



GROUP ON
EARTH OBSERVATIONS

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GEOSS Strategic Targets

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GEOSS Strategic Targets

Introduction

The strategic targets contained herein are 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 will be aligned during 2009 with these targets through a process that includes a gap analysis and the GEOSS Monitoring and Evaluation framework. Taken together, the strategic targets, the Work Plan (2009-2011 and following Work Plans) and the Monitoring and Evaluation 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.

The strategic targets respond to the call of the 2008 G8 Summit in Toyako (Hokkaido, Japan) and the 2009 G8 Summit in L'Aquila (Italy) 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 following steps were taken 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 GEOSS Building Block 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.

RATIONALE

- 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 aims to” 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.

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STRATEGIC TARGETS FOR GEOSS THROUGH 2015

The targets for each Building Block and Societal Benefit Area are framed in a text box. These summarise succinctly what GEO aims to achieve by 2015. The targets are immediately followed by a summary of the actions that will be undertaken to achieve the targets (“*This will be achieved through.*”). These, in turn, are followed by a description of the clearly defined outcomes that will be delivered, and against which we will demonstrate our success in achieving the target (“*This will be demonstrated by.*”). The outcomes inform the Monitoring and Evaluation process by providing achievements at the societal benefit level by which progress under the given target may be evaluated as GEOSS is implemented.

To provide context, a short draft definition of GEOSS is introduced. This is followed by the GEOSS vision and purpose as negotiated in 2005, together with a set of goals based on all GEO Ministerial declarations (2003, 2004, 2005, and 2007). 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

Definition of GEOSS

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

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.”

Strategic Goals of GEO in Support of GEOSS

- 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 systems;
- 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 infrastructures to benefit from and contribute to GEOSS, particularly in developing countries.

GEOSS Implementation Strategy

As well as facilitating interoperability between, access to and use of existing observations and information systems, comprehensive gap analysis and gap filling, integrated across all Societal Benefit Areas, is a cornerstone of the GEOSS implementation strategy. To this end, GEO will:

- Elucidate practical methods for filling critical gaps in, *inter alia*, observation specifications and parameters, geographical areas, and observation and information accessibility;
- Identify opportunities and measures to minimize gaps in data, metadata, and products;
- Set and address priorities for filling gaps.

1 BUILDING AN INTEGRATED SYSTEM OF SYSTEMS: THE GEOSS BUILDING BLOCKS

1.1 Architecture

Before 2015, GEO aims to:

1. Achieve sustained operation, continuity and interoperability of existing and new systems that provide essential environmental observations and information, including the GEOSS Common Infrastructure (GCI) that facilitates access to, and use of, these observations and information.

This will be achieved through:

- provision of long-term, continuous data and its periodic reanalyses with improved understanding which are:
 - fundamental for better comprehension of the Earth system;
 - dependent on operational support for component systems by GEO Members and Participating Organizations, including:
 - improved systems;
 - new instrumentation and measurement techniques;
 - the establishment and maintenance of baseline sites for global *in-situ* networks and data validation;
 - of a quality appropriate to meet user needs;
- identification of effective national coordination mechanisms across both observation-provider and observation-user communities;
- coordination at national, regional and global levels for linking and enhancing Earth observing and information systems;
- development of a framework to ensure data continuity, including the smooth transition from research to operational systems;
- adoption and advocacy of a comprehensive approach to global Earth observation systems, recognizing in particular the value of complementarity and integration of the surface- and subsurface-based, airborne and space-based components of GEOSS;
- securing the long-term use and protection of all parts of the radio frequency spectrum needed for its space-based and surface-based components;
- promotion of consistent standards and practices for observations across all earth systems by means of the GEOSS Common Infrastructure (GCI) which will:
 - consist of web-based portals, clearinghouses for searching data, information and services, registries and other capabilities supporting access to GEOSS components, standards, and best practices;
 - provide the framework and operational interfaces for comprehensive, coordinated, and sustained observations of the Earth system, including space, airborne and *in-situ* systems;
 - be constituted and populated by resources contributed from GEO Members and Participating Organizations, who will make best efforts to ensure sustained operation of the core components and related information infrastructure;

- maintain a process for interoperability that supports effective access to, exchange of and use of data, metadata and products across all GEOSS components, as identified in the appropriate GCI registries.

