

GEO Strategic Plan 2016-2025: Implementing GEOSS

Reference Document

This Document is submitted to the GEO-XII Plenary for information.

GROUP ON EARTH OBSERVATIONS

GEO Strategic Plan 2016-2025: Implementing GEOSS

Reference Document

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Introduction

This *Reference Document* is a companion to the *GEO Strategic Plan 2016-2025: Implementing GEOSS*, providing details on aspects of the Implementation Plan (Part B of the Strategic Plan).

More specifically, it includes an amplified description of the GEOSS, provides the expanded set of GEOSS Data Management Principles, presents expected results and indicators for monitoring progress as the Core Functions are implemented, and provides additional details on the four Implementation Mechanisms and the development of GEO Work Programmes. Given that engagement will be key to GEO's success over the next decade, the GEO Communications and Engagement Strategy is also included in the *Reference Document*.

GEOSS Description

GEOSS is a set of coordinated, independent Earth observation, information and processing systems that interact and provide access to diverse information for a broad range of users in both public and private sectors. GEOSS links these systems to strengthen the monitoring of the state of the Earth. It facilitates the sharing of environmental data and information collected from the large array of observing systems contributed by countries and organizations within GEO. Further, GEOSS ensures that these data are accessible, of identified quality and provenance, and interoperable to support the development of tools and the delivery of information services. Thus, GEOSS increases our understanding of Earth processes and enhances predictive capabilities that underpin sound decision-making.

GEOSS comprises both observing and information systems:

- **Observation systems** which include ground-, air-, water- and space-based sensors, field surveys, and citizen observatories. GEO works to coordinate the planning, sustainability and operation of these systems, aiming to maximize their added-value and use;
- **Data and information and processing systems** which include hardware (architecture) and software tools (such as models) needed for handling, processing and delivering data from the observation systems to provide information, knowledge, services and products.

GEOSS is responsive to user needs, supports a broad range of implementation options, and is able to incorporate new technologies and approaches for data collection and analysis (e.g. new satellites, cloud computing, sensor webs, Big Data, crowdsourcing and citizen science).

GEO promotes the adoption of the GEOSS Data Sharing and Data Management principles and facilitates and enables elements of GEOSS to be developed and operated so that user information requirements can be met.

GEO promotes and enables interoperability between contributing systems in GEOSS and maintains, operates and upgrades the technical components that allow users to search, discover, access and share data, products and services.

GEOSS, collectively, supports several functions:

- to address user requirements;
- to acquire observational data;
- to process data into useful products and services;
- to find, share, integrate and archive data, metadata and products based on the GEOSS Data Sharing and Data Management Principles; and
- to monitor performance of functionalities against the defined requirements and intended benefits.

The components of GEOSS are connected and tied together in a GEOSS architecture, which has the following principles:

Openness: The architecture shall be open and allow interoperability among multiple stakeholders to contribute their data and services and add value to the GEOSS.

Effectiveness: The architecture shall be capable of sufficient performance in all areas to support the Strategic Objectives of GEO in the implementation of GEOSS. **Flexibility:** The architecture shall be scalable, to meet current and future requirements; flexible, to meet a broad variety and scale of GEOSS requirements; and agile, to be able to provide solutions across GEOSS with minimum tailoring and re-architecture.

Sustainability: The architecture shall provide the solution for the near and long term in a cost-efficient manner, as technology, policies, and data providers change.

Reliability: The architecture shall be robust, and allow GEOSS to meet users' expectations and effectively manage risk.

As part of its evolution through 2025, GEOSS will be open to new contributions of observations, data, information products and services by the private sector and civil society, and exploit the opportunities afforded by new technologies in ways that make GEOSS more relevant to wide segments in society, and trusted as a key source of information about our planet.

GEOSS Data Management Principles

1.1 Background and Context

The background discussion for these initially proposed principles can be found in Document 7¹ from GEO-XI.

The GEOSS Data Management Principles build on the GEOSS Data Sharing Principles in the sense that they adumbrate what is required in terms of data management to allow data to be shared as Open Data, promptly and at minimum cost. Good data management implies a number of activities which ensure that data are discoverable and accessible, that they may be understood and used, and that they are looked after in the long term.²

A priority mission for GEO is to encourage the implementation of the Principles by organizations contributing to GEOSS. Guidelines for implementation will be provided elsewhere.

1.2 GEOSS Data Management Principles

To further maximize the value and benefit from data sharing, GEO will continue to work with partners to promote the use of key GEOSS Data Management Principles, including the need for common standards and interoperability arrangements. This will ensure that data and information of different origin and type are comparable and compatible, facilitating their integration into models and the development of applications to derive decision support tools. GEO therefore strives to promote and encourage the implementation of GEOSS Data Management Principles laid out below under five headings: discoverability, accessibility, usability, preservation, and curation.

Discoverability

DMP-1. Data and all associated metadata will be discoverable through catalogues and search engines, and data access and use conditions, including licenses, will be clearly indicated.

Accessibility

DMP-2. Data will be accessible via online services, including, at minimum, direct download but preferably user-customizable services for visualization and computation.

Usability

DMP-3. Data will be structured using encodings that are widely accepted in the target user community and aligned with organizational needs and observing methods, with preference given to non-proprietary international standards.

DMP-4. Data will be comprehensively documented, including all elements necessary to access, use, understand, and process, preferably via formal structured metadata based on international or

¹ GEO XI Document 7: *Towards Data Management Principles*.

² G8 Science Ministers' Statement (on Open Scientific Research Data), 13 June 2013
<https://www.gov.uk/government/news/g8-science-ministers-statement> : 'Open scientific research data should be easily discoverable, accessible, assessable, intelligible, useable, and wherever possible interoperable to specific quality standards.'

community-approved standards. To the extent possible, data will also be described in peer-reviewed publications referenced in the metadata record.

- DMP-5. Data will include provenance metadata indicating the origin and processing history of raw observations and derived products, to ensure full traceability of the product chain.
- DMP-6. Data will be quality-controlled and the results of quality control shall be indicated in metadata; data made available in advance of quality control will be flagged in metadata as unchecked.

Preservation

- DMP-7. Data will be protected from loss and preserved for future use; preservation planning will be for the long term and include guidelines for loss prevention, retention schedules, and disposal or transfer procedures.
- DMP-8. Data and associated metadata held in data management systems will be periodically verified to ensure integrity, authenticity and readability.

