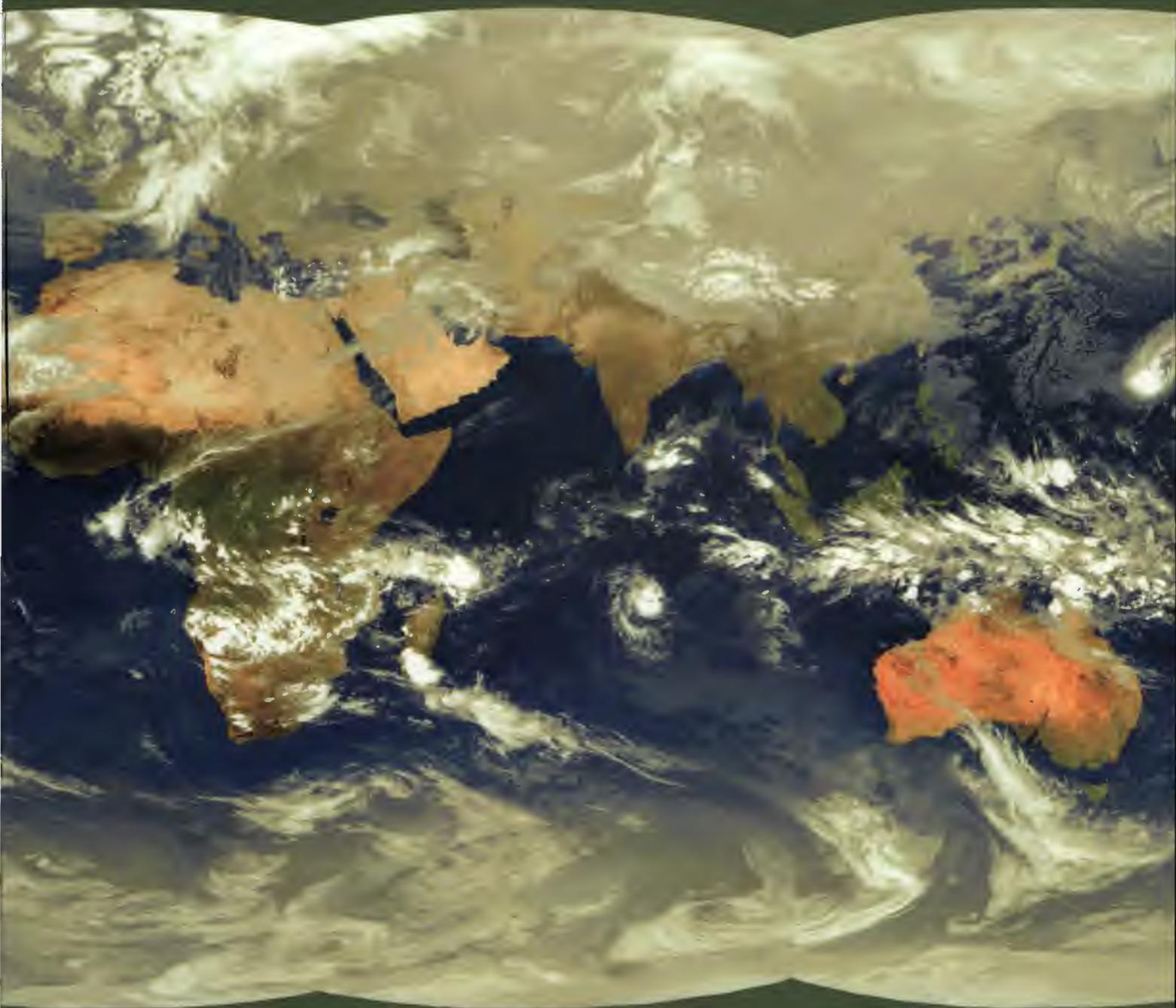


# Global Earth Observation System of Systems GEOSS



**10-Year Implementation Plan**

Group on Earth Observations

*Cover: World cloud map for 15:00 hours UCT on 1 February 2005. The mosaic is a composite of Meteosat-5, Meteosat-7, GEOS-9, GOES-10 and GOES-12 imagery (Copyright EUMETSAT 2005)*

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## Foreword

The Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan, endorsed by nearly 60 governments and the European Commission on 16 February 2005, is designed to qualitatively improve our understanding of the Earth system, markedly enhancing global policy- and decision-making abilities to promote the environment, human health, safety, and welfare.

