches of the Earth Observations for Disaster Risk Management component of the GEO 2017-2019 Work Programme. The application of advanced GNSS real time processing for positioning and ionospheric imaging provides very significant improvements to Tsunami Disaster Early Warning. Furthermore, the GTEWS initiative is in significant alignment with the goals of the Sendai Framework as outlined in the GTEWS supporting paper of the GAR19 report.

### Planned Activities

Geodesy4Sendai will work to influence the development of international ministerial level support and financial support for the GTEWS program for the Asia-Pacific and Caribbean economies while also accelerating the development of the GTEWS products to enhance existing and planned tsunami warning systems. These efforts will provide GNSS information to regional tsunami warning systems and national emergency services in formats that are readily assimilated.

Development activities will include:

- Encouragement of software, data exchange, and continued improvement of GTEW network design and performance. Geodesy4Sendai will develop protocols for the exchange of real-time GNSS tsunami warning data, the sharing of research results, and the development of support agreements.
- Strengthen broadband communication to underserved regions of the GNSS Tsunami Shield. Portions of the prototype GTEWS networks are not connected through real-time communications between receiver and analysis centres. Real-time GTEWS communications requirements can be met with current Fourth Generation wireless technology.
- Encourage national organizations including those mandated for natural hazards mitigation to develop agreements for inclusion of their GNSS receivers within the GNSS

Tsunami Shield. National or agency level restrictions for access to real-time GNSS data is the greatest challenge to the integration of an effective GTEW system.

- Design an optimal GNSS Tsunami Shield network for both crustal displacement and high-resolution Total Electron Content (TEC) monitoring. The GTEWS 2017 workshop recommended a numerical analysis that includes local geology, seismicity and communications infrastructure. Use existing GNSS sites wherever possible.
- Understand the operational requirements of existing tsunami warning systems and determine the steps required to interface these tsunami warning systems. GTEWS is an observational and analysis capability that must be integrated with public advisory and warning capability. The rapid and successful implementation of GTEWS will rely upon fluid interactions amongst national agencies.

### **Contributors**

**GEO Members:** Australia, Chile, China, Columbia, France, Germany, India, Italy, Japan, Mexico, New Zealand, Sri Lanka, United States.

**GEO Participating Organizations:** International Association of Geodesy (IAG), International Union of Geological Sciences (IUGG).

### **Related GEO Work Programme Activities**

BLUE-PLANET, EO4SDG, GEO-DARMA, EO4DRM, AOGEO.

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## Global Agricultural Drought Monitoring ([AGRI-DROUGHT](#))

### Overview

Drought is the most common and costliest natural disaster and has adversely affected water resources, agricultural production and welfare of people in the world. Timely and accurately monitoring drought and its impact on agriculture in the background of the global warming is essential for the decision making in terms of food security, water resources security and as well as the international aid to the affected areas.

In the past, more effort has been directed to meteorological drought monitoring, with the result that its methodologies and models are quite successful at present. However, provision of timely, on-demand, and ready-to-use agricultural drought data and information to worldwide users remains a challenging problem. The availability of various near real-time global remote sensing data promises a solution to the problem of the development of a global agricultural drought monitoring and loss assessment system integrating with remote sensing data and in situ data.

This Community Activity proposes to set up a global mechanism to coordinate the global agricultural drought monitoring systems and thereby significantly improve global agriculture drought monitoring technology and jointly overcome most limitations of current agriculture drought information that are expected by international bodies, as well as national users.

Global Agricultural Drought Monitoring aims to coordinate work on agricultural drought issues, jointly develop the method of monitoring agricultural drought towards a global coverage, and finally support GEOGLAM with timely agricultural drought information. Over time, it hopes to understand the processes and impacts of agricultural drought development in the background of global change and provide the adaptation advice for the global community.

### Planned Activities

- Prepare an inventory of current agricultural monitoring systems at regional and global levels around the world;
- Develop best practices for agricultural drought monitoring with remote sensing;
- Coordinate global agricultural drought monitoring systems towards a coordinated global agricultural drought information release;
- Develop regional showcases on agricultural drought monitoring, possibly in Asia; and
- Advocate for international and national funding to support agricultural drought monitoring proposals.

### Contributors

*GEO Members:* China, United States.

*GEO Participating Organizations:* United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP).

### Related GEO Work Programme Activities

GEOGLAM, GDIS.

### Point of Contact

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## Global Crop Pest and Disease Habitat Monitoring and Risk Forecasting ([CROP-PEST-MONITORING](#))

### Overview

Pests and diseases are major threats to food security in the world, especially for wheat, rice, and soybeans, the dominant foods around the world. Approximately 10 percent yield loss is caused by crop pests and disease every year, while in some regions the loss may be higher than 30 percent. Crop pests and diseases habitat monitoring and risk forecasting at continental and global scale are important to assess the effects of global change on agricultural production. Earth observation is very important for global crop monitoring and pest & disease forecasting due to its capability of producing large-scale data quickly and efficiently.

In 2018, satellite images and reanalysis datasets were used to monitor global wheat growth and the habitat of main wheat pests and diseases, including surface temperature, humidity, surface radiation, and released the first global wheat aphid and rust monitoring and forecasting product and report. In 2020-2022, this Community Activity will consider three main crop types, these being wheat, rice and soybeans, aiming to map the main pests and diseases for these crops, which include wheat aphids and rust, rice planthopper and blast, soybean aphids and mosaic virus.

The activity will focus on retrieving global crop planting areas, growth condition, pest and disease habitat, and risk forecasting based on high spatial and temporal resolution satellite data. First, land surface products and remote sensing indices will be combined to ascertain soil temperature and moisture which provides information about crop habitat, which allows us to ascertain which habitat types are attractive to pests and diseases and provide some information on where they may migrate to. Second, climatic and forecast data will be analyzed to give a probability of immigration or dispersal of pest and disease. Finally, crop growth condition, crop pests and diseases habitat monitoring, and pest and disease biological dispersal models will be integrated to map crop pest and disease spatial distribution and damage levels.

### Planned Activities

Three main work packages are included in the project:

- Satellite data and other higher-level remote sensing / Earth observations products (such as re-analyses and weather forecasts) will be used to perform a classification of vegetation surface in order to ascertain the habitat of the crop pests and diseases;
- Geographic and plant protection information will be assimilated to the remote sensing data and then a risk forecasting model will be built to assess the risk of the target pests and diseases; and
- An application and dissemination platform will be developed to deliver outputs to end users to control pests and diseases and enhance yield and quality.

### Contributors

*GEO Members:* China, United Kingdom.

### Point of Contact

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## Global Ecosystems and Environment Observation Analysis Research Cooperation ([GEOARC](#))

### Overview

GEOARC focuses on ecological and environmental monitoring at global or regional scales to provide information and knowledge services to support GEO priorities, including the Sustainable Development Goals, the Paris Agreement on climate change, and the Sendai Framework for Disaster Risk Reduction. This activity promotes a cooperation network to release an annual report and share related datasets through training courses or workshops.

This activity aims to:

- Improve standard methods for ecological and environmental monitoring at a global or regional scope;
- Promote an international cooperation network for all participants to support data sharing, product validation, information communication and public decision-making;
- Provide information and knowledge services to support the GEO engagement priorities; and
- Release annual reports and share related datasets via training courses or workshops, and deliver and exchange information among the current GEO Work Programme activities.

### Planned Activities

- Integrate multi-source data for global or regional terrestrial ecological and environmental monitoring, and provide analysis-ready data sets for sharing;
- Analyze and evaluate the global and regional ecosystem and environmental status and provide policy-oriented information for human health and environmental protection.
- Prepare and release an annual report to the public, to be shared along with related data products on the [GEOSS Portal](#), the [Global Change Research Data Publishing and Repository](#), and the [ChinaGEOSS DSNet](#); and
- Organize side events at the GEO Plenary and special sessions in various international conferences; hold or attend training workshops for the annual report and data product applications.

### Contributors

*GEO Members:* Australia, Bangladesh, Canada, China, Egypt, France, India, Italy, Republic of Korea, Netherlands, Pakistan, Spain, United Kingdom, United States.

