



GROUP ON  
EARTH OBSERVATIONS

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Strategic Targets: GEOSS Implementation by 2015

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This document is submitted to GEO-V for acceptance.



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## Strategic Targets: GEOSS Implementation by 2015

### INTRODUCTION

In March 2008, the GEO Executive Committee created the GEO Target Task Team (T3) to review and revise the GEOSS 10-Year Implementation Plan targets and to provide more focused guidance to the work of GEO Members and Participating Organizations in implementing GEOSS. This document represents the output of the work of the T3 to date. The new proposed targets were written with a view to the visions and goals expressed in the 10-Year Implementation Plan and its accompanying Reference Document. It is anticipated that, in preparation for the 2010 summit, the GEO 2009-2011 Work Plan and following Work Plans will be aligned, in early 2009, with the new targets through a process that includes a gap analysis and the GEOSS Performance Monitoring and Evaluation framework. Taken together, the strategic targets, the Work Plan and the performance framework will constitute an updated holistic view of GEO, and thus allow for a ready grasp of the work and direction of GEO. The strategic targets, once accepted by the GEO Plenary, will constitute the collective, refined commitment of the GEO Community to an operational GEOSS by 2015 and will serve as strategic guidance for all the GEO Committees and task teams. These targets should be promoted among participant and user communities to ensure understanding and broaden support for GEOSS.

The new strategic targets respond to the call of the 2008 G8 Summit in Tokyo to accelerate GEOSS efforts to meet the growing demand for Earth observations. Also, they are a further step towards addressing the challenges articulated by the 2002 World Summit on Sustainable Development, including the achievement of the Millennium Development Goals.

### STRATEGIC APPROACH: REFINED TARGETS, GOALS AND DEFINITION

The T3 began its work by examining the negotiated text of the GEOSS 10-Year Implementation Plan and its companion Reference Document, which contains 241 targets for 2, 6, and 10 years. The team agreed that the following steps were necessary to refine a layer of strategic targets:

- Provide a short definition of GEOSS, based on negotiated text.
- Articulate high-level goals for GEOSS implementation, taken from the language of the 2007 Cape Town Declaration, to guide GEOSS implementation.
- Formulate strategic targets for each transverse area and each societal benefit area (SBA), which encompass the ideas of the original targets. These targets will form the link between the negotiated text of the GEOSS 10-Year Implementation Plan and the text of the 2009-2011 GEO Work Plan, will facilitate the construction of a GEOSS Roadmap which maps the Work Plan tasks onto the targets, and will connect to the emerging framework for GEOSS monitoring and evaluation.
- Concentrate work on the remainder of the GEOSS implementation period, and refocus the targets through 2015, taking into account the progress that has been made, and the changing perspectives of the GEO Members and Participating Organizations. The newly developed monitoring and evaluation process will introduce the appropriate metrics to more accurately define the target benchmarks.

### ASSUMPTIONS

After the initial review, the T3 worked from the following assumptions in developing the revised targets:

- The 2- and 6-year targets in the 10-Year Implementation Plan have been accomplished or are being addressed through the current GEO Work Plan. The 10-year targets serve as the basis for the strategic targets presented herein.
- As GEOSS is a system of systems, the wording “GEO will” refers to GEO Members and Participating Organizations acting individually or in concert. GEO as an intergovernmental group will facilitate, advocate, and promote the achievement of these targets.

**TARGET MANAGEMENT – 2009 TO 2015**

GEO will review the strategic targets before each GEO Summit and recommend any adjustment. This review will be conducted in connection with the monitoring and evaluation framework.

## STRATEGIC TARGETS FOR GEOSS THROUGH 2015

The targets are framed in a text box and followed by explanatory language. To provide context, the GEOSS vision and purpose as negotiated in 2005 is provided, together with a set of goals based on the Cape Town Declaration of 2007. In addition, a short draft definition of GEOSS is introduced. Once accepted, the targets will form the basis for development of the Work Plan, and the proposed GEO 2009-2011 Work Plan will be checked for consistency against them.