It is important to recall that, during the period in which our countries and organizations collaborated so intensively to prepare this Plan, an important first success had already been achieved. Like few other partnerships before, the GEO succeeded in bringing together a diverse and rich tapestry of peoples and views, united in a concerted effort with a common vision, to rapidly advance the global agenda for sustainable development and sound environmental management. Ours is now the responsibility to ensure the deliverables and targets we had committed to in the GEOSS 10-Year Implementation Plan are met. Our full and enthusiastic support will be imperative to sustain the implementation and monitoring processes.

On matters pertaining to sustainable development, the voices of our citizens in recent years have been loud and clear. They expect clear and unambiguous responses from their leaders to the pressing challenges facing planet Earth. The successful implementation of GEOSS will be a practical and meaningful response to this call. Indeed, we are presented with a unique opportunity to implement a practical and visible global development initiative, which supports poverty eradication and human advancement within the context of the protection of the ecology of our planet.

Dr. Achilleas Mitsos, European Commission  
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*The GEO Co-Chairs*

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Understanding the Earth system – its weather, climate, oceans, atmosphere, water, land, geodynamics, natural resources, ecosystems, and natural and human-induced hazards – is crucial to enhancing human health, safety and welfare, alleviating human suffering including poverty, protecting the global environment, reducing disaster losses, and achieving sustainable development. Observations of the Earth system constitute critical input for advancing this understanding.

## Preamble

Interested countries and organizations have collaborated to develop this Plan to ensure comprehensive and sustained Earth observations. It builds on and adds value to existing Earth-observation systems by coordinating their efforts, addressing critical gaps, supporting their interoperability, sharing information, reaching a common understanding of user requirements, and improving delivery of information to users.

The purpose of this Plan is to summarize the essential steps to be undertaken, over the next decade, by a global community of nations and intergovernmental, international, and regional organizations, to put in place a Global Earth Observation System of Systems (GEOSS).

## 1 Purpose of this Plan

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

## 2 Vision for GEOSS

### 3.1 Purpose of GEOSS

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:

## 3 Purpose and Scope of GEOSS, and the Group on Earth Observations

- 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.

### **3.2 Scope of GEOSS**

GEOSS will provide the overall conceptual and organizational framework to build towards integrated global Earth observations to meet user needs. GEOSS will be a “system of systems” consisting of existing and future Earth-observation systems, supplementing but not supplanting their own mandates and governance arrangements. It will provide the institutional mechanisms for ensuring the necessary level of coordination, strengthening and supplementation of existing global Earth-observation systems, and for reinforcing and supporting them in carrying out their mandates.

GEOSS will capture the success of Earth-observation research programmes, and facilitate their transition to sustained operational use.

The established Earth-observation systems, through which many countries cooperate as members of the United Nations Specialised Agencies and Programmes and as contributors to international scientific programmes, provide essential building blocks for GEOSS. The implementation of GEOSS will seek to ensure effective consultation and cooperation with the UN system and other international and national agencies sponsoring or co-sponsoring the major component global observing systems on which GEOSS will be built.

The contributing systems will range across the processing cycle, from primary observation to information production. Through GEOSS, they will share observations and products with the system as a whole, and will take the necessary steps to ensure that the shared observations and products are accessible, comparable, and understandable, by supporting common standards and adaptation to users' needs.

GEOSS aspires to encompass all areas of the World, and to cover *in situ*, airborne, and space-based observations. GEOSS will be primarily focused on issues of regional and global scale and cross-sectorial applications, while also facilitating, if so invited, the operation and enhancement of Earth-observing systems that are focused on national, local and sector-specific needs. GEOSS will promote capacity building in Earth observation, building on existing local, national, regional, and international initiatives.

### **3.3 Group on Earth Observations (GEO)**

Membership in GEO is open to all member States of the United Nations and to the European Commission. GEO welcomes, as Participating Organizations, inter-governmental, international, and regional organizations with a mandate in Earth observation or related activities, subject to approval by GEO Members. GEO may invite other relevant entities to participate in its activities as observers.