This will be demonstrated by:

- Deployment, population, and enablement of sustained operations and maintenance of a user-friendly and user-accessible GEOSS Common Infrastructure (GCI), including the core components and functions that link the various resources of GEOSS.
- Coordinated planning and sustained operation of national, regional and global observing and information systems within an interoperability framework.
- Continual improvement in observations and information available to users through the transition of research outcomes and systems into operational use, and through an optimal mix of space-based, airborne and *in-situ* observing platforms.
- Increased efficiency in the operation of observational systems through convergence among global, regional and national facilities.
- Comprehensive gap analysis and gap filling, integrated across all Societal Benefit Areas, including issues pertaining to operational redundancy and succession planning (especially with respect to space missions) for systems and products.

1.2 Data Management

Before 2015, GEO aims to:

2. Provide a shared, easily accessible, timely, sustained stream of comprehensive data of documented quality, as well as metadata and information products, for informed decision-making.

This will be achieved through:

- preparation of and access to, among Member and Participating Organization communities, global and regional information encompassing:
 - geographic information such as basic global geodetic reference frames;
 - cross-cutting data sets such as land cover and land use information;
 - essential socio-economic information;
- data made available in accordance with GEOSS Data Sharing Principles, which includes:
 - 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 being made available with minimum time delay and at minimum cost;
 - all shared data, metadata and products being provided free of charge or no more than the cost of reproduction will be encouraged for research and education;
- promotion of a coordinated, life-cycle data management process to support improved simulation, modelling, and prediction capabilities for each Societal Benefit Area and across multiple Societal Benefit Areas;
- development of best practices, identified in the appropriate GCI registry, for observation, collection and access to data and information, including best practices for data quality assurance for both observing system data and information products;

- evaluation of emerging information sources, including communities that may be global and not formally associated with any particular GEO Member or Participating Organization, and encouraging access to the information through, or integration into, GEOSS, as appropriate.

This will be demonstrated by:

- Increased use of observations through advances in all aspects of life-cycle data management, integration, and data recovery and conversion.
- Open, reliable, timely, consistent, and free access to a core set of essential environmental observations and information products, supported by adequate metadata, by users across all GEOSS Societal Benefit Areas in accordance with GEOSS Data Sharing Principles.
- Removal of important data management deficiencies.
- Enhanced information extraction from historical, current and future source data.

1.3 Capacity Building

Before 2015, GEO aims to:

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| <p>3. Enhance the coordination of efforts to strengthen individual, institutional and infrastructure capacities, particularly in developing countries, to produce and use Earth observations and derived information products.</p> |
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This will be achieved through:

- working with and building on the capacity building efforts of GEO Members and Participating Organizations to further increase the synergies and effectiveness of national and international capacity building 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 Societal Benefit Areas.

This will be demonstrated by:

- Networking activities that specifically build individual, institutional and infrastructure capacity.
- Leveraging resources for Earth observation capacity building efforts.
- Uptake Increased use of Earth observation in policy and decision making.
- Enhanced participation of developing countries in GEO and GEOSS.

1.4 Science and Technology

Before 2015, GEO aims to:

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| <p>4. Ensure full interaction and engagement of relevant science and technology communities such that GEOSS advances through integration of innovations in Earth observation science and technology, enabling the research community to fully benefit from GEOSS accomplishments.</p> |
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This will be achieved through:

- promotion of research and development in key areas of Earth sciences to facilitate, on an ongoing basis, improvements to Earth observation systems;
- research and development for models, data assimilation modules and new or improved algorithms for global and regional services and products;
- encouraging and facilitating the transition of systems and techniques from research to operations by fostering collaboration and partnership between the operational and research communities;
- provision for sensor validation and verification so resource managers and industry can ensure sensors being developed are ready for operational use over a wide variety of environmental conditions;
- incorporation of science and technology outcomes that improve observing systems and observational capacity;
- improving interoperability between global observing systems and modelling systems;
- inclusion of societal needs in new research observing system planning and inclusion of research considerations in operational observing system planning;
- life-cycle data management and optimisation, data integration and information fusion, data mining, network enhancement, and design optimization studies, up-scaling and downscaling, and visualisation of large and diverse data sets.