### GEOSS STRATEGIC DEFINITION AND GOALS

#### GEOSS Vision and Purpose

(GEOSS 10-Year Implementation Plan, February 2005)

“The **vision** for GEOSS is to realize a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information.

The **purpose** of GEOSS is to achieve comprehensive, coordinated and sustained observations of the Earth system, in order to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behaviour of the Earth system. GEOSS will meet the need for timely, quality long-term global information as a basis for sound decision making, and will enhance delivery of benefits to society in the following initial areas:

- Reducing loss of life and property from natural and human-induced disasters.
- Understanding environmental factors affecting human health and well-being.
- Improving management of energy resources.
- Understanding, assessing, predicting, mitigating, and adapting to climate variability and change.
- Improving water-resource management through better understanding of the water cycle.
- Improving weather information, forecasting, and warning.
- Improving the management and protection of terrestrial, coastal, and marine ecosystems.
- Supporting sustainable agriculture and combating desertification.
- Understanding, monitoring, and conserving biodiversity.

GEOSS is a step towards addressing the challenges articulated by the United Nations Millennium Declaration and the 2002 World Summit on Sustainable Development, including the achievement of the Millennium Development Goals. GEOSS will also further the implementation of international environmental treaty obligations.”

#### Definition of GEOSS

The Global Earth Observation System of Systems (GEOSS) is a coordinating and integrating network of Earth observing and information systems<sup>1</sup>, contributed on a voluntary basis by Members and Participating Organizations of the intergovernmental Group on Earth Observations (GEO), to support

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<sup>1</sup> Information systems include processing of observational data, models, derived products and information services, as well as their distribution to users.

informed decision making for society, including the implementation of international environmental treaty obligations.

### **Strategic Goals of GEO in Support of GEOSS**

(based on the Cape Town Declaration of 2007)

- Sustain operation of comprehensive and coordinated Earth observation networks that meet user requirements in support of informed decision making;
- Sustain operations of the shared architectural GEOSS components and related information infrastructure;
- Address the need for timely, global and open data sharing across borders and disciplines, within the framework of national policies and international obligations, to maximize the value and benefit of Earth observation investments;
- Implement interoperability amongst observational, modelling, data assimilation and prediction capabilities;
- Foster research and development activities and coherent planning for future observation and information systems;
- Catalyze national, regional and global investments in scientific and technological advances and innovative approaches for upgrading and expanding Earth observations;
- Build the capacity of individuals, institutions and systems to benefit and contribute to GEOSS, particularly in developing countries;
- Provide a framework to identify and implement linkages across SBAs, thereby providing wider opportunities for synergistic collaboration.

## **1 BUILDING AN INTEGRATED GEOSS**

### **1.1 Architecture**

Before 2015, GEO will:

1. Develop, populate, and fully maintain a user-friendly and easily accessible common infrastructure for GEOSS, which will support a global community of users by facilitating the discovery, access and dissemination of the majority of the world's Earth observation resources and services, including data, metadata and products.

The GEOSS Common Infrastructure will provide the framework and operational interfaces to comprehensive, coordinated and sustained observations of the Earth system. The resources populating the common infrastructure will be provided by GEO Members and Participating Organizations, thereby enabling solutions for societal benefit areas.

To ensure success, GEO Members and Participating organizations will register the majority of the world's Earth observation resources and services with the common infrastructure as early as possible. Component resources and services must be registered in sufficient detail so that they may be used directly by client applications in a user-friendly way. A near-term milestone will be to increase the number and diversity of component resources and services connected to the common infrastructure.

The effort to develop the common infrastructure will continue to address GEO user needs by maintaining a process for supporting interoperability and compatible system interfaces for both observations and the models to generate information products. To support this effort, GEO will develop an essential set of recognized standards and interoperability arrangements for Earth

observation systems, ensuring necessary integration of in-situ, airborne, and space-based platforms, reducing the number of interoperability arrangements by progressive convergence. In doing so, GEO will focus on recognized standards and best practices that facilitate the integration and use of data and information products to support applications across the GEOSS societal benefit areas.