Curation

- DMP-9. Data will be managed to perform corrections and updates in accordance with reviews, and to enable reprocessing as appropriate; where applicable this shall follow established and agreed procedures.
- DMP-10. Data will be assigned appropriate unique, persistent, resolvable identifiers to enable documents to cite the data on which they are based and to enable data providers to receive acknowledgement of use of their data.

Core Functions: Monitoring, Evaluation, Expected Results and Indicators

GEO provides a platform for political dialogue on the role of Earth observations in achieving shared objectives, notably those of the global sustainable development agenda. GEO's advocacy for robust, Earth observation data collection systems (e.g., space, airborne and in-situ sensors and field surveys, for terrestrial, freshwater, ocean and atmosphere observations) and conditions for their effective use aims to ensure the availability of and access to global Earth observation data and information needed.

GEO acts as a broker, connecting users, data providers, engineers, scientists and other relevant experts across governments, the private sector, civil society and academia to create solutions to global challenges, which cross both country and disciplinary boundaries. This role requires deep engagement with and understanding of all of these communities in both developed and developing countries.

Three overarching Strategic Objectives guide the work of GEO in its second decade towards achieving outcomes that address societal challenges.

GEO will work to achieve these Strategic Objectives through a set of Core Functions. These are geared towards specific, measurable, and achievable results designed to enable an effective implementation, including monitoring of progress and evaluation of achievements. The Core Functions will be implemented through specific actions set out in the GPWs. GPW activities reflect GEO's specific choices on approach to implementation which may in many cases be incremental steps. Their effectiveness can be evaluated against expected results, which are defined based on indicators presented here.

1. MONITORING & EVALUATION

Monitoring and evaluation functions within GEO will be implemented in different ways depending on the Implementation Mechanism chosen.

The purpose of monitoring is to track the progress of the GPW. The GEO Secretariat will conduct monitoring on an on-going and systematic basis.

Evaluations inform improvement of GEO's activities by conducting assessments of the progress towards achieving the expected results. These evaluations will take note of other contributing activities that are not included in the GPW, but are attributable, at least in part, to GEO's actions. Results of the evaluation will help determine how effective GEO has been in terms of societal impacts. The evaluations previously performed by the Monitoring and Evaluation Working Group will be implemented through Foundational Tasks included in the GPW.

Two comprehensive evaluations should be conducted with one mid-way through the Strategic Plan period and the other near the end. The evaluations will address the full scope of the activities within GEO, although their primary focus should be on the Strategic Objectives and expected results. The mid-term evaluation will also include an assessment on the extent to which the priorities identified in the Mexico City Ministerial Declaration are being realized and re-orient / refine directions set out in the GEO Strategic Plan to take into account emerging trends and challenges.

Proposals for conducting additional evaluations on specific topics or Initiatives should be included in the GPWs. The results of the evaluations will be presented to the GEO Programme Board, the Executive Committee and Plenary. The GEO Secretariat will support the evaluations, including by providing the necessary links into GEO communities.

2. CORE FUNCTIONS, EXPECTED RESULTS AND INDICATORS

GEO will implement a set of Core Functions essential for the realization of its three Strategic Objectives set out in the GEO Strategic Plan. During the course of GEO's second decade, key elements of the monitoring and evaluation framework are established up-front. These include a more efficient and targeted approach to monitoring, one that is connected to the relevant Implementation Mechanism, as well as evaluations connected to GPW finalization, Ministerial meetings and the midterm review. To monitor progress and evaluate outcomes, a series of indicators underpin expected results. These are designed to be quantifiable, based on data used to manage implementation of the GPWs whilst allowing the actual targets to be refined as resourcing options become clearer during GPW preparation.

Core Function: Identifying user needs and addressing gaps in the information chain

Implement a structured approach to identifying user needs for observations and services. Beginning with areas where opportunities and relationships with users have been identified, convene key stakeholders across the value chain, from providers of the observations to the end user for whom services are developed, from the public and private sector, in order to:

- identify those Earth observations most needed, relevant and useful to users in each SBA;
- articulate the preferences of users with respect to information products and tools, including timeliness, format and frequency, in order to contribute value to the decision making process; and
- obtain commitments from providers to deliver these observations, products and tools in a comprehensive, coordinated and sustained way.

<i>Expected Results</i>	<i>Indicator</i>
<ul style="list-style-type: none"> • Identification of the information products and tools required for key user groups to use Earth observations to produce the actionable information necessary to address critical global and regional challenges and opportunities. 	<ul style="list-style-type: none"> • Number of SBA user communities for which Earth observations (EO)-enabled information product and tool preferences have been documented.
<ul style="list-style-type: none"> • Agreement on the highest-priority essential Earth observations for specific and multiple SBAs, based on relevance to critical global and regional challenges and opportunities, taking account of the feasibility of their translation into products and tools that deliver impact. 	<ul style="list-style-type: none"> • Number of SBAs for which high priority Earth observations have been identified, validated and approved by GEO Plenary.
<ul style="list-style-type: none"> • Commitments made by providers to end users to address the highest priority gaps in information chain. 	<ul style="list-style-type: none"> • Percentage of identified high priority (in-situ and satellite-based) Earth observations, information products and tools that are either currently available or that providers have committed to deliver.

Core Function: Sustaining foundational observations and data

Act to sustain observing systems and data provision by compiling global perspectives regarding existing and planned observational infrastructures. Establish a framework for Members, Participating Organizations, and other stakeholders to encourage the development of common observational strategies. Ensure decisions and actions are informed by coordinated, comprehensive and sustained Earth observations, as set forth in GEO's Vision.

<i>Expected Results</i>	<i>Indicator</i>
<ul style="list-style-type: none"> Ongoing predictable creation of the new satellite and non-satellite Earth observations required to address the approved highest-priority requirements. 	<ul style="list-style-type: none"> Number of Members and Participating Organizations making use of collective long-term planning scenario information for key observing systems to prioritize their funding and investments Number of gaps between actual data delivery compared to expected data delivery identified on an annual basis.
<ul style="list-style-type: none"> Minimization of non-productive overlap in observing systems as a result of programme coordination and data sharing. 	<ul style="list-style-type: none"> Reduction in number of non-productive overlaps identified in surveys.