This will be demonstrated by:

- Improved and new instrumentation and observation system design for *in-situ*, airborne, and space-based observation, benefiting from advances in science and technology.
- Increased accessibility of global sets of scientific data necessary for improved Earth System modelling in the different GEO Societal Benefit Areas.
- Increased accessibility of data and improved coordination and maintenance of observational systems through GEOSS are realized by the research community.

1.5 User Engagement

Before 2015, GEO aims to:

5. Ensure critical user information needs for decision making are recognized and met through Earth observations.

This will be achieved through:

- developing a framework to identify and implement linkages across Societal Benefit Areas, thereby providing wider opportunities for synergistic collaboration;
- active partnerships among and within Societal Benefit Areas, promoting synergy among GEO projects and activities through the concept of user communities of practice;
- increased development of data and information, with special emphasis on socio-economic applications and the development of methods, for models and tools required to make best use of these data in science and technology development and decision-making;

- use, enhanced by a user-oriented GEOSS Common Infrastructure, of Earth observation products and services across all Societal Benefit Areas of GEOSS, especially in and for developing countries.

This will be demonstrated by:

- Establishment of an agreed core set of essential environmental, geophysical, geological, and socio-economic variables needed to provide data, metadata and products in support of all GEOSS Societal Benefit Areas.
- Involvement of users in: reviewing and assessing requirements for Earth observation data, products and services; creating appropriate mechanisms for coordinating user requirements; utilizing data/information delivery systems; and capturing user feedback on an ongoing basis across Societal Benefit Areas.
- Increased use of geo-spatial data in all Societal Benefit Areas and in particular in developing countries.

2 THE 9 GEOSS SOCIETAL BENEFIT AREAS

2.1 Agriculture

Before 2015, GEO aims to:

6. Improve the utilization of Earth observations and expanded application capabilities to advance sustainable agriculture, aquaculture, fisheries and forestry in areas including early warning, risk assessment, food security, market efficiency, and, as appropriate, combating desertification.

This will be achieved through:

- a set of distributed joint experiments to compare and evaluate data and methods;
- a series of thematic workshops for the Global Agricultural Monitoring Community of Practice;
- capacity building, particularly for improved national agricultural monitoring;
- sharing of operational applications and decision making support systems and tools;
- establishing regional components of a global agricultural monitoring system of systems;
- developing and adopting standards and common reporting formats;
- advancing free and open data policies and data exchange;
- advocating for data continuity, expanded data coverage and coordinated data acquisition;
- closing critical spatial and temporal gaps in key observations;
- collaborating and coordinating with the fisheries, aquaculture, forestry and land cover mapping communities, including the Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD).

This will be demonstrated by:

- Increased use of Earth observing capabilities and supporting applications systems to produce timely, objective, reliable, and transparent agricultural and forest statistics and information at the national and regional level.
- Improved agricultural risk assessment and operational weather/climate forecast systems for early warning and food security.
- Effective early warning of famine leading to more timely mobilization of an international response in food aid.
- Expanded monitoring of agricultural land use change, through periodic regional and global assessments.
- Development of quantitative measurements of global and regional desertification.
- Increased capacity building through targeted workshops and joint multi-institution research teams.
- Improved collaboration and coordination on the use and applications of Earth observations for fisheries, aquaculture, forestry and land cover mapping.

2.2 Biodiversity

Before 2015, GEO aims to:

7. Establish, in conjunction with a comprehensive ecosystem monitoring capability, 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.

This will be achieved through:

- working with all parties interested in biodiversity observations, and notably the United Nations Convention on Bio-Diversity (UNCBD), as well as:
- utilizing the resources and experience of GEO Members and Participating Organizations, non-governmental organizations, data providers and aggregators, tool developers and operators, and other types of practitioners, in order to establish the biodiversity observation network (GEOBON), which will:
 - promote standards for data collection and data management;
 - continue the development of a network of worldwide biodiversity observations;
 - institute an ongoing process to identify gaps in implementation that need to be filled;
 - implement reporting on biodiversity (ecosystems, species, genes) status, trends, services, risks, and conservation to all stakeholders;
 - develop and implement a service to respond to requests for new products or services.