### Related GEO Work Programme Activities

MUSYQ, AOGEO.

### Point of Contact

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## Global Flood Awareness System ([GLOFAS](#))

### Overview

The Copernicus Emergency Management Service (CEMS) consists of four operational services: Emergency Mapping; European Forest Fire Information System; European Drought Observatory and European and Global Flood Awareness Systems (EFAS, GloFAS). These services provide monitoring and early warning of natural hazards at European and global levels.

CEMS-Floods operates as a complement to national and local warning systems with the aim to provide information in a consistent way. GloFAS 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 can predict floods up to 30 days in advance depending on the situation and river size. It can also provide a seasonal outlook with a lead time of eight weeks. It became fully operational in 2018, guaranteeing a 24/7 service as part of CEMS.

The principal objectives of GloFAS 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; and
- A sub-seasonal to seasonal outlook of low and high flows.

### Planned Activities

As GloFAS recently became fully operational, much effort during 2019 and 2020 will be dedicated to further development of the services. Most important over the coming period will be to improve the hydrological model and release additional global assessments of forecast performance. A new release is planned for late 2019/early 2020. This will also include a better archiving of the data in the Meteorological Archival and Retrieval System archive and dissemination of these data through the Copernicus Climate Data Store.

### Contributors

*GEO Members:* European Commission.

*GEO Participating Organizations:* European Centre for Medium-Range Weather Forecasts (ECMWF).

### Related GEO Work Programme Activities

GEOGLOWS.

### Point of Contact

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## Global Flood Risk Monitoring ([GFRM](#))

### Overview

Global Flood Risk Monitoring (GFRM) integrates information from multiple Earth observation systems to derive and deliver environmental intelligence characterizing intensive flood risk for the benefit of decision makers. This includes the coordination and analysis of timely, reliable and suitable observations with Earth system modelling and geospatial data management. To be more resilient to flood perils, GFRM enhances the ability to prepare for the anticipated hazards, adapt to changing conditions, and withstand and recover rapidly from disruptions.

As a Community Activity, GFRM is an inherently collaborative and transdisciplinary capability, which creates key partnerships and maintains engagement among diverse stakeholders and actors. Contributors promote shared access and use of open data for research, development and operations. Routine and timely coordination and cooperation through projects, workshops and capacity development drives the pace of innovation, improves modelling and mapping skills, spreads learning and advances readiness of research results for application. This in turn builds trust and modifies local behaviour through greater certainty, learning, and awareness of flood perils and security measures.

To realize these goals, GFRM initiated a formalized community of practice, creating a space where new and existing data/product providers and consumers, researchers and operators, and other stakeholders can work together. This community of practice provides incentives for partnerships to demonstrate the viability of flood risk monitoring on a global level informed by Earth observations in concert with meteorological and hydrological modelling, thereby creating new connections that increase the use of flood risk information in decision-making.

### Planned Activities

Elements of GFRM implementation include:

- A community of practice able to collect, process, and analyze changes due to complex and rapid flood stresses. Through early and ongoing stakeholder engagement, GFRM will assess impacts and apply knowledge to fill gaps with trusted data to yield scientifically defensible guidance supporting timely, reliable and suitable decisions;
- Pilot projects to increase access of diverse data sets, models and visualization products while testing the ability to provide efficient and actionable information;
- Demonstration projects to extend global reach of applications to ensure consistent intelligence products for risk-sensitive assessments and planning;
- Integration projects to bring together tool sets and capacity building to develop and maintain resilience and risk reduction efforts; and
- End-to-end integration of research and application within an Earth system framework to prevent new, reduce existing, and manage residual flood risk through increased analysis of exposure, vulnerability and coping capacity.

### Contributors

**GEO Members:** Ecuador, Luxembourg, Japan, Republic of Korea, Spain, United States.

**GEO Participating Organizations:** European Centre for Medium-Range Weather Forecasts (ECMWF).

**Other Contributors:** International Bank for Reconstruction and Development (IBRD), Red Cross Red Crescent Climate Centre, Singapore.

**Related GEO Work Programme Activities**

GEO-DARMA, GLOFAS, AMERIGEO.

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## Global Land Cover ([LAND-COVER](#))

### Overview

Information regarding land cover and land cover change over time is essential for a variety of uses such as environmental change analysis, geographical condition monitoring, urban and rural management, and Earth surface process modelling. While the world is now moving towards the implementation and monitoring of the United Nations 2030 Agenda, users are demanding more reliable land cover change data at higher spatial, temporal, and thematic resolutions, as well as results-oriented services. With this background, Global Land Cover is aiming to support the Sustainable Development Goals (SDGs) with reliable land cover change information and value-added applications.

### Planned Activities

- Using land cover change to define and generate essential SDG variables (ESDGVs) through workshop(s) and pilot testing jointly with the GEO Initiative EO4SDG and the UN Inter-agency and Expert Group on SDG Indicators (IAEG-SDGs) and its Working Group on Geospatial Information (WGGI);
- Documenting new approaches and tools for automated updating of global and regional land cover data and efficient generation of land cover change-related ESGVs through workshop(s) or journal special issue(s) jointly with the International Society for Photogrammetry and Remote Sensing (ISPRS) and the European Space Agency;
- Support inter-comparison and valuation of new global and regional land cover change data products (such as GlobeLand30- 2015 or Copernicus Global Land Service) jointly with the European Space Agency, the National Geomatics Centre of China (NGCC) and other stakeholders; and
- Organize land cover change related education and capacity building activities jointly with UN Committee of Experts on Global Geospatial Information Management (UN-GGIM) and ISPRS.

### Contributors

**GEO Members:** China, European Commission.

**GEO Participating Organizations:** European Centre for Medium-Range Weather Forecasts (ECMWF).

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## Global Observation of Deltas and Estuaries ([DELTA&ESTUARY](#))

### Overview

Deltas and estuaries are a link between the land and the sea, the locations of early settlements, and still embrace most megacities today. They are also important ecosystems combining terrestrial and marine eco-functions, and are the sites of the most dynamic biosphere-hydrosphere-pedosphere interactions. They are exposed to threats from both land and sea, such as catastrophic flooding, storm surges, tsunamis, as well as the long term impact of global warming and sea level rise. Changes in land use and urbanization have greatly changed the features of global deltas and estuaries and reduced their extent. Reservoir damming in river catchments has dramatically decreased sediment supplies and has caused coastal erosion in many delta and estuary areas. Pollution, land subsidence and wetland degradation in deltas and estuaries are global challenges requiring more Earth observation data to support stakeholder decision-making at local, regional and global scales.

Reliable, accurate, comparable, multidisciplinary and timely information on global deltas and estuaries is still not available, despite their having been important areas of surveys, observations and research by many countries, geological societies, and other research groups and disciplines. Recent advances in Earth observation data availability, in situ monitoring methodologies, and information technology provide new opportunities to monitor deltas and estuaries at local to global scales on a regular basis. A variety of sensors and increasing data availability and spatial resolution make it possible to understand delta and estuary evolution processes under natural and anthropogenic impacts with unprecedented spatial and thematic detail.

The goals of this Community Activity are: 1) to foster an interdisciplinary and trans-boundary platform to use global Earth observation data (including in situ monitoring) to better understand the pressures of deltas and estuaries and 2) to provide reliable information at a global scale to improve sustainability and resilience of social-ecological systems in global deltas and estuaries.

### Planned Activities

The following major activities are planned:

- Build a dataset of multi-sourced global Earth observation data for the past 20 years (and longer if data is available), together with socio-economic statistical information from selected deltas and estuaries on different continents and climate zones;
- Import and develop Earth observation tools to identify the critical parameters for variation and pressure of ecosystem and environment in deltas and estuaries;
- Analyze change over 5-10 year intervals and identify causes and consequences of ecosystem changes in major deltas and estuaries;
- Identify vulnerabilities and disaster risk of selected deltas due to climate change.

### Contributors

*GEO Members:* China, European Commission, Thailand, Vietnam.