Core Function: Fostering partnerships and mobilizing resources

Connect users, resource providers, and experts from different sectors in the domain of Earth observations and environmental information to form partnerships, in order to:

- work with funding agencies at national and international levels to encourage increased investment in GEO activities and use of Earth observation data;
- pool resources and develop knowledge and tools that realize beneficial economic, social and environmental impacts across all SBAs; and
- initiate and support studies that address challenges related to global resource mobilization, at all stages of the funding cycle, while providing input to policies relevant for Earth observations.

<i>Expected Results</i>	<i>Indicator</i>
<ul style="list-style-type: none"> Increased involvement and investment in GEO activities from national, international and private funding sources. 	<ul style="list-style-type: none"> Cumulative number of new partnerships in place with the private sector to i) provide technical, non-proprietary support of GEOSS development; and ii) promote the use and fair exploitation of GEOSS resources to deliver information products, decision support tools and service for the benefit of society; and with international development and donor organizations. Total annual contributions and number of Flagship Initiatives.
<ul style="list-style-type: none"> Increased use of Earth observation data. 	<ul style="list-style-type: none"> Citations of Earth observation data in key documents including scientific journals, government and international body studies and reports, and in metadata projects benefitting multiple SBAs. Number of new community activities in the GPW that identify benefits for specific SBAs.
<ul style="list-style-type: none"> National governments, regional governments and international bodies adopt policies that are based on Earth observations. 	<ul style="list-style-type: none"> Number of national governments, regional governments and international bodies that have adopted policies that build on Earth observation information.

Core Function: Advancing GEOSS and best practice in data management and sharing

Operate and continuously improve technical means that provide access to global Earth observation systems, so that the data, information, knowledge, products and services needed for scientific understanding and sound decision-making are increasingly easy to access, integrate, and use. Work with Members and Participating Organizations to implement the *GEOSS Data Sharing and Management Principles* and ensure that open data is discoverable, usable, accessible and preserved for integrated use across multiple communities. Promote life cycle management of data holdings, recovery of historic non-digital data, and the use of standards.

<i>Expected Results</i>	<i>Indicator</i>
<ul style="list-style-type: none"> Earth observation data, information, knowledge, products and services are easier to access, integrate and use. 	<ul style="list-style-type: none"> Number of information products and services that can be accessed directly through the GEOSS Portal. Number of datasets that can be downloaded directly, or processed in-situ, through the GEOSS Portal.
<ul style="list-style-type: none"> Increased implementation of GEOSS Data Sharing and Management Principles. 	<ul style="list-style-type: none"> Proportion of data accessible through the GEOSS Portal for which sufficient metadata is available to enable reliable traceability from a derived product to the fundamental observation data. Percentage of GEO Members reporting that they have implemented the GEOSS Data Sharing Principles.
<ul style="list-style-type: none"> Data holdings are life-cycle managed. 	<ul style="list-style-type: none"> Percentage of datasets accessible through the GEOSS Portal for which the custodian reports compliance with GEO-approved best practice approaches to life-cycle data management.
<ul style="list-style-type: none"> Historic non-digital data are recovered. 	<ul style="list-style-type: none"> Number of key legacy datasets that have been digitized for users.

Core Function: Implementing sustained global and regional services

Support for the global sustainable development agenda and evidence-based decision-making. Monitor progress towards policy goals, such as strengthening SDG monitoring frameworks, and support necessary transitions towards achieving these goals. Incubate and pilot regional or global initiatives that provide data or information services to meet shared information needs for societal benefit. Develop strategies for handover and long-term ownership of service provision in host organizations.

<i>Expected Results</i>	<i>Indicator</i>
<ul style="list-style-type: none"> Increased use of data in monitoring and implementation of critical international frameworks and policy goals. 	<ul style="list-style-type: none"> Number of cases of demonstrated use of Earth observation-based information services in support of the global sustainable development agenda. Number of international frameworks for which GEO activities provided, or played a key role in establishing processes which provided, data as part of the evidence base for implementation or monitoring of progress.

<ul style="list-style-type: none"> • Implementation of regional or global initiatives within GEO that provide data or information services to meet shared information needs for societal benefit. 	<ul style="list-style-type: none"> • Number of regional or global initiatives within GEO for which a formal partnership with the relevant international or regional institution has been established.
<ul style="list-style-type: none"> • Transfer of GEO service provision initiatives to sustainable host organizations. 	<ul style="list-style-type: none"> • Number of regional or global initiatives that have been transferred to permanent host organizations and which continue to be operational more than 3 years after the hand-over.

Core Function: Cultivating awareness, building capacity and promoting innovation

Cultivate awareness among key decision makers and stakeholders, including UN bodies, donor organizations, businesses, and other communities of intermediary- and end-users, of the value and importance of Earth observations. Build capacity in the domains of infrastructure and know-how, and facilitate the take-up of new and innovative approaches, such as crowd sourcing and cloud-based computing.

Establish and implement a communication and stakeholder engagement strategy. Provide input to policies and initiatives relevant for Earth observations such as protecting spectral domains from competing uses and basic global reference measurements (e.g. gravity, bathymetry and topography) that provide fundamental information underpinning all observation systems. Establish a collaboration framework for GEO Members and Participating Organizations from both developed and developing regions, for example through long-term research partnerships or twinning projects. Assist developing countries and regions in increasing their capacity to acquire, share, store, maintain and utilize Earth observation data and information; demonstrate solutions, disseminate best practices, organize training workshops. Strengthen cooperation at regional and national level by identifying country-specific opportunities to develop Earth observation plans and establishing national GEO structures.

<i>Expected Results</i>	<i>Indicator</i>
<ul style="list-style-type: none"> • Increased awareness among key decisions makers and stakeholders of the value and importance of Earth observations. 	<ul style="list-style-type: none"> • Number of UN agencies/bodies participating actively in GEO Initiatives and Flagships.
<ul style="list-style-type: none"> • Basic global reference measurements (e.g. gravity, bathymetry and topography) are established and provide the information required to underpin application of Earth observation data through GEO activity 	<ul style="list-style-type: none"> • Instances of reported gaps in available global reference measurements.
<ul style="list-style-type: none"> • Increased collaboration between countries with differing capacities and regions. 	<ul style="list-style-type: none"> • Number of GEO Flagships, GEO Initiatives and GEO Community Activities that involve contributions from both developed and developing countries.
<ul style="list-style-type: none"> • Increased development of regional and national EO plans. 	<ul style="list-style-type: none"> • Percentage of GEO Members that report that they have developed national Earth observation plans. • Number of regional (multi-state) and Participating Organizations Earth observation plans that have been developed.