2. Ensure the fully-coordinated development and implementation of future Earth observing systems, including satellite, airborne, and in-situ, as well as transition of research systems into operational systems.

GEO will develop a framework to ensure data continuity, a major element being the smooth transition from research systems to operational ones. GEO will also adopt and advocate a composite approach to global Earth observation systems, recognizing in particular the value of complementarity and integration of the surface-based and space-based components of GEOSS. In so doing, this target will address the need for comprehensive gap analysis and gap filling, integrated across all societal benefit areas, as well as issues pertaining to operational redundancy and succession planning (especially with respect to space missions).

GEO will also ensure coordination at national, regional and global levels in order to link, upgrade and expand Earth observing and information systems. Further, GEO Members and Participating Organizations will make best efforts to ensure sustained operation of the architectural GEOSS components and related information infrastructure.

## 1.2 Data Management

Before 2015, GEO will:

3. Deliver a continuous long-term stream of comprehensive and reliable data, metadata, and data and information products for a core set of essential environmental, geophysical, and geological variables needed to support all GEOSS societal benefit areas. Ensure that these comprehensive data sets, including historical data and reanalyses, are available on a continuous basis, and shared according to GEOSS Data Sharing Principles.

The provision of long-term, continuous basic data and its reanalyses with improved understanding is fundamental for the better comprehension of the Earth system and requires operational funding for component systems by GEO Members, including improved and new instrumentation techniques and establishment and maintenance of baseline sites for global *in situ* networks. GEOSS shall develop means and processes for data quality assurance, for both observing system data and information products. To ensure success, GEO will also secure the long-term use and protection of all parts of the radio frequency spectrum needed for its space-based and surface-based components.

GEO will facilitate, among countries and research communities, the preparation and operationalization of, and access to, global and regional information. This encompasses both geographic information, such as basic global geodetic reference frames, as well as the underpinning socio-economic information.

These data will be made available in accordance with GEOSS Data Sharing Principles, as follows:

- There will be full and open exchange of data, metadata and products shared within GEOSS, recognizing relevant international instruments and national policies and legislation;
- All shared data, metadata and products will be made available with minimum time delay and at minimum cost;
- All shared data, metadata and products being free of charge or no more than the cost of reproduction will be encouraged for research and education.

To ensure success, GEO will establish a coordinated, life-cycle data management approach within and across the societal benefit areas, to support improved simulation, modelling, and prediction

capabilities. GEO will also develop best practices and coordinated approaches to observation and collection of data and information, including processing, mining, archiving, dissemination, analysis, reprocessing, assimilation, data mining and visualization of large and diverse data sets. This will allow improved modelling and prediction for targeted application areas within each societal benefit area and across multiple societal benefit areas as appropriate.

### 1.3 Capacity Building

Before 2015, GEO will:

4. Coordinate, at national and international levels, efforts to enhance individual, institutional, and infrastructure capacities for Earth observation and derived information in all SBAs.

Capacity building needs to access, use, and produce Earth observation data and products on a sustainable basis will be achieved by:

- Working with and building on the capacity building efforts of GEO Members and Participating organization to further increase the synergies and effectiveness of national and international programmes;
- Ensuring the engagement and committed involvement of resource providers in the GEO capacity building process;
- Enhancing capacity building efforts to ensure the integration of mature Earth observation-based information systems into day by day end-user practices including decision making, management processes and planning for all SBAs;
- Increasing awareness amongst policy and decision makers, especially in developing countries, on the benefits from Earth observation technology and the need to support capacity building for Earth observation integration into decision making.

### 1.4 Science and Technology

Before 2015, GEO will:

5. Ensure full interaction and engagement of relevant science and technology communities into GEOSS implementation so that state of the art technology and latest Earth science knowledge is continuously applied in its development and operation. GEOSS integrated observations, models and data sets will strongly support scientific research and technological development.