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## In-Situ Observations and Applications for Ecosystem Status of China and Central Asia ([IN-SITU-ESC](#))

### Overview

In situ observations, whether for validating remote sensing or for direct analysis, are important to synthetically analyze biodiversity and ecosystem assessment. In situ observations are a focus of research of many international organizations such as the International Long-term Ecological Research (ILTER) network, the Convention on Biological Diversity (CBD), the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES), and UN Environment. The Chinese Ecosystem Research Network (CERN), along with some Chinese organizations including the Ministry of Ecology and Environment (MEE) and the Ministry of Agriculture and Rural Affairs (MARA), have collected a huge amount of in situ ecological observational data in China. However, the value of the data has not been fully recognized due to a lack of data products, which can help to prepare analyses of national biodiversity and ecosystem service assessment. The Research Center for Ecology and Environment of Central Asia (RCEECA) is also willing to contribute some of their data. UN Environment can collaborate as a coordinator of the activity.

The objectives of the project are 1) to collect the in situ ecological observation data in China and Central Asia produced by the above-mentioned organizations and institutions using standard data quality control methodology, 2) to produce and share in situ long-term ecological observational data products to support Sustainable Development Goals (SDGs) 13 (Climate Action) and 15 (Life on Land) of the United Nations 2030 Agenda.

### Planned Activities

- Sharing methodologies and procedures for generating datasets and long-term continuous data products from in situ observations developed in CERN with other participants including MEE, MARA, sub-centres of RCEECA in Tajikistan, Kazakhstan and Kyrgyzstan, and with UN Environment.
- Producing crucial data products related to Essential Biodiversity Variables and Essential Ecosystems Services Variables (such as plant species richness, ecosystem productivity) jointly with MEE, MARA, and other participants.
- Constructing a data portal to share the data with communities and public users.

### Contributors

**GEO Members:** China.

**GEO Participating Organizations:** UN Environment.

**Other Contributors:** Kazakhstan, Tajikistan.

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## Multi-source Synergized Quantitative Remote Sensing Products and Services ([MUSYQ](#))

### Overview

As more and more Earth observation data have accumulated, many countries have developed remote sensing product generation systems based on different satellite series. However, the different remote sensing products are inconsistent and often cannot satisfy application requirements, which becomes a key bottleneck in restricting the high-level application of Earth observation data. MUSYQ is intended to promote not only access to the data, but the technology and standards to support multi-source synergized remote sensing data processing, common product generation, global product evaluation and validation.

MUSYQ is a continuation of the existing Community Activity in the GEO 2017-2019 Work Programme, which has formed the standardized processing ability for 24 kinds of sensor data. With the rapid development of Chinese remote sensing satellites, there is more application potential to support the three GEO engagement priorities due to the constantly improving spatial and temporal resolution.

The key philosophy of MUSYQ is to integrate multi-sensor data to achieve high accuracy and good spatial-and-temporal continuous common remote sensing products. All the datasets have been shared via the GEOSS portal to support different applications. For example, MUSYQ has supported GEOARC and AOGEO for global ecosystem environment monitoring and analysis, including several typical ecological environment elements and hot environment issues. MUSYQ products have also been directly used to support the task group 7 “Environment Monitoring and Protection” in AOGEO to evaluate the environmental status of Asia and Oceania region.

### Planned Activities

In 2020-2022, MUSYQ will focus on:

- Improving multi-source remote sensing data processing, normalization, or standardization, especially for Chinese satellite data;
- Improving the inversion algorithms to enhance the accuracy of quantitative remote sensing products;
- Establishing an operational common quantitative remote sensing product validation network; and
- Promoting the data sharing of the common quantitative remote sensing products for applications.

### Contributors

*GEO Members:* Australia, China, France, Italy, Portugal, United Kingdom, United States.

### Related GEO Work Programme Activities

GEOARC.

### Point of Contact

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## Next Generation Earth Observation Services ([NEXT-EOS](#))

### Overview

The NextEOS Community Activity operates a set of advanced platform services, in support of Earth observation technology innovators and application builders, and addressing the GEO engagement priorities. NextEOS relies on a federated data hub and a cloud platform for Earth observation. The NextEOS data hub and platform constitute the basis for continuous integration and testing of new technology and ideas coming from application providers building tomorrow's solutions, applications and knowledge in Earth observations. As such, NextEOS operates a testbed environment dedicated to the integration, testing and transfer to operations of partners' applications, through a set of collaborative processes and platform services that in turn are adding value to the applications contributed to GEOSS, and help make GEOSS stay updated and relevant.

At the core of NextEOS is the interoperability of subsystems, relying on internationally accepted standards, thus promoting the approach of a collaborative testbed environment for providers of Earth observation, information and processing systems.

### Planned Activities

During the 2020-2022 period, NextEOS will focus on 1) ensuring operational availability, maintenance and evolution of the NextEOS platform services; in support of selected GEO activities; 2) Delivering sustained support to the applications that have been integrated over 2018-2019 as "pilots" of the European Commission project NextGEOSS ; 3) engagement with additional data, applications and knowledge providers.

Specific proposed activities include:

- Consolidate outreach and on-board testbed participants in NextEOS;
- Organize Steering Committee meetings;
- Setup governance structures;
- Engage with stakeholders within the GEO work programme and beyond;
- Prepare transition to a Community Activity;
- Setup an engagement plan for providers;
- Organize architecture implementation pilots; and
- Perform operations, maintenance and evolutions.

### Contributors

**GEO Members:** Italy, Norway, Portugal.

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## Night-time Light Remote Sensing for the Sustainable Development Goals ([NIGHT-LIGHT](#))

### Overview

The United Nations 2030 Agenda for Sustainable Development Goals (SDGs) provides the world a bright path for a more sustainable future. The SDGs aim to solve a number of key issues, such as extreme poverty, income inequality, and disaster risk reduction. Evaluating the implementation progress toward the SDGs is critically important since the international community can focus on the unsolved issues far behind the 2030 Agenda. Night-time light remote sensing images have been widely applied in socioeconomic research and have shown great potential for monitoring some SDG indicators. Although a number of international organizations have noticed the great value of night-time light for SDGs, a shortage of skills and knowledge on night-time light has limited its use.

This Community Activity aims to produce high quality night-time light products, and derive a variety of night-time light-based thematic products including poverty maps, electrification maps, regional inequality maps and regional growth maps as well as disaster evaluation maps. These products will map the implementation progress of SDGs from both spatial and temporal perspectives. In addition, several application cases for monitoring SDGs at regional scales (e.g. disaster-affected and war-torn regions) will also be carried out based on the products. The data products and application reports will be delivered to international users, including inter-governmental organizations, aid groups, and investment agencies to fill the gap between the night-time light remote sensing community and potential users the night-time light products for SDGs.

### Planned Activities

- Develop high resolution night-time light products for sustainable development. The existing coarse resolution night-time light remote sensing imagery can help monitor human settlements at large scales but cannot provide sufficient spatial details at the street level. Finer resolution images are very useful in mapping human settlements details but their application to large scales is often limited. The purpose of this community activity is to highlight human settlements by integrating 30 m resolution Landsat and the coarse resolution night-time light remote sensing data. Considering that both Landsat and night-time light remote sensing have long historical archives, we expect our investigation on combining them together will also enable tracking human settlements expansion over time.
- Develop standard night-time light products, including poverty maps, regional inequality maps and urban growth trajectory, for general applications of sustainable development based on the high-resolution night-time light products. Develop special night-time light products, such as humanitarian disaster maps, for hotspot areas such as extremely poor countries and conflict regions.
- Build a data sharing network. Exchange research ideas between different data providers and product developers. Advocate building a data sharing platform (e.g. website interface and contact information lists) from different night-time light data provider and product developers.
- Develop a user network. Contact current and potential users, from the social science community, the natural science community, the banking system, governmental

departments as well as non-governmental organizations, of night-time light products. Summarize the users' requirement on the night-time light products.

- Collaborate with regional and global organizations. Provide the night-time light products to the United Nations, non-governmental organizations and investment agencies. Train these organizations to analyze the issues of sustainable development such as poverty, humanitarian disasters and impact of aid projects by use of night-time light products.
- Disseminate research results. Participate in international conferences, workshops and sessions. Publish scientific articles.

### **Contributors**

*GEO Members:* China, Israel.