GEO Implementation Mechanisms

GEO employs different mechanisms to implement its Core Functions, i.e. any activity included in the GPWs. These serve to distinguish between more substantial activities with dedicated resources, and smaller-scale activities, often driven by best-effort initiatives of individuals or small groups. By implementing all actions adequately and appropriately, GEO focuses its resources on selected priorities and matches expectations with available capacity.

The four GEO Implementation Mechanisms are defined as follows:

- GEO Community Activities;
- GEO Initiatives;
- GEO Flagships;
- GEO Foundational Tasks.

1 GEO COMMUNITY ACTIVITIES

GEO Community Activities allow stakeholders to cooperate flexibly in a bottom-up fashion, with a low initiation cost, and can include a broad variety of activities. GEO Community Activities may, for example, define user needs, explore new frontier applications or demonstrate technical possibilities, or agree on specific observation or analysis protocols. They are often conceptual, investigative or developmental in nature. GEO Community Activities are typically smaller-scale undertakings with commitments for contributions often disparate, made at the level of institutions or individuals. Users may be involved to the extent that they have been identified and engaged.

GEO Community Activities may form spontaneously at the initiative of interested parties. All necessary resources may not be completely identified from the beginning and the objectives may be defined at a relatively general level. Corresponding to their disparate nature, the styles of management may vary considerably among different GEO Community Activities.

Examples of GEO Community Activities in the transitional GPW 2016 include the Global Urban Observation, and Information Task and the Global Water Quality Information Task.

1.1 Establishing GEO Community Activities

Any self-formed group within the GEO Community may propose GEO Community Activities at any time. Often, Communities of Practice (CoP) may be the natural frameworks within which ideas can be conceptualized and matured. The initiating groups develop brief proposals describing the activities, including its objectives, schedule, contributors and stakeholders. GEO Community Activities may also arise as a result of GEO's engagement activities or Memoranda of Understanding between the GEO Secretariat and other institutions.

The GEO Secretariat accepts proposed Community Activities into the GPW and associated Progress report, based on agreed criteria. Most importantly, the GEO Secretariat must verify that a proposed Community Activity is aligned with GEO's objectives and direction. The Secretariat may also make recommendations on a proposal with respect to, for example, augmenting contributions, improving coordination with existing GEO Initiatives or other GEO Community Activities, or sharpening support for GEO's Strategic Objectives.

GEO Community Activities may evolve into GEO Initiatives if and when they provide an Implementation Plan that is accepted by the GEO Programme Board.

1.2 Criteria for establishing GEO Community Activities

- Objective(s) shared by a group of interested partners;
- Multi-national stakeholder group or scope; and
- Relevance to GEO's Strategic Objectives.

1.3 Contributors

Primary contributors to GEO Community Activities are Participating Organizations, GEO Members (through their corresponding institutions or *in situ* international observation networks), and possibly other partners from the private sector. GEO Community Activities may also include contributions from individual citizens through citizen observatories.

1.4 Management and coordination

GEO Community Activities are self-organized and implement flexible arrangements defined by participants. The GEO Secretariat may facilitate communication and implementation through, for example, limited support in organizing meetings.

A Lead must be identified for the GEO Community Activity, who acts as an interface for the GEO Secretariat and other interested parties.

1.5 Reporting to GEO

The GEO Secretariat will seek information from GEO Community Activities (through the Lead) on progress and developments. Where such information can be obtained, it will be included in the annual GEO Progress Report.

1.6 Monitoring and Evaluation

The GEO Secretariat monitors the development of GEO Community Activities through regular interaction with the Lead. GEO does not evaluate Community Activities.

GEO INITIATIVES

GEO Initiatives allow Members and Participating Organizations to coordinate their actions and contributions towards a common objective within an agreed, yet flexible framework. They develop and implement prototype services according to GEO priorities. GEO Initiatives may, for example, demonstrate technical feasibilities through pilot services. GEO Initiatives concern activities for which the user communities are known at a general level (but may not yet have been fully defined in detail), where some products and services may exist (but may have not yet been fully consolidated), and where resourcing options have been identified (but may have not yet been fully identified or analyzed). Contributions are typically made in kind, including observation systems operated to serve the Initiative's objectives, models, funded projects, or other programmes.

GEO Initiatives have a clearly identified objective that responds to needs of GEO Members and Participating Organizations and an implementation plan setting out how that objective is to be achieved. Initial contributions by Members, Participating Organizations, and private sector players are identified to the extent known. Further commitments may often be sought during the implementation of the GEO Initiative. Relevant stakeholders should be engaged in the development of the Initiative, with the user community being integrated into the GEO Initiative as it develops. Clarifying user needs and consolidating communities should be an objective of GEO Initiatives.

Some GEO Initiatives may evolve into GEO Flagships if and when accepted by Plenary following a recommendation by the GEO Programme Board. However, GEO Initiatives may also be taken up

directly by a Participating Organization, or be discontinued if, in particular, their objective has been achieved. The implementation plan should outline any expectations with respect to the final phase of the Initiative.

1.7 Establishing GEO Initiatives

Any GEO Member, Participating Organization, or the GEO Secretariat may conceptualize and propose a new GEO Initiative based on a detailed Implementation Plan. These are discussed and further developed by those proposing the Initiative together with the GEO Programme Board. The SBA Working Groups should be involved when developing GEO Initiatives. Where Communities of Practice (CoP) can contribute to the development of the Implementation Plan, they should be engaged at an early stage. Their role is described in the implementation plan. The GEO Programme Board works to establish consensus concerning the proposed objectives and the implementation plan, and to ensure that a sufficient level of resources and contributions are committed for successful implementation of the GEO Initiative. All contributions – in kind or otherwise – are listed, described, and valued in the implementation plan. Contributions may include specific commitments from GEO Members, Participating Organizations, private sector partners, or other third parties. If and when this can be achieved, the GEO Programme Board may accept the new GEO Initiative.

By accepting a new GEO Initiative, GEO supports its objectives and commits or acknowledges the resources specified in the implementation plan.