The implementation of GEOSS will support research efforts that are necessary for the development of tools required in all societal benefit areas. GEO will promote research and development in key areas of Earth sciences to facilitate, on an ongoing basis, improvements to Earth observation systems. It will also encourage and facilitate the transition of systems and techniques from research to operations in fostering partnerships between operational institutions and research groups. Special emphasis will be given to:

- Improved and new instrumentation and system design for in situ, airborne, and space-based observation on a long-term basis;
- Life-cycle data management, data integration and information fusion, data mining, network enhancement, and design optimization studies;
- Development of models, data assimilation modules and other algorithms for global and regional services and products;
- Involvement of developing countries in the transfer of science and technology.

## **1.5 User Engagement**

Before 2015, GEO will:

6. Achieve the world wide recognition of GEOSS as an essential source of Earth system data and information, meeting user needs for decision making and planning, with special regard to developing countries.

7. Identify in full engagement with users a core set of cross-cutting, essential environmental, geophysical, and geological variables needed to provide data, metadata and products in support of all GEOSS societal benefit areas.

The above targets will be achieved by:

- Identifying a core set of cross-cutting, essential environmental, geophysical, and geological variables needed to provide data, metadata and products in support of all GEOSS societal benefit areas;
- Involving users in reviewing and assessing requirements for Earth Observation data, products and services, and creating an appropriate mechanism for coordinating user requirements across societal benefit areas. Fostering partnerships among and within societal benefit areas, promoting the concept of user communities;
- Facilitating the development of data and information for socio- economic applications, and encouraging the development of methods, models and tools required to make best use of these data;
- Fostering the use of Earth observation products and services across the societal benefit areas of GEOSS, especially in developing countries.

## **2 THE 9 GEOSS SOCIETAL BENEFIT AREAS**

### **2.1 Disasters**

Before 2015, GEO will:

8. Enable the global coordination of observing and information systems to support all phases of the risk management cycle associated with hazards (mitigation and preparedness, early warning, response, and recovery).

GEOSS will contribute to reducing losses associated with disasters by providing data and information to policy and decision makers for actions associated with disaster preparedness, response and recovery. This will include:

- 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;
- Supporting the implementation of the Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters (HFA), in particular the priorities for action.

## 2.2 Health

Before 2015, GEO will:

9. Accelerate the development and application of Earth observation derived information, indicators, models and tools available through GEOSS that facilitate the early detection, prevention, monitoring, mitigation, and reduction of environmental risks to human health, and ensure worldwide access.

Working with the World Health Organization and the global community of human health and environment experts, GEO will develop and implement health-and-environment projects to advance the application of observation, monitoring and forecasting systems to health decision-making processes. These projects will foster the use of established and emerging observation systems in operational health-related applications for air quality, infectious diseases, and vector-borne diseases, and develop associated products such as forecasts and alerts compliant with the Common Alerting Protocol (CAP). These projects will include efforts to examine terrestrial, freshwater, and marine (ocean) ecosystems and their services, to establish causality between changes in flora, fauna and other factors affecting the emergence and transmission of disease. The projects will document links between water and communicable diseases, as part of the life cycle of vectors or as a medium infecting populations. The projects will also facilitate the integration of Earth science databases and emerging information products with public health data, socioeconomic data, and epidemiological information needed in decision support systems for health care planning and delivery.

To support this target GEO, will develop a global network of scientists, researchers, practitioners and other operational end users with free access to an expanded inventory of available Earth observation data, metadata and products applicable to public health. The network will provide input relating to the technical specification of new major environmental observation capabilities, including *in situ* and remotely sensed observations that will allow historical data analysis and early detection of changes that influence health. The network will also facilitate Earth observation training and capacity building for future scientists, researchers, public health policy makers and practitioners, and end users, including the development of a best practices catalogue in this domain.

## 2.3 Energy

Before 2015, GEO will:

10. Provide, and increase the use of, relevant environmental, geophysical and geological data and information for planning and operation of existing and new energy systems, with emphasis on improving energy availability, minimizing environmental impact and providing information for energy policy planning.