*GEO Participating Organizations:* United Nations Institute for Training and Research (UNITAR).

*Other Contributors:* Asian Development Bank (ADB).

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## Space and Security ([SPACE&SECURITY](#))

### Overview

The Space and Security Community Activity aims to protect the wellbeing and security of countries and citizens by exploiting suitable space assets and collateral data.

Space and Security intends to:

- Provide a forum for discussion and organize capacity building initiatives;
- Establish and foster cooperation with key entities and stakeholders;
- Collect user requirements and needs;
- Identify observational and capability gaps to be filled by space assets;
- Explore how to take maximum benefit from the usage of very large quantities of heterogeneous data;
- Identify, develop and assess innovative applications, services and platforms encompassing the whole data lifecycle;
- Contribute to the implementation of relevant projects in the framework of research and innovation initiatives; and
- Build synergies with relevant GEO activities.

Space and Security aims at enhancing:

- Resilience of society against natural and man-made disasters;
- Protection of critical infrastructures;
- Efficiency in tasks related to border and maritime surveillance as well as to civil protection and humanitarian aid; and
- Capacity of relevant stakeholders to achieve the security-relevant SDGs.

Furthermore, Space and Security works towards raising awareness and adoption of open data, citizen science, in situ data and advanced technologies in the space and security domain.

### Planned Activities

Over the 2020-2022 period, Space and Security will focus on the consolidation of the community and on the implementation of initial solutions. The identified key activities for the period are to:

- Grow Space and Security by incorporating new members;
- Enhance internal communication within Space and Security and external communication in relevant fora;
- Implement user scenarios within potential pilot projects for Space and Security.

### Contributors

**GEO Participating Organizations:** Association of the Geological Surveys of the European Union (EuroGeoSurveys); European Space Agency (ESA), European Union Satellite Centre (EU SatCen), IHE Delft Institute for Water Education (IHE); World Food Programme (WFP).

### Point of Contact

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## Space Climate Observatory ([SCO](#))

### Overview

The Space Climate Observatory (SCO) is a response mechanism aiming to address global changes and propose key adaptation and mitigation measures. Its ultimate objective is to fill the gap currently existing at international, regional and national levels to assess and monitor the impact of climate change using space and in situ observations with models.

SCO will provide easier access to multisource data in addition to existing global climate datasets (such as Essential Climate Variables) and to downscale scenarios of climate change impacts to a finer scale. SCO will reinforce climate change impact monitoring capacities, such as for forest fires, impacts on crops, coastal areas, urban heat island, ocean biology, glacier retreat, health, and so on. SCO will be science based, co-built in an international partnership framework, and will take direct benefit from recently available high-resolution Earth observation data.

While international research programs on climate have already well demonstrated the role of anthropogenic impacts on climate change with identified key trends at the global level, there is still an urgent need to address climate change-induced risks at finer scales to allow effective actions from all parties, including civil society, the private sector, financial institutions, cities and other subnational authorities, local communities and indigenous peoples.

To address these needs, SCO will promote at the international level an easier access to high-resolution satellite data, in situ data, as well as processing and modelling capacities that are needed to produce finer scale climate change scenarios. This will be done through international cooperation on climate change adaptation issues between space agencies, research institutions, citizen science entities and stakeholders.

In general terms, SCO intends to support four international engagements:

- The Cancun Adaptation Framework;
- Article 7 (on adaptation) of the Paris Agreement on climate change;
- Sustainable Development Goal (SDG) 13 “Take urgent action to combat climate change and its impacts”, as well as other relevant SDGs; and
- The Sendai Framework for Disaster Risk Reduction.

While launched in the framework of the One Planet Summit in Paris (December 2017), SCO can also be considered as an outcome of the International Academy of Astronautics Mexico Summit Declaration stating that international coordination is imperative to address climate change issues.

SCO will be complementary to existing international programs and work in coordination with the United Nations Office for Outer Space Affairs (UNOOSA), the Committee on Earth Observation Satellites (CEOS), the Global Climate Observing System (GCOS) and will sustain the work of the United Nations Framework Convention on Climate Change (UNFCCC) and the Intergovernmental Panel on Climate Change (IPCC). Downstream from these major programs, the SCO aims to help regions, countries and subnational entities to prepare for climate change in relation to GEO Societal Benefit Areas, to provide trans- and multi-disciplinary expertise in monitoring the impacts already visible, and to build, exchange and transfer realistic scenarios to best address them across the territory.

The main outcome from SCO should be the emergence of an international forum or platform for gathering space agencies, frontier technologies, research institutions, citizen science entities, funding agencies, national and subnational stakeholders willing to promote the co-production

and use of finer-scale climate change impact scenarios, products and indicators to promote actions, strengthen resilience and reduce vulnerability with regard to climate change impacts.

## Planned Activities

The following activities are planned for the first 2-year period:

- Sign an international Protocol Agreement with agencies willing to participate and define partnerships with international bodies, including: CEOS, GCOS, the World Climate Research Programme (WCRP), and the Global Framework for Climate Services (GFCS);
- Set up governance bodies, starting with the Steering Committee.
- At a technical level, the international SCO system first version could gather:
  - A web portal;
  - Space agency coordination to build up a unified space data access;
  - Referenced information about impact studies;
  - Reference to local initiatives;
  - First definition of the common architecture and common tools.
- Impact case studies, ideally for each priority area as defined by the GFCS, these being: agriculture and food security, disaster risk reduction, energy, health, and water.

Within two years from its creation, SCO should show concrete realizations in areas already presented as proofs of concept at the Toulouse Space Show in June 2018:

- Global warming, heatwaves and urban hothouses;
- Glaciers melting faster, sea level rise impact at the coasts;
- Pollutants and green gases, impact on city air quality;
- More frequent droughts and impacts on agriculture and water resources management;
- Extreme events, precipitations and floods; and
- Freshwater reserves.

## Contributors

**GEO Members:** Austria, Azerbaijan, Brazil, China, United Arab Emirates, Ethiopia, France, Germany, Greece, India, Israel, Italy, Mexico, Portugal, Romania, Sweden, Thailand, Ukraine, United Kingdom.

**GEO Participating Organizations:** European Space Agency (ESA), United Nations Office for Outer Space Affairs (UNOOSA).

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## The International Grand Global Ensemble ([TIGGE](#))

### Overview

TIGGE (The International Grand Global Ensemble) is a dataset, established by the World Weather Research Programme in 2006, comprised of operational global ensemble forecast data from ten weather forecasting centres. TIGGE is designed to span the medium-range (out to day 15), but a similar multi-model ensemble, the Sub-seasonal to Seasonal Prediction Project (S2S) dataset, a joint World Weather Research Programme (WWRP) and World Climate Research Programme (WCRP) effort, was created in 2015 with contributions from 11 centres to extend across the sub-seasonal to seasonal range (up to day 60). Both systems provide data bases of ensemble predictions, for scientific research on predictability and development of probabilistic weather forecasting methods.

### Planned Activities

During 2018, the S2S project proposed a Phase II implementation plan (November 2018 - December 2023), which includes:

- S2S database enhancements;
- Research activities; and
- Enhancement of operational infrastructures and user applications, such as Research to Operations (R2O) and a real-time pilot for S2S applications.

The complete S2S Phase II implementation plan is available [online](#).

### Contributors

***GEO Participating Organizations:*** European Centre for Medium-Range Weather Forecasts (ECMWF), World Meteorological Organization (WMO).

### Point of Contact

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## Understanding the Impacts and Value of Earth Observations (GEO-VALUE)

### Overview

The goal of this task is to develop overall capacity, methods and case studies to facilitate the way we understand, measure and promote the value of Earth observations, helping to justify the investments which are made. Case studies are being used to understand and measure the benefits, whilst story-telling is increasingly being used to promote the results. The goal is to provide clear benefits assessments of individual products or services and impact assessment of programmes. Whilst assessing the benefits and impacts is the primary goal, results lead also to a deeper understanding of the use of Earth observations which can help further market studies and promotional activities.