Sound management of the Earth system, in both its natural and human aspects, requires information that is timely, of known quality, long-term, and global. Ensuring that such information is available to those who need it is a function of governments and institutions at all levels. Despite laudable efforts, the current situation with respect to the availability of Earth observations is not optimal. This is particularly true with respect to coordination and data sharing among countries, organizations and disciplines, and meeting the needs of sustainable development. There are large spatial and temporal gaps in data coverage. Moreover, there is an eroding observational infrastructure, inadequate long-term data archiving, and no assured continuity for many essential observing systems. Consequently, targeted collective action is needed to bring observing systems in line with the requirements for addressing a range of issues of concern to society.

## 4 Benefits of GEOSS

### 4.1 Societal Benefit Areas

GEOSS will yield advances in the societal benefit areas defined by its purpose and scope. Each area has compelling reasons for the Earth-observation advances envisioned in GEOSS.

For information needs common to many societal benefit areas, GEOSS will facilitate the development and provision of common products such as maps of topography, bathymetry, river systems, infrastructure, and land cover and land use, and a geodetic reference frame for Earth observation. Interpretation and use of Earth observations requires information on the drivers and consequences of change, including geo-referenced socio-economic data and indicators.

The following are brief summary statements of topics covered and key outcomes in each area.

#### 4.1.1 *Disasters: Reducing loss of life and property from natural and human-induced disasters*

Disaster-induced losses can be reduced through observations relating to hazards such as: wildland fires, volcanic eruptions, earthquakes, tsunamis, subsidence, landslides, avalanches, ice, floods, extreme weather, and pollution events. GEOSS implementation will bring a more timely dissemination of information through better coordinated systems for monitoring, predicting, risk assessment, early warning, mitigating, and responding to hazards at local, national, regional, and global levels.

#### 4.1.2 *Health: Understanding environmental factors affecting human health and well-being*

Health issues with Earth-observation needs include: airborne, marine, and water pollution; stratospheric ozone depletion; persistent organic pollutants; nutrition; and monitoring weather-related disease vectors. GEOSS will improve the flow of appropriate environmental data and health statistics to the health community, promoting a focus on prevention and contributing to continued improvements in human health worldwide.

*4.1.3 Energy: Improving management of energy resources*

GEOSS outcomes in the energy area will support: environmentally responsible and equitable energy management; better matching of energy supply and demand; reduction of risks to energy infrastructure; more accurate inventories of greenhouse gases and pollutants; and a better understanding of renewable energy potential.

*4.1.4 Climate: Understanding, assessing, predicting, mitigating, and adapting to climate variability and change*

The climate has impacts in each of the other eight societal benefit areas. Coping with climate change and variability demands good scientific understanding based on sufficient and reliable observations. GEOSS outcomes will enhance the capacity to model, mitigate, and adapt to climate change and variability. Better understanding of the climate and its impacts on the Earth system, including its human and economic aspects, will contribute to improved climate prediction and facilitate sustainable development while avoiding dangerous perturbations to the climate system.

*4.1.5 Water: Improving water-resource management through better understanding of the water cycle*

Water-related issues addressed by GEOSS will include: precipitation; soil moisture; streamflow; lake and reservoir levels; snow cover; glaciers and ice; evaporation and transpiration; groundwater; and water quality and water use. GEOSS implementation will improve integrated water-resource management by bringing together observations, prediction, and decision-support systems and by creating better linkages to climate and other data. In situ networks and the automation of data collection will be consolidated, and the capacity to collect and use hydrological observations will be built where it is lacking.

*4.1.6 Weather: Improving weather information, forecasting and warning*

The weather observations encompassed by GEOSS are based on the requirements for timely short- and medium-term forecasts. GEOSS can help fill critical gaps in the observation of, for example, wind and humidity profiles, precipitation, and data collection over ocean areas; extend the use of dynamic sampling methods globally; improve the initialization of forecasts; and increase the capacity in developing countries to deliver essential observations and use forecast products. Every country will have the severe-weather-event information needed to mitigate loss of life and reduce property damage. Access to weather data for the other societal benefit areas will be facilitated.