GEO will ensure the availability of independent cross-cutting data sets and improved prediction capabilities that will support safe, efficient and affordable construction and operation of energy plants with low environmental impact, thus contributing to improved balance between energy demand and supply. The information will include:

- Climatological and ecosystem information for understanding the renewable energy resource potential, for optimal design and for environmental impact assessments;
- Geophysical and geological data, e.g. gravity and magnetic data, for fossil fuel exploration;
- Short and long term weather and ocean forecasts to predict energy demand, load and supply as well as potential hazards;
- Monitoring data, including greenhouse gases, to prevent undesired impacts of energy production, exploration, extraction, transportation and consumption.

## 2.4 Climate

Before 2015, GEO will:

11. Ensure the availability of the climate-relevant observations and provide global coordination of information generated to support the assessment of climate variability and change, and decision-making for adaptation and mitigation.

The above target will be achieved by ensuring the availability of fully coordinated observing, prediction, and information systems from: GCOS component systems; all components of the World Climate Programme and the World Climate Research Programme (WCRP); other international and national research and applications programs; the assessment role of the Intergovernmental Panel on Climate Change (IPCC); the policy development role of the UN Framework Convention on Climate Change (UNFCCC); as well as future national and regional climate service centers. GEO will contribute to major advances in the monitoring and predictability of climate on seasonal, interannual and decadal time scales, including the occurrence of extreme events.

12. Facilitate a comprehensive global carbon observation and analysis system in support of decision-making, including monitoring and support of environmental treaty obligations.

A carbon observing system is required both to advance the understanding of the carbon cycle, and to serve as a monitoring tool. The full extent of such a carbon observing system will include aspects of atmospheric, oceanic and terrestrial carbon observations. Particular attention will be given to:

- Continuous monitoring of global terrestrial carbon storage, ensuring forest monitoring, carbon observation and associated modelling, based on improved observing methods for measuring biomass and carbon fluxes, in situ and remotely;
- Wildland fire, which is an important and widespread agent of forest damage and loss. Global systems and networks are in place, providing early warning and rapid detection of fire, using commonly understood terminology and allowing for mutual assistance across boundaries.

## 2.5 Water

Before 2015, GEO will:

13. Develop an integrated, sustained operational global water-cycle observation system to monitor the quantity and quality of water in order to create improved availability, and to support global water management and understanding of climate variations, at national, regional and basin levels, and over all spatial distributions.

Develop a sustained, operational monitoring system for the global water cycle, combining space-based and in-situ observation networks. The in-situ network will include integrated in-situ reference sites for monitoring essential variables for water cycle measurement, and promote the upgrading of in-situ networks in regions where current networks do not meet standards for observations, network enhancements, data systems, planning frameworks and implementation programs. This will allow for different types of measurements to be planned in a structured way across variables, sensors, platforms and nations and in some cases development of sensor technology. The system will include a broad range of integrated data products that cover many different spatial and temporal scales, combining detailed point in-situ measurements with coarser comprehensive coverage provided by satellites.

14. Increase the use of Earth observations in facilitating and enabling integrated water resource management worldwide at local and regional levels, with emphasis on improved decision support tools for water management and governance, and for monitoring and prediction of hydro-meteorological extremes, e.g., droughts and floods.

GEO will facilitate the development of water cycle data sets and related information products (e.g. basin mapping), at both global and basin scales, exploiting past and current in-situ and satellite-based observations as well as fostering their integration into advanced models for integrated water resource management. Special attention will be given to developing local, regional and global hydrological risk (e.g., floods, droughts) prediction and management systems and expanded applications of integrated water resource management for sustained development and applications. GEO will also facilitate the development of the next generation of improved/enhanced products and innovative observations (with special emphasis on observational gaps: e.g., precipitation at high latitudes and water quality measurements from space), for water resources management.

The networks will address water resources in terms of quantitative availability and water quality, and GEO will work to ensure that the data and data sets produced by this system of networks will be widely available. Information products and services that flow from these integrated water cycle data sets will be tailored to the needs of stakeholders and end-users.

## 2.6 Weather

Before 2015, GEO will:

15. Improve severe weather information to mitigate loss of life and reduce property damage, close critical gaps in meteorological observations, and ensure access to weather data for the other social benefit areas.