A body of knowledge is being assembled and consolidated by the GEOValue Community, which can be strengthened by bringing in new players both geographically and in terms of multi-disciplinary skills. In the period 2020-2022, GEOValue will continue to collect case studies, develop a framework for analyses, promote the methods being used and encourage others to apply them to existing and new programmes. The results will be an assembly of accessible case studies and methodologies in a structured repository to guide practitioners. Links will be developed with a number of GEO Flagships and Initiatives in order to assist them in analyzing their impact.

### Planned Activities

- Identify and consolidate representative case studies for collaboration and baseline analyses (continuous);
- Develop a framework to help structure analyses and provide options of appropriate methods to assess the case or programme value;
- Compile a knowledge base (a structured inventory and repository) of methods and cases;
- Provide access to webinars on the value of Earth Observation (EO) data, information, and applications;
- Organize international events to bring together economists and scientists, policy analysts and decision makers to look at methodologies, use cases and applications (e.g. Montreal Q3 2020);
- Engage with other GEO Programme activities to provide guidance on methodologies and prepare case studies
- Organize sessions or presentations at conferences; and
- Publish in open literature of peer reviewed articles, workshop proceedings, and other GEOValue material.

### Contributors

**GEO Members:** Canada, European Commission, South Africa, United States.

**GEO Participating Organizations:** European Association of Remote Sensing Companies (EARSC), European Space Agency (ESA), Federation of Earth Science Information Partners (ESIP), (IEEE).

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# Foundational Tasks

## A New Structure for GEO Foundational Tasks

Foundational Tasks were introduced in the GEO 2016-2025 Strategic Plan as the organizing framework for enabling functions that support the other Work Programme activities. These functions could include, among other things: coordination actions, gap analyses, implementation of technical elements for accessing GEOSS, and operations of the Secretariat. Collectively, the Foundational Tasks represent all GEO Trust Fund expenditures, as well as contributions, both financial and in-kind, from GEO Members, Participating Organizations and other organizations and individuals.

The set of Foundational Tasks described below are based on the experience gained during implementation since 2016. In some areas, the needs and priorities within GEO evolved such that much greater Secretariat support was found to be required than was originally anticipated. In other areas, the means that were initially identified to meet requirements were re-examined and replaced with other approaches. At a general level, the Secretariat is also of the view that a simpler structure, with fewer Foundational Tasks, will be easier to manage and support under current budget levels.

More specifically, the changes have been driven by several factors:

- Increased emphasis on the GEO engagement priorities (2030 Agenda for Sustainable Development; the Paris Agreement on climate change; and the Sendai Framework on Disaster Risk Reduction);
- Requests from the GEO community for greater integration among various components of the GEOSS infrastructure, to ensure their interoperability, reduce duplication and strengthen the services provided;
- Reorientation of the GEO strategy on strengthening observing networks away from coordination of other organizations responsible for the networks toward identifying and filling observational gaps that impact the work of GEO Flagships and Initiatives;
- Need for an enhanced level of support and interaction with the Programme Board and the activities in the GEO Work Programme;
- Refocusing of capacity building activities from coordination across the GEO toward a model of supporting and facilitating efforts within GEO Work Programme activities, guided by a new strategy for capacity development;
- Response to the Expert Advisory Group and their framework for a Results-oriented GEOSS;
- Redefinition of staff responsibilities in the Secretariat, as described in the Concept of Operations document approved by the GEO Executive Committee in July 2019; and
- Secretariat Operations is largely the continuation of the existing Management and Support Foundational Task. The key changes anticipated here are the need to provide more regular contact with GEO Members and Participating Organizations and to meet the somewhat greater workload requirements associated with managing the new GEO Associates category.

## **GEO Engagement Priorities Coordination**

### **Overview**

This Foundational Task leads GEO's efforts in engaging key stakeholders in supporting GEO's Mission and Vision and, more specifically, on GEO's engagement priorities: the UN 2030 Agenda on Sustainable Development; the Paris Agreement on Climate Change, and the Sendai Framework on Disaster Risk Reduction. It is also responsible for coordinating engagement with UN agencies and other organizations, including those within the GEO community (that is, within GEO Member countries or Participating Organizations) as well as external organizations, in support of the GEO mandate, including the GEO Work Programme.

### **Expected Outcomes**

- Implementation of a consistent and coordinated GEO strategy for engaging external organizations, in particular with respect to the GEO engagement priorities, across the GEO community.
- Increased and stronger connections between GEO Work Programme activities and international policy organizations and with national ministries in GEO Member countries.
- Increased engagement of commercial sector organizations in the GEO Work Programme, especially small, medium and micro-sized enterprises (SMMEs).
- Broader awareness and understanding of GEO, its activities, and its results among users and potential users of Earth observations.
- Increased investment in the GEO Work Programme from non-traditional sources, including foundations and philanthropies.

### **Components**

#### ***GEO Engagement Priorities Coordination***

- Coordination of GEO's engagement with UN agencies and other organizations responsible for various components of the policy frameworks. Engagement with GEO Members, Participating Organizations and GEO Work Programme activities regarding their contributions toward implementation of projects and services, and use of Earth observations in decision making, related to the engagement priorities.

#### ***Commercial Sector Engagement***

- Identification of opportunities for commercial sector involvement in the GEO Work Programme, particularly of SMMEs, and communication of those opportunities to commercial sector organizations.

#### ***Communications***

- Development and implementation of the GEO Communications Plan, including targeted communications messages, campaigns, content and products. Fostering press relations, support to event promotion and coordination of GEO events, promotion of relevant events, opportunities and media coverage with the GEO community. Facilitation of information flow within the GEO community, particularly through the GEO Communicators Network, liaison with GEO Work Programme activity leads, cross-promotion of activities and campaigns, promotion of brand standards, and dissemination of examples of Earth observation use and impact.

### ***Resource Mobilization***

- Development and implementation of a strategy for outreach to potential funders. Provision of guidance and support to GEO Work Programme activities and others regarding funding applications.

### **Implementing Bodies**

- GEO Secretariat
- Earth Observations for the Sustainable Development Goals (EO4SDG)
- GEO Climate Working Group
- GEO Disaster Risk Reduction Working Group

### **Point of Contact**

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## **GEOSS Data, Information and Knowledge Resources**

### **Overview**

This Foundational Task will analyze the current state and trends (including needs and gaps assessments) with respect to Earth observing systems (both remote sensing and in situ). It will also advocate open data sharing and data life-cycle management, while exploring methods for facilitating access to data and developing information resources based on the latest advances in technologies.

### **Expected Outcomes**

- Increased sustainability of current Earth observing systems and recommendations for new fit-for-purpose systems based on needs assessments.
- Increased number of free and open Earth observations datasets, in adherence with the GEOSS Data Sharing Principles and Data Management Principles.
- Lower barriers for uptake of Earth observations and open-source technology to produce applications for environmental monitoring.

### **Components**

#### ***Satellite Observations***

- Support GEO's efforts to promote uptake of Earth observations by providing evidence of the unique and complementary value of satellite data to successful delivery of GEO Work Programme activities. Promote uptake of satellite observations into space agency repositories, data aggregators and cloud storage for use in analyses and global policy reporting, closely linked with the GEO Knowledge Hub. Advocate production of integrated multi-satellite Analysis Ready Datasets.

#### ***In situ Observations***

- Improve access to in situ data and provide coordination and repository services where needed. Advocate new data collection systems and encourage integration of user requirements with respect to in situ data, which will be closely linked with the GEO Knowledge Hub.

#### ***Modelling***

- Support algorithm and model development, and advocate integration of information from in situ, airborne and space-based observations through data assimilation and models. Facilitate access to model data (e.g. initialization, boundary conditions, reanalyses, output) and increase sharing of the modelling and analysis methods needed to transform data into useful products, especially for developing countries.

#### ***Advancing GEOSS Data Sharing and Data Management Principles***

- Continue promotion of free, full, open and timely access to Earth observation datasets, products and services. Maintain dialog with governments and support the uptake and implementation of the GEOSS Data Sharing and Data Management Principles by GEO Members and Participating Organizations, and raise awareness of the technical, organizational, and resource implications of their implementation.