*4.1.7 Ecosystems: Improving the management and protection of terrestrial, coastal and marine resources*

Observations are needed on the area, condition, and natural-resource stock levels of ecosystems such as forests, rangelands, and oceans. GEOSS implementation will seek to ensure that methodologies and observations are available on a global basis to detect and predict changes in ecosystem condition and to define resource potentials and limits. Ecosystem observations will be better harmonized and shared, spatial and topical gaps will be filled, and in situ data will be better integrated with space-based observations. Continuity of observations for monitoring wild fisheries, the carbon and nitrogen cycles, canopy properties, ocean colour, and temperature will be set in place.

#### *4.1.8 Agriculture: Supporting sustainable agriculture and combating desertification*

Issues addressed by GEOSS will include: crop production; livestock, aquaculture and fishery statistics; food security and drought projections; nutrient balances; farming systems; land use and land-cover change; and changes in the extent and severity of land degradation and desertification. GEOSS implementation will address the continuity of critical data, such as high-resolution observation data from satellites. A truly global mapping and information service, integrating spatially explicit socio-economic data with agricultural, forest, and aquaculture data will be feasible, with applications in poverty and food monitoring, international planning, and sustainable development.

#### *4.1.9 Biodiversity: Understanding, monitoring and conserving biodiversity*

Issues in this area include the condition and extent of ecosystems, distribution and status of species, and genetic diversity in key populations. Implementing GEOSS will unify many disparate biodiversity-observing systems and create a platform to integrate biodiversity data with other types of information. Taxonomic and spatial gaps will be filled, and the pace of information collection and dissemination will be increased.

### **4.2 User Involvement**

The benefits of GEOSS will be realized globally by a broad range of user communities, including managers and policy makers in the targeted societal benefit areas, scientific researchers and engineers, civil society, governmental and non-governmental organizations and international bodies, such as those assisting with the implementation of multilateral environmental agreements. Engagement of users in developing countries will maximize their opportunities to derive benefits from GEOSS.

GEO will perform a coordination role to address the adequacy, efficiency, and integrative way user requirements are being met, and transmit recommendations for improvements to the relevant contributing systems.

The needs of users, and the technical solutions to those needs, change with time. GEO will organize regular GEOSS User Fora among and within societal benefit areas or sub-areas, making use of user communities where they exist and catalyzing the formation of new ones where they do not. It will also create an appropriate mechanism for coordinating user requirements across societal benefit areas. The function of the User Fora will be to document and review user requirements, assess the extent to which they are being met, and make recommendations to GEO with the objective of improving the delivery of information appropriate to user needs.

## 5 Technical Approach, Capacity Building, and Outreach

5 GEOSS, collectively, has several functional components:

- to address identified common user requirements
- to acquire observational data
- to process data into useful products
- to exchange, disseminate, and archive shared data, metadata and products, and
- to monitor performance against the defined requirements and intended benefits.

GEO will employ a range of methods to advance the implementation of the Plan, tailoring them as required to address each of the various implementation issues. The methods will include: establishment of standing and specific task-oriented GEOSS structures; referring specific tasks to participating international organizations or agencies; coordinating and cooperating with national agencies; collaboration between international organizations; providing a forum for dialogue and resolution of issues at varying levels from ministerial and senior-official levels to scientific and technical levels; and advocacy within and across existing systems and other mechanisms.

GEOSS will be based on existing observing, data-processing, data-exchange and dissemination systems, while fostering and accommodating new systems operated by GEO Members and Participating Organizations, as needs and capabilities develop. The technical commitments of a GEO Member or Participating Organization will apply only to those contributions that they have identified.

Long-term continuity of existing observations is required. In addition, activities to facilitate research, capacity building, and outreach will be carried out and coordination focal points will be provided.

The utilization of new technologies and know-how will be carried out in accordance with international and national legislations.

### 5.1 Observations and Modelling

In the implementation of GEOSS, increased sharing of methods for modelling and analysis needed to transform data into useful products will be advocated.