This will be demonstrated by:

- Increased routine collection of long term *in-situ* and remotely sensed biodiversity observations.
- Access through GEOSS to a large panel of biodiversity observations, including satellite, aerial and *in-situ*.
- Increased information sharing on biodiversity conservation and sustainable use of biodiversity resources.
- Implementation of a mechanism that enables users to interact with the development of biodiversity observations systems and request services.
- Increased availability of biodiversity information necessary to respond to and support related topics (ecosystems, health, climate, etc.).
- Increased information to reduce the cost and support the management of biodiversity issues.

2.3 Climate

Before 2015, GEO aims to:

8. Achieve effective and sustained operation of the global climate observing system and reliable delivery of climate information of a quality needed for predicting, mitigating and adapting to climate variability and change, including for better understanding of the global carbon cycle.

This will be achieved through¹:

- the full implementation of the WMO-IOC-UNEP-ICSU Global Climate Observing System (GCOS) as the climate observing component of GEOSS, *and especially through strong support for the climate-relevant functions and activities of:*
 - the IOC-WMO-UNEP-ICSU Global Ocean Observing System (GOOS);
 - the FAO-WMO-UNESCO-UNEP-ICSU Global Terrestrial Observing System (GTOS);
 - the WMO Global Observing System (GOS) and Global Atmosphere Watch (GAW);
 - the research observing systems and observing systems research of the WMO-IOC-ICSU World Climate Research Programme (WCRP) and other climate-relevant international programs;
 - CEOS, as coordinator of the satellite components of GCOS;

and their enhancement and supplementation as necessary, including closure of critical gaps, to ensure the availability of all the climate and climate-related observations needed to support GEOSS;

- promotion of data sharing as well as coordination of data management and exchange systems;
- contributions to major advances in the monitoring and prediction of climate on seasonal, interannual and decadal time scales, including the occurrence of extreme events;
- strengthened GCOS support for the assessment role of the IPCC and the policy development role of the UNFCCC;
- enhanced efforts for data rescue and digitization.

This will be demonstrated by:

- Improved scientific understanding, modelling and prediction of climate.
- Accessibility of all the observational data needed for climate monitoring and services in support of adaptation to climate variability and change.
- Development and facilitation of a comprehensive (atmosphere, ocean, land) global carbon observation and analysis system in support of monitoring based decision-making and related environmental treaty obligations.
- Availability of all Essential Climate Variables needed by the WCRP, the IPCC and the UNFCCC.

2.4 Disasters

Before 2015, GEO aims to:

9. 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).

This will be achieved through:

¹ Acronyms: CEOS-Committee of Earth Observation Satellites; FAO-Food and Agriculture Organization; GCOS-Global Climate Observing System; ICSU-International Council for Science; IOC-Intergovernmental Oceanographic Commission; IPCC-Intergovernmental Panel on Climate Change; UNEP-United Nations Environment Programme; UNESCO-United Nations Educational, Scientific and Cultural Organization; UNFCCC-United Nations Framework Convention on Climate Change; WCRP-World Climate Research Programme; WMO-World Meteorological Organization.

- 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;
- development of multi-hazard and/or end-to-end approaches, as appropriate to meet the needs for disaster risk reduction, preparedness and response in relevant hazard environments;
- supporting the implementation of the priorities for action identified in the *Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters (HFA)*.

This will be demonstrated by:

- Improved use of observations and related information to inform policies, decisions and actions associated with disaster preparedness and mitigation.
- More effective access to observations and related information to facilitate warning, response and recovery to disasters.
- Increased communication and coordination between national, regional and global communities in support of disaster risk reduction, including clarification of roles and responsibilities and improved resources management.
- Improved national response to natural and man-made disasters through delivery of space-based data, resulting from strengthened International Charter on "Space and Major Disasters."
- Support to the successful implementation of the *Hyogo Framework for Action 2005-2015*.