### **Implementing Bodies**

- Committee on Earth Observation Satellites (CEOS)
- GEOSS Data Sharing and Data Management Working Group
- GEO Secretariat

### **Point of Contact**

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## **GEOSS Infrastructure Development**

### **Overview**

The GEOSS Infrastructure Development Foundational Task leads the development and implementation of the common infrastructural elements that constitute the implementation of GEOSS and, by extension, support the Earth observation data and information needs of GEO Work Programme activities, as well as the realization of the GEOSS Data Sharing and Data Management Principles.

For the purpose of this document, the GEOSS Infrastructure includes, at the present time, the GEOSS Platform, GEONETCast, and emerging new components such as the GEO regional infrastructures and the GEO Knowledge Hub (pending approval by GEO Plenary).

### **Expected Outcomes**

- Open access to, and re-use of, the data, information and knowledge resources developed by (or made available to) GEO Flagships, Initiatives and Community Activities.
- Easy discovery and access to data and information resources made available by GEOSS data providers, including customization for particular user groups or communities.
- Documented user expectations and requirements regarding GEOSS services, expansion of the user base and increased user satisfaction through improved user experience.
- Continual improvement of GEOSS services to ensure they meet user expectations and needs, taking advantage of new developments in technologies and standards.
- GEOSS Platform architecture development, operation and evolution.

### **Components**

#### ***GEOSS Platform Operation***

- Maintain current operating functionalities, including:
  - GEOSS Portal as the public interface of the GEOSS Platform, with the data and information resources brokered through the GEO Discovery and Access Broker (GEO DAB);
  - GEO DAB refining the ranking scheme used to prioritize discovery matching results and improving the online DAB statistics;
  - Status Checker describing the quality of service of the online services published by GEOSS data providers; and
  - GEO Yellow Pages service describing the GEOSS data providers and their brokering arrangements.

#### ***Support GEO Community Data and Information Needs***

- Broker additional providers of data and other resources, addressing requests coming from GEO Work Programme activities, in close synergy with the GEOSS Data, Information and Knowledge Resources Foundational Task.

#### ***GEO Knowledge Hub Development***

- Design and implement the GEO Knowledge Hub as a new component of the GEOSS Infrastructure. The Knowledge Hub is envisioned as a set of curated and linked documents that contain relevant information for Earth observation applications and which is integrated with the GEO website. It is intended to provide authoritative,

validated and reproducible content for evidence-based reporting on policy commitments and decision-making. Content for the GEO Knowledge Hub will be provided by GEO Work Programme activities.

#### ***GEONETCast Operation***

- Continue operations of this global network of sustained and cost-effective satellite-based data and information dissemination systems;
- Ensure dissemination of data and information through GEONETCast that directly supports GEO Work Programme activities.
- Support maintenance, training and installation of GEONETCast user reception stations; and
- Consider complementarities between GEONETCast and other GEOSS data access mechanisms.

#### ***GEOSS Platform Documentation***

- Document the GEOSS Platform architecture, services, and application programming interfaces (APIs) to facilitate interoperability and the growth of a GEO data and information ecosystem.

#### ***GEOSS Infrastructure Evolution***

- Advance the evolution of the GEOSS Infrastructure architecture, based on analysis of the evolving landscape of information technology, changing patterns of production and use of Earth observation products and services, and the specific user requirements expressed by GEO Flagships and Initiatives. Main actions include:
  - Design the architecture of the evolving GEOSS Infrastructure.
  - Develop and test new GEOSS Infrastructure functionalities, solutions and components (to address the new architecture), engaging the GEO community.
  - Facilitate the principle of interoperability of all GEOSS components, including regional GEO infrastructures
  - Facilitate the sharing and reusability of the data, services and models generated to satisfy user needs of both the regional and global GEO communities.
  - Prepare documentation and training materials describing the new components and solutions.

#### ***Open-source Solutions***

- Support the use of open-source software, web services and cloud computing to enable low-barrier solutions for the development of applications making use of open and freely accessible Earth observations, especially for developing countries.

### **Implementing Bodies**

#### ***GEOSS Infrastructure Development Task Team***

- Oversees the various activities and components within the Foundational Task, ensuring their connection and synergy.

#### ***GEOSS Platform Operations Team***

- Daily operations of the GEOSS Platform components (GEOSS Portal, GEO DAB, Status Checker and GEO Yellow Pages), and their documentation.

***GEOSS Infrastructure Evolution Working Group***

- Responsible for the GEOSS Infrastructure Evolution component (including members from the former GEOSS EVOLVE).

***GEONETCast Operations Team***

- Daily operations and further development of the GEONETCast network.

***GEO Secretariat***

- Development of the proof of concept for the GEO Knowledge Hub.
- Coordination of efforts on Open-source solutions.

**Point of Contact**

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## **GEO Work Programme Support**

### **Overview**

The GEO Work Programme is the primary coordination and planning instrument used by GEO to select and prioritize its activities. The GEO Programme Board is the governance body which is tasked with overseeing the development, implementation and monitoring of the GEO Work Programme. The purpose of the GEO Work Programme Support Foundational Task is to provide the operational capacity to advise the GEO Programme Board and to implement their decisions and recommendations.

### **Expected Outcomes**

- GEO Programme Board has the information, advice and other support required to fulfil its functions and duties.
- Decisions by GEO Members and GEO governing bodies are informed by analyses and reports based on regular collection of data and information on GEO Work Programme activities.
- Leads and participants of GEO Work Programme activities have the information, tools and support required to effectively implement their activities.

### **Components**

#### ***Programme Board Support***

- Preparation of Programme Board meeting agendas and documents, in consultation with the Programme Board co-chairs. Logistics, analysis and document support to Programme Board subgroups.

#### ***GEO Work Programme Development***

- Coordination of the development process for triennial GEO Work Programmes. Review of implementation plans for GEO Flagships, Initiatives and Community Activities. Drafting of implementation plans for GEO Foundational Tasks. Preparation of GEO Work Programme summary documents and updates.

#### ***GEO Work Programme Monitoring and Liaison***

- Implementation of regular contact with GEO Work Programme activity leads. Provision of guidance and assistance to GEO Work Programmes. Development and coordination of requests for data and information from GEO Work Programme activities. Maintenance of databases for GEO Work Programme monitoring. Analysis of monitoring data and preparation of reports on progress in the GEO Work Programme. Development and production of indicators derived from monitoring data.

#### ***GEO Work Programme Capacity Development***

- Provision of targeted advice and assistance to GEO Work Programme activity leads and participants to enable them to design, implement and measure the effectiveness of co-design and co-production, user engagement and capacity development within their activities.

### **Implementing Bodies**

- GEO Secretariat

- Capacity Development Working Group

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## **GEO Secretariat Operations**

### **Overview**

The GEO Secretariat Operations Foundational Task is intended to support sound management and administration of the resources of the GEO Trust Fund and to provide logistical support for GEO statutory meetings such as Ministerial Summits, GEO Plenary, GEO Executive Committee and GEO Programme Board.

### **Expected Outcomes**

- GEO Trust Fund resources are managed in accordance with Annex D of the GEO Rules of Procedure.
- Secretariat human resources are allocated and managed to support the highest priorities of GEO, within the framework of the staffing plan approved by GEO Executive Committee.
- Financial and in-kind resources to the GEO Trust Fund and Secretariat are available to support the activities of the Secretariat, as approved by the GEO Executive Committee.
- Effective and efficient conduct of GEO meetings.

### **Components**

#### ***Management of the GEO Trust Fund***

- Preparation of a draft Trust Fund Budget and financial income and expenditure accounts. Management of Secretariat mission travel planning and reporting. Management of incoming contributions. Management of extra-budgetary resources for specified activities and associated reporting requirements. Contract administration. Support to the Budget Working Group.

#### ***Management of Secretariat Human Resources***

- Preparation of staffing plans. Management of staff recruitment and performance review processes. Coordination of secondments and liaison with home institutions.

#### ***Conference and Meeting Management***

- Coordination with external meeting hosts. Preparation of Ministerial Summit, Plenary and Executive Committee documents. Participation on and support to working groups for the preparation of GEO Plenary meetings and Ministerial Summits. Management of registration processes and support to participants from developing countries.