Within 2 years, a mechanism will be established for coordinating user needs across the various societal benefit areas. GEO will facilitate the development and maintenance of a distinct and common user-requirements database for GEOSS, building on and linking to existing user-requirements databases. These requirements will include specifics such as location, frequency and accuracy. On the same time scale, a collaboration mechanism for sharing costs and benefits will be developed for observations and infrastructures for which the defined requirements may not be met by single-party activities alone. GEO will also provide a framework for securing the future continuity of necessary observations and initiating new observations. GEO could act as a forum for discussion on common implementation issues at regional and trans-national levels, such as transportation of *in situ* observation devices across borders.

The implementation of GEOSS will facilitate, within 2 years, the establishment and maintenance of baseline sites for global *in situ* networks.

GEO will establish, within 10 years, its system of systems to provide timely data and products for local, national, regional, and international policy makers. In the implementation of GEOSS, harmonization of observations, real- or near-real-time

monitoring, integration of information from *in situ*, airborne and space-based observations through data assimilation and models, and early detection of significant and extreme events will be advocated. Integration of *in situ*, airborne and space-based observations within the various societal benefit areas will be encouraged, as will the establishment of global, efficient, and representative networks of *in situ* observation to support process studies, satellite-data validation, and algorithm and model development, as well as the detection, documentation and attribution of change.

## **5.2 Products, Data Management, and Radio-Frequency Protection**

Current status assessments and descriptions, as well as predictive products in each of the domains of socio-economic benefit are required. The implementation of GEOSS will facilitate, within 2 years, the development and availability of shared data, metadata, and products commonly required across diverse societal benefit areas.

GEOSS will encourage the adoption of existing and new standards to support broader data and information usability.

GEO will advocate, within 2 years, through appropriate representations to the International Telecommunications Union (ITU), the protection of radio frequencies critical to Earth observation.

The implementation of GEOSS will facilitate, within 6 years, data-management approaches that encompass a broad perspective of the observation-data life cycle, from input through processing, archiving, and dissemination, including reprocessing, analysis and visualization of large volumes and diverse types of data.

The implementation of GEOSS will establish, within 6 years, international information sharing and dissemination drawing on existing capabilities through appropriate technologies, including, but not limited to, Internet-based services.

## **5.3 Architecture and Interoperability**

The success of GEOSS will depend on data and information providers accepting and implementing a set of interoperability arrangements, including technical specifications for collecting, processing, storing, and disseminating shared data, metadata and products. GEOSS interoperability will be based on non-proprietary standards, with preference given to formal international standards. Interoperability will be focused on interfaces, defining only how system components interface with each other and thereby minimizing any impact on affected systems other than where such systems have interfaces to the shared architecture.

For those observations and products contributed and shared, GEOSS implementation will facilitate their recording and storage in clearly defined formats, with metadata and quality indications to enable search, retrieval, and archiving as accessible data sets.

GEO will establish, within 2 years, a process for reaching, maintaining, and upgrading GEOSS interoperability arrangements, informed by ongoing dialogue with major international programmes and consortia. That process is to be sensitive to technology disparities among GEO Members and Participating Organizations.

Attention is drawn to the importance of using existing international standards organizations and institutes as a focal point for the GEOSS interoperability objectives as they relate to and use standards.

For the most commonly used open-standard interfaces, the GEOSS process will advocate some implementations having no restrictions on being modified freely, commonly known as “open-source” software.

To enable implementation of the GEOSS architecture, GEOSS will draw on existing Spatial Data Infrastructure (SDI) components as institutional and technical precedents in areas such as geodetic reference frames, common geographic data, and standard protocols. GEO Members and Participating Organizations and their contributions will be catalogued in a publicly accessible, network-distributed clearinghouse maintained collectively under GEOSS. The catalogue will itself be subject to GEOSS interoperability specifications, including the standard search service and geospatial services.

#### **5.4 Data Sharing**

The societal benefits of Earth observations cannot be achieved without data sharing. The following are GEOSS data-sharing principles:

- 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 cost of reproduction will be encouraged for research and education.

Use of data or products does not necessarily imply agreement with, or endorsement of the purpose behind the gathering of such data.

#### **5.5 Research Facilitation**

GEO will advocate research and development in key areas to facilitate, on an ongoing basis, improvements to Earth-observation systems, including:

- Improved and new instrumentation and system design for *in situ*, airborne, and space-based observations 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 that are able to produce global and regional products more effectively.