1.8 Criteria for establishing GEO Initiatives

GEO Initiatives must meet all criteria used for Community Activities (see 1.2). In addition:

- User need or application perspective identified;
- Pilot or prototype information service or product developed or demonstrated;
- Contribution to satisfying user need;
- User institutions identified with plans to solicit their advice;
- Sufficient resources for activities identified and committed;
- Clear relevance to GEO's Strategic Objectives demonstrated;
- GEOSS Data Sharing and Data Management Principles implemented;
- Implementation Plan, detailing:
 - Objective(s), shared by partners;
 - The information service or product provided;
 - Schedule for implementation;
 - Perspective(s) for evolution;
 - Quantified, itemized resources, including from Members, Participating Organizations, private sector partners and the GEO Secretariat, enabling substantial progress towards objectives;
 - Partners, including target user groups;
 - Capacity Building activities
 - User representatives engaged, often in advisory roles;

- Governance and management mechanisms; and
- Monitoring and Evaluation procedures.

1.9 Contributors

Primary contributors to GEO Initiatives are typically Participating Organizations, GEO Members (through their corresponding institutions), and interested partners from the private sector. The specific contributions and the roles of the different contributors may vary between different GEO Initiatives and are described in the implementation plan.

1.10 Management and coordination

GEO Initiatives are generally managed as projects. The detailed arrangements may vary between different GEO Initiatives and are defined in the implementation plan. GEO Initiatives should have effective dedicated steering boards or similar mechanisms that oversee implementation of the Initiative. Members of the steering board should be representatives of those partners providing significant resources to the implementation. Representatives of user communities should also be engaged in the steering board, or advisory mechanisms, as appropriate.

GEO Initiatives may define their steering and advisory mechanisms according to their specific needs, though lessons may be learned from other Initiatives or Flagships.

Typically, an Initiative coordinator will be identified. They will typically be resourced by a contributing Member or Participating Organization. In some cases, the coordinator might be established within the GEO Secretariat. The coordinator is responsible for coordinating the implementation of the agreed implementation plan and reporting to GEO on progress and other related issues. A sufficiently resourced Initiative coordinator is an important criterion for accepting a new GEO Initiative.

1.11 Reporting to GEO

The Initiative coordinator is responsible for all reporting to GEO. This includes in particular:

- Progress reports in contribution to the annual GEO Progress Report. These will be reviewed by the GEO Programme Board; and
- Presentations to Plenary, the Executive Committee or the GEO Programme Board, as necessary.

Since many of the contributions will be made in-kind, further reporting will generally be required by individual contributors within their respective contexts.

1.12 Monitoring and Evaluation

Monitoring and evaluation activities are defined in the Implementation Plan. At a general level, the GEO Programme Board will monitor progress on the basis of the reports from the project coordinator and may recommend changes to the implementation, as needed.

GEO FLAGSHIPS

GEO Flagships differ from GEO Initiatives in that they respond to a referenced policy mandate, have matured to deliver a pre- or near-operational service, and serve user groups that are actively steering the Flagship. They are accepted by Plenary based on a GEO Programme Board recommendation.

GEO Flagships allow GEO Members and Participating Organizations to spin-up operational services serving common needs. They may operate for as long as they are able to generate sufficient impact to

attract support for their activities. Once the services reach a mature, operational stage, they may be taken up by user institutions (e.g. GEO Participating Organizations), for their continued operation over the long term. GEO Flagships have a clear policy mandate in a convention, treaty or programme. Contributions are typically made in-kind, including observation systems operated to serve the initiative's objectives, models, funded research projects or programmes, but may also include direct financial contributions or those that are earmarked within the Trust Fund as being in support of a particular GEO Flagship.

GEO Flagships have both a clearly identified objective and an implementation plan that describes how that objective is to be achieved. Corresponding contributions by GEO Members, Participating Organizations, and private sector players are identified at the outset. While these contributions must be sufficient to implement the initial objective of a GEO Flagship, additional contributions and partners may be added during implementation. The relevant user communities are fully engaged and assume a leading role in the implementation.

GEO Flagships may develop a service or services through to maturity, whereupon the service(s) may be taken up by a Participating Organization, or to be transferred into a new organization. The Implementation Plan outlines expectations with respect to the final phase of the Flagship.

Examples for GEO Flagships in the transitional GPW 2016 include the Global Forest Observation Initiative (GFOI) and the Global Agricultural Monitoring Initiative (GEO-GLAM).

1.13 Establishing GEO Flagships

GEO Flagships evolve from GEO Initiatives. When a GEO Initiative has matured in terms of service provision, stakeholder engagement, and is aligned with the priorities of GEO, the GEO Programme Board may recommend that Plenary accept an Initiative as a GEO Flagship. This recommendation and the corresponding Plenary decision are based on the implementation plan, which must clearly set out how the criteria for GEO Flagships are met. These include the pre-operational delivery of the necessary information, through products or services, to meet the needs of identified users. These users must be identified and involved in appropriate functions in the Flagship. The responsibility for further developing the Flagship implementation plan remains with the proposing team.

The GEO Programme Board may identify gaps in critical information to support the adequacy of the proposal vis-a-vis the criteria for Flagships. Where SBA Working Groups or Communities of Practice (CoP) can contribute to the development of the implementation plan, they should be engaged at an early stage, with their role described in the implementation plan. The GEO Programme Board works to establish consensus regarding the proposed objectives and the implementation plan and achieve a sufficient level of contributions for its successful implementation. All contributions – in kind or otherwise – are listed, described, and valued in the implementation plan. Contributions may include specific commitments from GEO Members, Participating Organizations, private sector partners, or other third parties. If and when this can be achieved, the GEO Programme Board formally recommends the new Flagship to Plenary.

By accepting a new GEO Flagship, GEO supports the Flagship's objectives and commits and/or acknowledges the resources specified in the Implementation Plan.

1.14 Criteria for establishing GEO Flagships

GEO Flagships must meet all criteria used for GEO Initiatives (see 2.2). In addition:

- Policy mandate from international treaty, convention, programme, or strongly articulated policy obtained;
- Substantial activity in terms of resources and partners involved;
- Information service or product pre- or near-operationally provided;
- User needs satisfied to a significant degree;

- Specific user institutions fully engaged, including mechanisms to enable steering and feedback by these, e.g. an active role in a Steering Board; and
- Implementation Plan (see 2.2), including also perspective(s) for operationalization.

1.15 Contributors

Primary contributors to GEO Flagships are typically Participating Organizations, GEO Members (through their corresponding institutions), and interested partners from the private sector. The specific contributions and the roles of the different contributors may vary between different Flagships and are described in the implementation plan.