#### ***Relations with GEO Members, Participating Organizations and GEO Associates***

- Maintenance of contact databases of GEO Members, Participating Organizations and Associates. Management of processes for review of Participating Organization and Associate applications. Implementation of activities to mobilize financial and in-kind resources for the GEO Trust Fund and GEO Secretariat.

#### ***Coordination of GEO Evaluations***

- Preparation of evaluation terms of reference and briefings for GEO governance bodies. Coordination of calls for nomination to evaluation teams and provision of support to evaluation teams.

### **Implementing Bodies**

- GEO Secretariat
- Budget Working Group
- GEO Week and Ministerial Summit Working Groups
- Host nations of GEO Plenary and other GEO meetings.

### **Point of Contact**

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## Table of Acronyms

AAI	Authentication and Authorization Infrastructure
AARSE	African Association of Remote Sensing of the Environment
ACIS	Advancing Communications Networks
ADP	Asian Development Bank
ADPC	Asian Disaster Preparedness Center
ADS	Atmosphere Data Store
AFRICULTURES	Enhancing Food Security in African Agricultural Systems with the support of Remote Sensing
AFRIGEO	Africa Group on Earth Observations (Regional GEO)
AFRIGIST	African Regional Institute for Geospatial Information Science and Technology
AfriWRM	AfriGEO Water Resource Management initiative
AFWCCI	African Water Cycle Coordination Initiative
AIR-Centre	Atlantic International Research Centre
AMA	Agricultural Monitoring in the Americas
AMAP	Arctic Monitoring and Assessment Programme
AMERIGEO	Americas Group on Earth Observations (Regional GEO)
AMIS	Agricultural Monitoring Information System
AOD	Aerosol Optical Depth
AOGEO	Asia-Oceania Group on Earth Observations (Regional GEO)
AP-BON	Asia-Pacific Biodiversity Observation Network
APCC	Asian Pacific Climate Centre
APN	Asia-Pacific Network for Global Change Research
APRU	Association of Pacific Rim Universities
AQUAWATCH	AquaWatch (GEO Initiative)
ARCTIC-GEOSS	Arctic GEOSS (GEO Community Activity)
ARD	Analysis-Ready Data
ARSSTEE	African Regional Centre for Space Science and Technology Education
ASEAN	Association of Southeast Asian Nations
AsiaRiCE	Agriculture and Food Security
ASREN	Arab States Research and Education Network
ATLANTIC-EO	Earth Observations in the Atlantic Region
AU	African Union
AWCI	Asian Water Cycle Initiative
B&R	Belt and Road
BLUE-PLANET	Oceans and Society: Blue Planet (GEO Initiative)
BON	Biodiversity Observation Network
C3S	Copernicus Climate Change Service (GEO Community Activity)
CAMS	Copernicus Atmospheric Monitoring Service (GEO Community Activity)
CBD	Convention on Biological Diversity
CCAD	Commission for the Environment and Development
CCMI	Central Caribbean Marine Institute
CEMADEN	National Centre for Monitoring and Alerts of Natural Disasters (Brazil)
CEMS	Copernicus Emergency Management Service
CEOS	Committee on Earth Observation Satellites
CEPREDANAC	Disaster Prevention Coordination Centre (Centro de coordinación para la prevención de los desastres) for Central America and the Dominican Republic
CERN	Chinese Ecosystem Research Network
CIESIN	Centre for International Earth Science Information Network
CIIFEN	International Research Centre on El Niño
CLIMATE-OBS	Climate Observation, Simulation and Impacts (GEO Community Activity)
CM4EW	Crop Monitor for Early Warning (GEOGLAM)

CMIP	Coupled Model Inter-comparison Project
CMORPH	National Oceanic and Atmospheric Administration Climate Prediction Center Morphed
CNES	National Centre for Space Studies
COMIFAC	Arab States Research and Education Network (ASREN), Central African Forests Commission
COMPASS	Comprehensive Assessment Tool
COP	Conference of the Parties
CoP	Community of Practice
CORDEX	Coordinated Regional Climate Downscaling Experiment
CREAF	Ecological and Forestry Applications Research Center
CREATE	Collaborative Reanalysis Technical Environment (NASA)
CROP-PEST-MONITORING	Global Crop Pest and Disease Habitat Monitoring & Risk Forecasting (GEO Community Activity)
CRTEAN	Regional Center for Remote Sensing North Africa States
CSDR	Construction and Services of Chinese High-resolution Satellite Data Resources (GEO Community Activity)
CSEOL	Citizen Science Earth Observation Lab
DE-AFRICA	Digital Earth Africa (GEO Community Activity)
DELTA&ESTUARY	Global Observation on Deltas and Estuaries (GEO Community Activity)
DG GROW	Directorate General for Internal Market, Industry, Entrepreneurship and SMEs
DG RTD	Directorate General Research and Innovation
DIAS	Data Integration and Analysis System (GEO Initiative)
DIAS	Data and Information Access Services
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
DSS	Decision Support System
EARSC	European Association of Remote Sensing Companies
EAV	Essential Agricultural Variable
EBV	Essential Biodiversity Variable
ECV	Essential Climate Variable
ECWMF	European Centre for Medium-Range Weather Forecasts
ECZ	Earth Critical Zone
EEA	European Environmental Agency
EFFIS	European Forest Fire Information System
EIS-AFRICA	Environmental Information Systems – Africa
EMEP	European Monitoring and Evaluation Programme
EMI	Mountain Research Initiative
EMP	Environmental Monitoring and Protection
EO4DRM	Earth Observations for Disaster Risk Management (GEO Community Activity)
EO4EA	Earth Observations for Ecosystem Accounting (GEO Initiative)
EO4HEALTH	Earth Observations for Health (GEO Initiative)
EO4ILM	Earth Observations for Indigenous-led Land Management
EO4MIN	Earth Observations for Managing Mineral Resources (GEO Community Activity)
EO4SD	Earth Observations for Sustainable Development
EO4SDG	Earth Observations in Service of the 2030 Agenda for Sustainable Development (GEO Initiative)
EO4SENDAI-MONITORING	Earth Observation and Copernicus in Support of Sendai Monitoring (GEO Community Activity)
EO4WEF	Earth Observations for the Water-Energy-Food Nexus (GEO Community Activity)
EO-IIP	Earth Observation Industrial Innovation Platform (GEO Community Activity)
EOSC	European Open Science Cloud
EOV	Essential Ocean Variable
EPOS	European Plate Observing System
EREV	Essential Renewable Energy Variable
ESA	European Space Agency
ESDGV	Essential Sustainable Development Goal Variable
ESGF	Earth System Grid Federation
EU SatCen	European Union Satellite Centre