Working with the WMO and the weather community, GEOSS will improve weather information, forecasting and warnings on a global basis, particularly in developing countries, by:

- Increasing the capacity to deliver essential observations for improved forecast products;
- Closing critical gaps in the observation networks (in-situ, remote and space based) with special regard to the oceans;
- Enhancing existing meteorological observational networks;
- Providing integrated data collection and automated dissemination of observed data and products, as well as data discovery, access and retrieval services;
- Accessing data from observational networks outside the meteorological networks;
- Providing data for development of a global system for severe weather warnings using the best forecasting techniques available for decision making in disaster mitigation;
- Supporting main technological components of meteorological information production and delivery infrastructure (telecommunications, data processing);
- Providing information about meteorological data and products through GEOSS tools for users outside the weather community.

## 2.7 Ecosystems

Before 2015, GEO will:

16. Improve the sustainable management and protection of terrestrial, coastal, and marine resources through the design and implementation of a comprehensive monitoring capability of all ecosystems and the human impacts on them.

This target will be achieved by:

- Establishing a global standardised ecosystem classification system as a basis for worldwide inventory, assessment and monitoring;

- Developing and implementing a global, standardized inventory of major ecosystems and the protected areas within them;
- Providing operational monitoring of major ecosystems on an annual basis including properties such as cover type, species composition, vegetation structure, height and age, net and ecosystem productivity; biomass estimates of vegetation and soils based on remote sensing and sampled in situ observations using internationally agreed standards;
- Environmental flow requirements of river baseflow and peak flow exist, as well as human requirements for irrigation and power plant cooling water and domestic usage, necessary for ensuring a balance between salt water intrusion and fresh water outflow in estuarine areas of coastal rivers, and ensures vitality of floodplain and riparian vegetation;
- Develop methodologies to understand interactions between human settlements and ecosystems to support decision-making.

## 2.8 Agriculture

Before 2015, GEO will:

17. Establish a coordinated global operational agricultural early warning system for food security and improved market efficiency.

The agricultural community, in close collaboration and coordination with forest and land cover mapping communities, will:

- Enhance national-level agriculture reporting and statistics systems by integrating Earth Observation-based precision farming methods, in situ and airborne surveys and socio-economic data, including use of multiple, space-based platforms that will provide overlapping coverage during multiple times during the growth stages of crops;
- Develop global Earth observation requirements for satellite and in-situ observations that are coordinated with existing and planned (through 2015) satellite launches. These requirements will also address region-specific requirements, including the very-high resolution requirements, to identify small plots and highly heterogeneous cropping patterns;
- Develop a global standard for national-level reporting and statistics for agricultural production, aquaculture and fisheries monitoring using data and information derived from Earth observations, survey systems, and statistical estimation systems, as appropriate, and integrated with socio-economic data to provide timely and accurate data and information;
- Establish an integrated system for timely, accurate and quantitative global land cover and land cover change mapping, particularly for use in agricultural, forestry and coastal zone applications;
- Establish specific Earth observation requirements for the world's growing reliance on food from irrigation systems, and ensure linkage of the global agricultural monitoring system with the global water monitoring system.

## 2.9 Biodiversity

Before 2015, GEO will:

18. Establish a worldwide biodiversity observation network to collect, manage, share and analyze observations of the status and trends of the world's biodiversity, and enable decision-making in support of the conservation and improved management of natural resources.

Working with all parties interested in biodiversity observations, and notably UNCBD, and based upon the resources and experience of GEO Member institutions, GEO Participating Organizations, non-governmental organizations, data providers and aggregators, tool developers and operators, and other types of practitioners, the biodiversity observation network will implement:

- The routine collection of long term in situ and remotely sensed biodiversity observations;
- The promotion of standards for data collection and data management;
- The continued development of a network of worldwide biodiversity observations;
- An ongoing process to identify gaps in implementation that need to be filled;
- Reporting on biodiversity (ecosystems, species, genes) status, trends, services, risks, and conservation to all stakeholders;
- A service to respond to requests for new products or services.