1.16 Management and coordination

GEO Flagships are generally managed as projects; the detailed arrangements may vary among different GEO Flagships and are defined in the implementation plan. GEO Flagships should have effective dedicated steering boards that are oversee the Flagship implementation. Members of the Steering Board should involve user representatives and representatives of those partners providing significant resources to the implementation.

GEO Flagships may define steering and advisory mechanisms according to their specific needs, though lessons may be learned from other GEO Initiatives or Flagships.

Typically, a project coordinator will be appointed at the GEO Secretariat. The project coordinator is responsible for coordinating the implementation of the agreed Implementation Plan and reporting to GEO on progress and issues. A sufficiently resourced project coordinator is an important criterion for accepting a new GEO Flagship.

1.17 Reporting to GEO

The project coordinator is responsible for all reporting to GEO. This includes in particular

- Progress reports in contribution to the annual GEO Progress Report. These will be reviewed by the GEO Programme Board;
- Presentations to Plenary; and
- Presentations to the Executive Committee or the GEO Programme Board, as requested.

GEO Flagships will generally establish Steering or Advisory Groups. These mechanisms are defined in the Implementation Plan. Also, as many of the contributions will be made in-kind, further reporting will generally be required by individual contributors within their respective contexts.

1.18 Monitoring and Evaluation

The required monitoring and evaluation activities are defined in the Implementation Plan. At a general level, the GEO Programme Board will monitor progress on the basis of the reports from the project coordinator and may recommend changes to the implementation, as needed.

GEO FOUNDATIONAL TASKS

GEO Foundational Tasks allow GEO to implement selected, enabling tasks to achieve GEO Strategic Objectives and Targets. These include coordination actions, gap analyses, the implementation of technical elements for accessing GEOSS, and other routine operations of the GEO Secretariat. Thus, they provide important support functions to GEO Flagships, GEO Initiatives, and GEO Community Activities. The Core Functions set out in the *GEO Strategic Plan 2016-2025: Implementing GEOSS* are the primary reference for these functions. Contributions are often made available from the GEO

Trust Fund and may be complemented by further contributions – either directly or in kind – from GEO Members, Participating Organizations, or other partners.

The GEO Secretariat frequently plays a central role in implementing Foundational Tasks or coordination to ensure good progress towards its Target.

Examples of GEO Foundational Tasks in the transitional GPW 2016 include the operation and evolution of the GEOSS Common Infrastructure, the implementation of data sharing and management principles, or the protection of radio frequencies required for Earth observations.

1.19 Establishing GEO Foundational Tasks

GEO Foundational Tasks are included in the GPW and are accepted by Plenary when it accepts each GPW in its totality. The GPW is proposed by the GEO Secretariat. It includes an indication of the resource contribution from the GEO Trust Fund, staff resources from the GEO Secretariat, and direct or in-kind contributions from GEO Members, Participating Organizations and other partners. Requests for additional funds that have not been made available from the Trust Fund, GEO Members, and Participating Organizations are also set out in the GPW. Further detailed documentation on the activity may be maintained by the GEO Secretariat.

By accepting the GPW GEO commits to resource the activities it contains at the levels indicated in the GPW.

1.20 Criteria for establishing GEO Foundational Tasks

- Implements or supports the implementation of at least one of the GEO Core Functions;
- Sufficient resources identified and committed in GPW;
- Description in the GPW detailing:
 - Objective(s) and Target(s) to be addressed;
 - Specific deliverable to be produced;
 - The activities planned over the period covered by the GPW;
 - Schedule for implementation;
 - Cost and resources, including from the GEO Trust Fund, Members, Participating Organizations, and private sector partners;
 - Requests for additional resources linked to specific activities; and
 - Role of the GEO Secretariat and other actors.

1.21 Contributors

Primary contributors to GEO Foundational Tasks are GEO Members, Participating Organizations, and further partners. GEO Members and Participating Organizations also contribute through allowing the GEO Secretariat to use staff and financial resources on the Foundational Tasks.

1.22 Management and coordination

Depending on the specific case, GEO Foundational Tasks may be directly implemented by the GEO Secretariat according to its internal management or by other mechanisms such as a Working Group coordinated by the GEO Secretariat. Advisory mechanisms may be set up for individual Foundational Tasks, as needed.

1.23 Reporting to GEO

The GEO Secretariat will report in annual GEO Progress Report on the activities, progress and issues in GEO Foundational Tasks.

At its own initiative or at the request of GEO SBA Teams the GEO Secretariat brings particular items to the attention of GEO, such as to Plenary, the Executive Committee, or the GEO Programme Board.

1.24 Monitoring and Evaluation

The GEO Programme Board reviews the progress towards the implementation of GEO Foundational Tasks based on the annual GEO Progress Report. The GEO Secretariats regularly arranges and conducts independent evaluations of the Foundational Tasks.

SUMMARY TABLE

Overview of Implementation mechanisms

	GEO Flagships	GEO Initiatives	GEO Community Activities	GEO Foundational Tasks
Purpose / character	pre-/near-operational service(s) top-down	pilot or prototype service(s); top-down	develop, test, or demonstrate application(s); bottom-up	enabling or support function(s) top-down
Initiated by	Specified Members, Participating Organization		GEO Community	GEO Secretariat
Accepted by	Plenary	GEO Programme Board	GEO Secretariat Director	Plenary (with GPW)
Criteria	<ul style="list-style-type: none"> • Policy mandate • Near-operational • Satisfies user need • User institutions specified • Resources identified and committed 	<ul style="list-style-type: none"> • Development, demonstration, pilot • Targets user need • Some users identified • Resources identified and committed 	<ul style="list-style-type: none"> • Relevance to GEO's Strategic Objectives 	<ul style="list-style-type: none"> • Implements/supports GEO Core Function • Sufficient resources, identified and committed in GPW
Management and coordination	Dedicated mechanism; coordinator		Community-based	GEO Secretariat or Working Group
User engagement	Specifically identified , fully engaged, role in steering.	Target user groups generally identified , with at least an advisory role.	May vary, depending on activity.	May vary, depending on Task.