2.5 Ecosystems

Before 2015, GEO aims to:

10. Establish, in conjunction with a comprehensive biodiversity observation network, a wide-ranging monitoring capability for all ecosystems and the human impacts on them, to improve the assessment, protection and sustainable management of terrestrial, coastal and marine resources and the delivery of associated ecosystem services.

This will be achieved through:

- developing and promulgating wider availability of methodologies to understand interactions between human settlements and ecosystems;
- refinement of techniques for the delivery of ecosystem services;
- development of tools for decision making in support of the assessment, protection and sustainable management of ecosystems;
- working with established international monitoring communities and networks.

This will be demonstrated by:

- Implementation of a global standardised ecosystem classification system and map as a basis for worldwide inventory, assessment and monitoring.
- Implementation of a global, standardized inventory of major ecosystems and the protected areas within them.
- Increased operational monitoring of major ecosystems on land on an annual basis, including properties such as land cover type; species composition; vegetation structure, height and age; net ecosystem productivity; and biomass and carbon estimates of vegetation and soils based on remote sensing and sampled *in-situ* observations using internationally agreed standards.

- Increased operational monitoring of major marine and coastal ecosystems on an annual basis including properties such as extent, water temperature, salinity, pH and pCO₂, phytoplankton species composition and productivity and marine resource stocks, based on remote sensing and sampled *in-situ* observations using internationally agreed standards.
- Increased knowledge of environmental flow requirements of river baseflow and peak flow, as well as human requirements for irrigation and power plant cooling water and domestic usage.

2.6 Energy

Before 2015, GEO aims to:

11. Close critical gaps in energy-related Earth observations and increase their use in all energy sectors in support of energy operations, as well as energy policy planning and implementation, to enable affordable energy with minimized environmental impact while moving towards a low-carbon footprint.

This will be achieved through:

- engaging and working with governments, national and international energy agencies, the energy industry, research communities and other stakeholders in order to:
 - map user needs and requirements for specific energy data sets (e.g. geophysical, geological, biological, weather, climatological, pollutant and greenhouse gases as well as socio-economic data);
 - develop best practices for the integration of information as well as support capacity building.
- initiating environmental impact studies to identify what data are needed to collect and share by developers to ensure impacts on the environment be as low as reasonably possible for all energy sources (biomass, fossils, geothermal, hydropower, nuclear, ocean, , solar and wind);
- initiating application and demonstration projects where earth observations are used for all sources of energy, thus enabling:
 - improved energy management, including balance between energy demand and supply as well as development of alternative energy scenarios;
 - safe, efficient and affordable development and operation of existing and new energy resources, with emphasis on minimizing environmental and societal impact while moving towards a low-carbon footprint;
 - advancement of the application of data, systems and tools.

This will be demonstrated by:

- Significant increase in use of Earth observations by all sectors for improved:
 - Environmental, economic and societal impact assessments of energy exploration, extraction, conversion, transportation and consumption.
 - Prediction of potential hazards to the energy infrastructure.
 - Prediction of the production of intermittent sources of energy.
 - Mapping of renewable energy potential.

2.7 Health

Before 2015, GEO aims to:

12. Substantially expand the availability, use, and application of environmental information for public health decision-making in areas of health that include allergens, toxins, infectious diseases, food-borne diseases, and chronic diseases, particularly with regard to the impact of climate and ecosystem changes.

This will be achieved through:

- working with the World Health Organization (WHO) and the global community of human health and environment experts in order to develop and implement health-and-environment projects which will:
 - advance the application of observation, monitoring and forecasting systems to health decision-making processes;
 - foster the use of established and emerging observation systems in operational health-related applications for air and water quality, infectious diseases, and vector-borne diseases, and develop associated products such as forecasts and alerts compliant with the Common Alerting Protocol (CAP);
 - 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;
 - document links between water and communicable diseases, as part of the life cycle of vectors or as a medium infecting populations;
 - 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.
- development of a global network of scientists, researchers, practitioners and other operational end users which will:
 - provide free access to an expanded inventory of available Earth observation data, metadata and products applicable to public health;
 - 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;
 - facilitate Earth observation training and capacity building for future scientists, researchers, public health policy makers and practitioners, and end users, including contributions of best practices in this domain to the GCI best practices registry.