GEOSS implementation will promote research efforts that are necessary for the development of tools required in all societal benefit areas. It will also encourage and facilitate the transition from research to operations of appropriate systems and techniques. This includes facilitating partnerships between operational groups and research groups.

#### **5.6 Capacity Building**

The GEO capacity-building strategy follows the World Summit on Sustainable Development concept of a global partnership between those whose capacity needs development and those who are able to assist in the process, recognizing that activities have intertwined social, environmental, and economic impacts.

The GEO capacity-building strategy will be based on best practices derived from studying successful and less-successful approaches.

Within 2 years, GEO will:

- Produce a comprehensive review and analysis of gaps and methodologies, based on existing and planned capacity-building efforts.
- Facilitate, together with existing efforts, the maintenance and strengthening of education, training, research and communication.
- Facilitate, with developing countries and across all societal benefit areas, the establishment and maintenance of baseline sites for global *in situ* and remote-sensing networks that cannot always be justified on national grounds alone, in cooperation with relevant global research programmes and activities to ensure that synergies in observations and understanding are achieved.
- Develop a network of experts involved in existing capacity-building initiatives related to Earth observation, and encourage users to access this knowledge base.
- Encourage, in each societal benefit area, the development of capacity-building components as a requirement for any network, project, activity, or User Fora that will be a component of GEOSS.
- Facilitate access to data and models, particularly for developing countries.

Within 6 years, GEO will:

- Advocate funding of multinational projects to leverage the end-to-end value of observations, including the establishment of necessary infrastructure.
- Produce monitoring and evaluation mechanisms for GEO capacity-building efforts.
- Facilitate education and training to provide a global base of technical expertise for GEOSS.

Within 10 years, GEO will seek to have in place a sustained capacity-building strategy that will have significantly strengthened the capability of all countries, and particularly developing countries, to:

- Use Earth-observation data and products (e.g. process, integrate, model) following accepted standards.
- Contribute to, access, and retrieve data from global data systems and networks.
- Analyze and interpret data to enable development of decision-support tools and to advance understanding in the nine societal benefit areas.
- Integrate Earth-observation data and products with other data and products, for a more complete view and understanding of problems and derived solutions.
- Improve infrastructure development in areas of poor observational coverage.
- Develop recommended priorities for new or augmented efforts in capacity building.

### 5.7 Outreach Plan

Outreach is essential to many aspects of GEO activities. The outreach objective is to promote and increase the general awareness of the benefits of Earth observation, especially among present and future users, beneficiaries and sponsors of relevant systems.

Within 2 years, GEO will produce and begin to implement an outreach plan directed towards key target audiences, including decision makers and policy makers; the general public; industry and service communities; scientific and technical communities; education entities; non-governmental organizations; public-interest advocacy groups; and international financial institutions and official development assistance agencies.

In subsequent years, GEO will continue to implement and periodically revise the outreach plan.

GEO will develop its international outreach activities in partnership with its participating UN and other intergovernmental and international organizations. For instance, UNESCO is the lead agency for the 2005-2014 “Decade of Education for Sustainable Development”, which has several key actions in common with GEOSS.

## **6 Governance**

### **6.1 Functions**

The functions of GEO include:

- Overseeing implementation of the Plan, including monitoring and evaluating progress.
- Further developing and periodically updating the Plan, taking into account existing activities and evolving needs and capabilities.
- Identifying opportunities and measures to minimize gaps in data, metadata, and products.
- Setting and addressing priorities for filling gaps.
- Coordinating efforts to involve and assist developing countries in improving and sustaining their contributions to observing systems, their access to and effective utilization of shared data, metadata, and products, and the related technologies.
- Facilitating exchange of shared data, metadata, and products.
- Measuring, monitoring, and facilitating interoperability.
- Drawing on the expertise of the international scientific and technological communities.
- Facilitating user involvement and conducting outreach at global and regional levels.
- Adopting an Annual Work Plan and associated budget.
- Selecting the *Director of the Secretariat*.
- Establishing and adopting its operating rules and procedures.
- Consulting, coordinating, and liaising with relevant UN Specialized Agencies and Programmes, and international scientific organizations.

## **6.2 Organizational Structure**

GEO, comprising the Members and Participating Organizations, is established on a voluntary and legally non-binding basis, with voluntary contributions to support activities.