GEO Work Programme Development

1. INTRODUCTION

The GEO Work Programme (GWP) presents the activities that GEO undertakes to implement its Core Functions. It describes GEO Community Activities, GEO Initiatives, and GEO Flagships, and defines GEO Foundational Tasks. The GWP serves two functions:

- It is used by GEO Members and Participating Organizations to agree on priorities and activities, including the use of the resources made available through the GEO Trust Fund and the GEO Secretariat. By quantifying resources needed for the activities including and valuating the contributions committed, the GWP provides a tool to match ambitions with available resources; and
- It provides an overview of GEO's plans, thus serving as a basis to help stakeholders align their contributions. The GWP is complemented by annual GEO Progress Reports on the developments within GEO Community Activities, GEO Initiatives, GEO Flagships, and GEO Foundational Tasks.

A GWP Reference Document is maintained by the GEO Secretariat, complementing the GWP itself. It contains important background information on principal objectives of the actions in the GWP, their link to GEO Targets and Strategic Objectives, and on monitoring and evaluation activities. Thus, it represents a compilation of the implementation plans of GEO Flagships, GEO Initiatives and other relevant documents.

2. GEO WORK PROGRAMME

The GWP is proposed by the GEO Secretariat based on input from GEO Members, Participating Organizations, and the greater GEO Community. It strives to optimally pursue the realization of the Strategic Objectives through implementation of GEO's Core Functions constrained by the identifiable resources. It is further developed by the **GEO Programme Board**, which

- ensures alignment with the priorities of GEO Members and Participating Organizations;
- identifies resource commitments by GEO Members and Participating Organizations; and
- provides recommendations to Plenary for approval, in accordance with the Implementation Mechanisms description.

Thus, the GWP implements a top-down mechanism towards the selection of GEO activities. It should be noted that the GWP does not, in itself, guarantee that the activities it contains are sufficient or effective in implementing GEO Core Functions or realizing GEO's objectives. This type of analysis should be performed through dedicated actions for monitoring progress and evaluation of the activities undertaken.

The GWP is presented for acceptance by **GEO Plenary**. By accepting the GWP, GEO:

- **Accepts** that the GEO Foundational Tasks should be implemented with the resources indicated; and
- **Takes note** that the GEO Flagships, GEO Initiatives and GEO Community Activities are expected to be implemented with the corresponding indicative resources.

3. 2016-2025 WORK PROGRAMMES

The GWP for 2016 represents a transitional GWP, serving as a bridge from the first 10 years of GEO (2005-2015) to the next ten years.

The subsequent GWPs will cover three-year time periods. This will allow implementing longer-term activities coherently. The following GWPs are:

- GWP 2017-2019 – developed by the GEO Secretariat, in consultation with the GEO Community, together with the GEO Programme Board during 2016;
- GWP 2020-2022 – developed by the GEO Secretariat in consultation with the GEO Community, together with the GEO Programme Board during 2018-19; and
- GWP 2023-2025 – developed by the GEO Secretariat in consultation with the GEO Community, together with the GEO Programme Board during 2021-2022.

GEO may accept revisions of the multi-annual GWPs at the annual Plenary meeting, based upon recommendations of the GEO Programme Board.

4. DEVELOPMENT OF THE GEO WORK PROGRAMME

The development of the GWP is coordinated by the GEO Secretariat. The transitional GWP 2016 was developed in consultation with the GEO Community under the guidance of the IPWG and the Executive Committee during 2015.

From the 2017-2019 GWP onwards, the GEO Programme Board will be responsible for

- Guiding the GEO Secretariat in developing the GWP and ensuring that the knowledge and capacity of the GEO Community is used as appropriate; and
- Prioritizing the allocation of resources, aiming to ensure full implementation of GEO's Core Functions and optimally advancing the achievement of the GEO Strategic Objectives, while respecting the responsibilities of resource-providers.

The GWP is developed in three phases:

- An initiation phase to collect input from the GEO Community, the GEO Members and Participating Organizations, as well as interested third parties, including from the private sector;
- A consolidation phase to agree on the implementation actions among GEO Participating Organizations and Members and to identify the necessary resources; and
- An acceptance phase to formally accept the GWP and commit the necessary resources.

a. Initiation phase

The aim of the **initiation phase** is for the GEO Secretariat to propose a draft GWP that

- implements all GEO Core Functions and advances GEOs Strategic Objectives;
- responds to the needs and interests of GEO Members and Participating Organizations;
- recognizes and builds on the capacities available in the GEO Community.

During the **initiation phase** the GEO Secretariat engages with specific stakeholders such as UN Programmes, Foundations, Treaties or Conventions, the GEO Community at large, and GEO Plenary delegations. The engagement process could be carried out through dedicated discussions, workshops, or consultation processes. The GEO Community can bring forward new proposals or suggest

modifications to ongoing activities. (Note that GEO Community Activities can be added at any time). Input should also be provided by relevant advisory boards.

The initiation phase concludes with presentation of a draft GWP by the GEO Secretariat.

b. Consolidation phase

The aim of the **consolidation phase** is to align the GWP with GEO (Member and Participating Organizations) priorities and available resources.

During the consolidation phase the GEO Programme Board, supported by the GEO Secretariat, will discuss all GEO Foundational Tasks included in the draft GWP and actively help to make necessary resources available that will enable their implementation. Discussions with potential contributors and the stakeholders active in the activity's implementation will be held during this phase to adjust the activity's content until it can realistically be implemented with resources available.

Also, for GEO Flagships and GEO Initiatives the GEO Programme Board will review progress with reference to their respective implementation plans and take action to help address any issues.

The consolidation phase concludes with a formal recommendation of the draft GWP for Plenary acceptance.

The consolidation phase includes the Plenary discussion on the GWP and concludes with the formal acceptance of the GWP.

c. Acceptance phase

The aim of the **acceptance phase** is to achieve formal acceptance of the GWP and commitment of the resources made available by GEO Members.

During the acceptance phase the GEO Secretariat supports GEO delegations in preparing their commitments at Plenary through, for example, providing complementary material and reporting updates on expected resource commitments.

GEO Communications and Engagement Strategy

The GEO Communications and Engagement Strategy (Engagement Strategy) focusses on issues and needs that are foundational to the ultimate success of GEO in the period 2016-2025.

The Engagement Strategy will be comprised of several layers:

1. Overarching communication activities;
2. Developing engagement messages geared towards identified priority stakeholders, to be delivered at targeted events;
3. Convening specific segments of the GEO community with interested stakeholders in face-to-face workshops, forums and one-on-one dialogues, to identify stakeholder needs and potential GEOSS-based solutions; and
4. Developing partnerships between interested stakeholders and GEO experts to deliver the added-value of GEO and GEOSS directly to these strategic partners.