EUMETSAT	European Organization for the Exploitation of Meteorological Satellites
EUROGEO	European Group on Earth Observations (Regional GEO)
EuroGeoSurveys	The Association of the Geological Surveys of the European Union
EV	Essential Variable
EWV	Essential Water Variable
FAO	United Nations Food and Agriculture Organization
FRA	Forest Resource Assessment
FRP	Fire Radiative Power
G20	Group of Twenty
GAR	Global Assessment Report on Disaster Risk Reduction
GBIF	Global Biodiversity Information Facility
GCMs	General Circulation Models
GCOS	Global Climate Observing System
GDIS	Global Drought Information System
GEANT	Pan-European research and education network that interconnects Europe's National Research and Education Networks
GEO	Group on Earth Observations
GEOARC	Global Ecosystems and Environment Observation Analysis Research Cooperation (GEO Community Activity)
GEO-BON	GEO Biodiversity Observation Network (GEO Flagship)
GEO-CITSCI	GEO Citizen Science (GEO Community Activity)
GEO-CRADLE	GEO Capacity Building in the North Africa, Middle East, Balkans and Black Sea Region (GEO Initiative)
GEO DAB	GEO Discovery and Access Broker
GEO-DARMA	Data Access for Risk Management (GEO Initiative)
GEODESY4SENDAI	Geodesy for the Sendai Framework (GEO Community Activity)
GEO-ECO	GEO Global Ecosystem Initiative (GEO Community Activity)
GEO-EV	GEO Essential Variables (GEO Community Activity)
GEOLAM	GEO Global Agricultural Monitoring (GEO Flagship)
GEOGLOWS	GEO Global Water Sustainability (GEO Initiative)
GEO-GNOME	GEO Global Network for Observation and Information in Mountain Environments (GEO Initiative)
GEO-LDN	GEO Land Degradation Neutrality Initiative (GEO Initiative)
GEOSS	Global Earth Observation System of Systems
GEOSS Data CORE	GEOSS Data Collection of Open Resources for Everyone
GEO-VALUE	Understanding the Impacts and Value of Earth Observations (GEO Community Activity)
GEO-VENER	GEO Vision for Energy (GEO Initiative)
GEO-WETLANDS	GEO Wetlands Initiative (GEO Initiative)
GFCS	Global Framework for Climate Services
GFRM	Global Flood Risk Monitoring (GEO Community Activity)
GFOI	Global Forest Observations Initiative (GEO Flagship)
GHS	Greenhouse Gas
GLOBAL-LAND-COVER	Global Land Cover (GEO Community Activity)
GLOFAS	Global Flood Awareness System (GEO Community Activity)
GME	Global Mountain Explorer
GMES and Africa	Global Monitoring for Environment and Security and Africa
GMP	Global Monitoring Plan
GNSS	Global Navigation Satellite System
GOFC-GOLD	Global Observation of Forest and Land Cover Dynamics
GOOS	Global Ocean Observing System
GOS4M	Global Observation System for Mercury (GEO Flagship)
GOS4POPS	Global Observation System for Persistent Organic Pollutants (GEO Initiative)
GPCC	Global Precipitation Climatology Centre
GPM	Global Precipitation Measurement
GPSDD	Global Partnership for Sustainable Development Data

GRSS	Geoscience and Remote Sensing Society
GSNL	GEO Geohazard Supersites and Natural Laboratories (GEO Initiative)
GTEWS	GNSS enhancement for Tsunami Early Warning Systems
GUOI	Global Urban Observation and Information (GEO Initiative)
GWIS	Global Wildfire Information System (GEO Initiative)
GWOS	Global Wetlands Observing System (GEO Initiative)
HUMAN-PLANET	GEO Human Planet (GEO Initiative)
IAEG-SDG	Inter-agency and Expert Group on SDG Indicators
IAG	International Association of Geodesy
IASC	International Arctic Science Committee
IBEC	Inter-Balkan Environment Centre
iBOL	Consortium for the Barcode of Life
IBRD	International Bank for Reconstruction and Development
ICOS	Integrated Carbon Observation System
ICPAC	Intergovernmental Authority on Development Climate Prediction and Application Centre
IEEE	Institute of Electrical and Electronics Engineers
IGWCO	Integrated Global Water Cycle Observations
IHE	IHE Delft Institute for Water Education
IIASA	International Institute for Applied Systems Analysis
IISs	Integrated Information Systems
IN-SITU-ESC	In-Situ Observations and Applications for Typical Ecosystem Status of China and Central-Asia (GEO Community Activity)
IOC	Intergovernmental Oceanographic Commission
IOCARIBE	Intergovernmental Oceanographic Commission's Sub-Commission for the Caribbean and Adjacent Region
IPBES	Science Policy Platform on Biodiversity and Ecosystem Services
IPCC	Intergovernmental Panel on Climate Change
IRENA	International Renewable Energy Agency
IRRI	International Rice Research Institute
ISC	International Science
ISPRS	International Society for Photogrammetry and Remote Sensing
ITC	International Institute for Geo-Information Science and Earth Observation
IUCN	International Union for the Conservation of Nature
IUGG	International Union of Geodesy and Geophysics
IWMI	International Water Management Institute
IWRM	Integrated Water Resources Management
JAMSTEC	Japan Agency for Marine-Earth Science and Technology
JECAM	Joint Experiment for Crop Assessment and Monitoring
LASAC	Land Satellite Remote Sensing Application Center
LDN	Land Degradation Neutrality
LRTAP	Long-range Transboundary Air Pollution
MARA	Ministry of Agriculture and Rural Affairs
MARS	Monitoring Agricultural Resources
MBON	Marine Biodiversity Observation Network
MEE	Ministry of Ecology and Environment
MGD	Methods and Guidance Documentation
MNR	Ministry of Natural Resources
MODIS	Moderate Resolution Imaging Spectroradiometer (NASA)
MRV	Measurement, Reporting and Verification
MUSYQ	Multi-Source Synergized Remote Sensing Products and Services
NASA	National Aeronautics and Space Administration
NASG	National Agency of Surveying, Mapping and Geo-information
NDC	Nationally Determined Contribution
NEPAD	New Partnership for Africa's Development

NEXT-EOS	Next Generation Earth Observation Services (GEO Community Activity)
NFMS	National Forest Monitoring System
NGCC	National Geomatics Centre of China
NGO	Non-governmental Organization
NIDIS	National Integrated Drought Information System
NIGHT-LIGHT	Night-time Light Remote Sensing for Global Sustainability (GEO Community Activity)
NOAA	National Oceanic and Atmospheric Administration
NREN	National Research and Education Network
OCI	Oceans, Coasts, and Islands (AOGEO activity)
OECD	Organisation for Economic Co-operation and Development
OECS	Organization of Eastern Caribbean States
OGC	Open Geospatial Consortium
OSS	Sahara and Sahel Observatory
P2P-Americas	Pole-to-Pole Marine Biodiversity Observation Network of the Americas
POGO	Partnership for Observation of the Global Oceans
POP	Persistent Organic Pollutant
PRIMA	Partnership for Research and Innovation in the Mediterranean Area
R2O	Research to Operations
RCEECA	Research Center for Ecology and Environment of Central Asia
RCMRD	Regional Centre for Mapping of Resources for Development
RCP	Representative Concentration Pathway
RESTEC	Remote Sensing Technology Centre (Japan)
S2S	Sub-seasonal to Seasonal Prediction Project
SADC	Southern Africa Development Community
SAON	Sustaining Arctic Observing Networks
SAR	Synthetic Aperture Radar
SBA	Societal Benefit Area
SCO	Space Climate Observatory (GEO Community Activity)
SDG	Sustainable Development Goal
SEEA	System of Environmental-Economic Accounting
SICA	Central American Integration System
SMMEs	Small, Medium and Micro-sized Enterprises
SOPs	Standard Operating Procedures
SPACE&SECURITY	Space and Security (GEO Community Activity)
SPI	Standardized Precipitation Index
TEC	Total Electron Content
TIGGE	Thorpex Interactive Grand Global Ensemble Evolution into a Global Interactive Forecast System (GEO Community Activity)
UFORIC	Understanding Flooding on Reef-lined Island Coasts
UHOP	Uniform High-Elevation Observing Platform
UN	United Nations
UN Environment	United Nations Environment Programme
UNCCD	United Nations Convention to Combat Desertification
UNDP	United Nations Development Programme
UNDRR	United Nations Office for Disaster Risk Reduction
UNECA	United Nations Economic Commission for Africa
UNECE	United Nations Economic Commission for Europe
UNESCAP	United Nations Economic and Social Commission for Asia and the Pacific
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNESCWA	United Nations Economic and Social Commission for Western Asia
UNFCCC	United Nations Framework Convention on Climate Change
UN-GGIM	United Nations Committee of Experts on Global Geospatial Information Management
UN-Habitat	United Nations Human Settlement Programme
UNITAR	United Nations Institute for Training and Research

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UNOOSA	United Nations Office for Outer Space Affairs
UNSD	United Nations Statistics Division
UNU-EHS	United Nations University, Institute for Environment and Human Security
UWI	University of the West Indies
WACREN	West and Central African Research and Education Network
WCI	Water Cycle Integrator
WCRP	World Climate Research Programme
W-E-F Nexus	Water-Energy-Food Nexus
WFP	World Food Programme
WGGI	Working Group on Geospatial Information
WHO	World Health Organization
WMO	World Meteorological Organization
WQIS	Water Quality Information Service
WRI	World Resources Institute
WSSD	World Summit on Sustainable Development
WWRP	World Weather Research Programme

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