This will be demonstrated by:

- Access to improved environmental information and tools to support the global community of human health and environment experts.
- Increased use of environmental information and tools to support decision making in epidemics and/or disease management and planning for well-being. The effectiveness of these tools is demonstrated in at least 3 specific areas on different continents.
- Increased Applying outcomes from other Societal Benefit Areas to improve health and well-being.

2.8 Water

Before 2015, GEO aims to:

13. Produce comprehensive sets of data and information products to support decision-making for efficient management of the world's water resources, based on coordinated, sustained observations of the water cycle on multiple scales.

This will be achieved through:

- development of a sustained, operational monitoring system for the global water cycle, combining space-based, airborne, and *in-situ* observation networks which will:
 - address water resources in terms of quantitative availability and water quality;
 - include integrated *in-situ* reference sites for monitoring essential variables for water cycle measurement;
 - promote the upgrading of *in-situ* networks in regions where current networks do not meet emerging standards for observations, network enhancements, data systems, planning frameworks and implementation programs;
 - 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;
 - deliver 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.
- development of widely available, sustained water cycle data sets and related information products, at both global and basin scales, tailored to the near- and long-term needs of stakeholders and end-users, which will:
 - exploit past and current *in-situ* and satellite-based observations as well as fostering their integration into advanced models for integrated water resource management;
 - focus attention on developing local, regional and global hydrological risk (e.g., floods, droughts) assessment, prediction and management systems and expanded applications of integrated water resource management for sustained development;
 - promote the next generation of improved/enhanced products and innovative observations (with special emphasis on observational gaps: e.g., precipitation and run-off at high latitudes and water quality measurements from space), for water resources management.

This will be demonstrated by:

- An operationalized and sustained global network of *in-situ* observation sites.
- Increased availability of information products and services for monitoring changes in the water cycle, including clouds and precipitation, appropriate for both research and integrated water resource management.
- Increased availability of data and information, including quantity and quality of both surface and groundwater, to support a water cycle decision making system.
- Routine, reliable production of “watershed” and human health indicators from satellite data, surface and subsurface data, and data assimilation capabilities.

2.9 Weather

Before 2015, GEO aims to:

14. Close critical gaps in meteorological and related ocean observations, and enhance observational and information capabilities for the protection of life and property, especially with regard to high-impact events, and in the developing world.

This will be achieved through:

- the programmes and activities of the World Meteorological Organization (WMO), and building on enhanced observational capabilities, which will:
 - monitor the performance and impact of global meteorological and related ocean observing systems, and facilitate the closure of critical gaps in observations and capabilities, utilizing a mix of space-based and *in-situ* observing systems as appropriate;
 - make progress towards implementing the Vision for the Global Observing System 2025;
 - encourage the design and implementation of optimal observational networks to better meet the needs of users for observational data;
 - promote the improvement of data assimilation, modeling systems, and verification and assessment techniques;
 - advance the use of observations in forecasting and warning services globally, advocate for research and development in key areas and encourage the rapid transfer of related research outcomes into operational use, especially in developing countries;
 - encourage more direct, two-way interactions between users, managers of observing systems and providers of forecasts, building on enhanced observational capabilities, to improve the forecast process;
 - provide integrated data collection and automated dissemination of observational data and products, as well as data discovery, access and retrieval services.

This will be demonstrated by:

- Identification and addressing of critical gaps in observational networks that reflect, in particular, the needs of developing countries, the need for continuity in space-based and *in-situ* observations, and the potential benefits of an interactive observing system to support user needs.
- Improvements in the range and quality of services for high impact weather forecasting due to the design, future development, and operation of global observing, data assimilation, numerical modelling, and user application techniques.
- More accurate, reliable and relevant weather analyses, forecasts, advisories and warnings of severe and other high impact hydrometeorological events enabled by enhanced observational capabilities.