The overall communications activities (i) will lay the foundation for GEO's outreach to a global audience, and will include the development of foundational materials and communication channels.

The engagement messaging (ii) and the selection of specific venues to deliver those messages will be based on GEO's strengths and competencies compared to existing or emerging national, regional and global challenges. This will be coupled with how the GEO community can most effectively communicate the targeted message to the priority audience.

After identifying interested potential partners, GEO will convene (iii) dialogue sessions that will include specific segments of the GEO community and interested stakeholders. Such events will provide both stakeholders and GEO the opportunity to learn about the stakeholders' actual needs and requirements, and which requirements GEO has the capacity to address.

Finally, partnerships will be created (iv) between specific members of the GEO community with the capability to address the actual user requirements, and interested partners, all with a goal of delivering the requested service to the stakeholders. Drawing on its engagement with stakeholders, GEO aims to deliver the tools, knowledge, products and services suitable for effective exploitation of Earth observations by user communities.

In circumstances where engagement with a particular sector or individual organization is at an early stage, the preliminary engagement activities will generally be led by the GEO Secretariat, while in areas of established relationships representatives of the GEO community will lead with support from the Secretariat to ensure consistency of overall messages. In both situations, the ultimate goal is to use GEO's convening power to bring together potential partners and GEO community experts to develop robust, strategic partnerships focused on collaborative development of end-to-end solutions that meet the users' needs.

Initial set of engagement priorities (with an indicative list of possible partners):

a) Co-developing solutions to user needs by convening forums of users and providers for Societal Benefit Areas to define global Earth observation user needs

Central to GEO's success is its capability to connect with users to understand their needs for information and knowledge. GEO will convene a process for defining the Earth observation user needs for the Societal Benefit Areas (SBAs). Engagement events will bring together users and key stakeholders from across the value chain from outside GEO with data and information providers and

knowledge experts from within the GEO community, which will facilitate dialogues to identify and document EO user needs. This will enable GEO to understand and articulate the characteristics and preferences of users regarding pertinent information products and tools, including timeliness, format and frequency, to contribute value to the decision making process.

GEO will conduct these efforts by focusing on a small number of SBAs at a time, which may be selected through consultation with GEO Plenary. The GEO community, with support from the Secretariat, will conduct an initial assessment of SBA-specific strengths and capabilities and existing relationships, which will then be compared to existing or emerging issues and opportunities, thereby identifying the set of SBAs in which to focus engagement activities.

Documented GEO user needs will provide the foundation for strategic discussions by GEO Principals about coordinating, sustaining and planning observations. Further, with knowledge about critical observation needs, GEO will obtain commitments from providers to effectively deliver these observations, information, products and services in a comprehensive, coordinated and sustained way, regionally and/or globally, as appropriate.

b) UN Agencies, Treaties and Conventions

Sustainable Development Goals (SDGs): GEO will expand its partnership with the UN Statistics Division and the UN Initiative on Global Geospatial Information (UN GGIM), other relevant UN agencies (UNEP, UNOOSA, etc.), selected Member States, in particular developing countries, and other partners (The World Bank, CEOS, etc.) to help build processes, mechanisms and human capacity to integrate Earth observations with national statistical accounts to improve the measuring, monitoring and achievement of the SDGs.

In addition, GEO will deepen its partnership with the World Health Organization (WHO), UN Water, UNEP, UNESCO, the Sustainable Development Solutions Network, CIESIN and other partners in the development and implementation of the GEMI initiative (Integrated monitoring of water and sanitation related SDG targets), with a particular focus on integrating Earth observations into existing, traditional water quality and water management measuring and monitoring mechanisms.

Multilateral Environmental Agreements (MEAs): GEO will develop new or deepen existing partnerships with the UN organizations responsible for specific MEAs (e.g., UN International Strategy for Disaster Reduction (UNISDR), Ramsar Convention on Wetlands of International Importance (Ramsar), Convention on Biodiversity (CBD)), Member States and other stakeholders to integrate Earth observations into national processes to measure, monitor and achieve agreed MEA goals.

c) International Development Banks and Non-Governmental Organizations (NGOs)

Integrating Earth observations into decision-making: Through partnerships with international development banks, GEO will demonstrate the value of Earth observations in decision-making in developing countries, understand country-specific needs and help to develop capacity to use Earth observation information in decision-making through the delivery of products and services tailored to those countries' needs. Similarly, GEO will encourage, as appropriate, the systematic use of Earth observations in the various project management phases of the development banks: assessment, monitoring and evaluation.

Ecosystem Accounting: Through partnerships with international development banks and NGOs (e.g. The Nature Conservancy, Conservation International, The Natural Capital Coalition), GEO will help integrate Earth observations in ecosystem accounting by assisting governments to develop ecosystem accounts at the national level, thus establishing a critical link between Earth observations and the core efforts of the UN Statistical Commission System of Environmental-Economic Accounting (UNSEEA).

d) Foundations

Integrating the use of Earth observations into in-country activities: GEO will deepen existing or develop new strategic partnerships with national, international and global foundations to help develop in-country capacity to utilize Earth observations in the implementation of funded and future projects, with an initial focus in the agriculture, health and water domains.

e) Commercial Sector

Increasing up-take of GEOSS resources: On the basis of clear criteria, GEO will develop partnerships with selected companies, and their Associations, to facilitate contributions to and increased up-take of GEOSS resources for the development of applications, information and products to be used by decision makers.

Turning data into tools: On the basis of clear criteria, GEO will identify and convene potential partners (valued-add providers, mobile application developers, data integrators, etc.) to collaboratively identify user needs and GEO capabilities to develop value-products for specific user needs. GEO will also seek to engage companies to help deliver user driven applications, tools and resources in GEO initiatives and activities.

f) Global Scientific Initiatives

Future Earth: GEO will look to increase the utilization of and contributions to GEOSS by the Future Earth community, and develop a broader and more robust partnership addressing domain-specific needs collaboratively identified by the Future Earth and GEO communities.

Belmont Forum: GEO will build on its existing partnership with the Belmont Forum by assisting in the implementation of the recommendations of the E-infrastructures and Data Management Collaborative Research Action (subject to the approval of these recommendations).