GEO will meet in Plenary at least annually at the senior-official level, and periodically at the ministerial level.

GEO will take decisions by consensus of its Members. Decisions on implementation of the Plan will be based upon sound scientific and technical advice obtained through appropriate consultation with the research and observation communities.

To support its work, the GEO Plenary will establish:

- An elected Executive Committee.
- Subsidiary bodies as appropriate, including science and technical advisory mechanisms.
- A Secretariat.

## **6.3 Secretariat**

The Secretariat, led by the Director, will facilitate and support GEO activities. The Secretariat will consist of co-located, well-qualified, professional and administrative staff.

## **7.1 Funding of GEOSS**

The total cost for implementing GEOSS will be significant, but only limited resources will need to be provided through GEO. Most of the resources will be provided through existing national and international mechanisms, and by voluntary contributions to special projects. Unless otherwise agreed, any costs arising from GEO activities will be borne by the Member or Participating Organization that incurs them and will be subject to the availability of funds, personnel, or other resources.

Members and Participating Organizations may make voluntary financial or other contributions to GEO activities, including the baseline activities of the Secretariat, through a trust fund to be administered by the Secretariat. Other entities may make contributions to finance specific activities approved by GEO.

## **7.2 Performance Indicators**

GEO will develop performance indicators for GEOSS.

It is expected that time will be needed to make arrangements for the successor mechanism, following adoption of this Plan at the Third Earth Observation Summit in February 2005. To maintain current momentum, the Terms of Reference for the *ad hoc* GEO will be extended until such Terms of Reference are superseded, recognizing that, in order for the necessary transitional arrangements to be completed, the *ad hoc* GEO Terms of Reference will need to continue until the first meeting of the successor GEO.

## **7 Funding, and Measuring Progress**

## **8 The Transition Period**



We, the participants in the Third Earth Observation Summit held in Brussels, Belgium, on February 16, 2005:

Recalling the Declaration of the first Earth Observation Summit, held in Washington, D.C., on July 31, 2003, and the Framework Document adopted at the Second Earth Observation Summit, held in Tokyo, on April 25, 2004;

Building on the commitment made at those Summits to move toward a comprehensive, coordinated, and sustained Earth observation system of systems, taking into account the particular needs of developing countries;

Remaining cognizant of the fact that observing and understanding the Earth system more completely and comprehensively will expand worldwide capacity and means to achieve sustainable development as envisioned in our commitments in the Johannesburg Plan of Implementation adopted at the 2002 World Summit on Sustainable Development, and will yield advances in many specific societal benefit areas, including disaster reduction, health, energy, weather, climate, water, ecosystems, biodiversity, agriculture and combating desertification;

Acknowledging the achievements of the established national, regional, and international observing systems, including those sponsored and cosponsored by a number of UN Specialised Agencies and Programmes; and

Determined to build upon, strengthen and expand, where appropriate, the established observing systems by working with and through existing planning and coordination mechanisms;

Affirm our support to the process, recognizing the increased attention to our initiative with more countries and organizations participating since the first Summit;

Acknowledge with appreciation the work of the ad hoc Group on Earth Observations (GEO) to develop a 10-Year Implementation Plan, based on user requirements and building on existing systems, and seeking to undertake concerted capacity-building efforts, especially within developing countries;

Endorse the 10-Year Implementation Plan as the basis for its further development and for establishing a Global Earth Observation System of Systems (GEOSS) to fulfill user requirements among various socio-economic benefit areas;

Note with appreciation the extensive supporting information compiled in the GEOSS 10-Year Implementation Plan Reference Document prepared by the ad hoc GEO;

Establish the intergovernmental Group on Earth Observations (GEO), to take those steps necessary to implement GEOSS in accordance with its implementation plan;

Encourage the governments of all UN member states to participate in GEO and invite the governing bodies of the UN Specialised Agencies and Programmes and other relevant international and regional organizations, which sponsor and cosponsor established global, regional, and national observing systems, to endorse the implementation of GEOSS and to encourage and assist GEO in its work;

Request GEO to consult the intergovernmental and other sponsors of the component systems of GEOSS on progress and on issues involved in implementation of the Plan;

Affirm our intention to provide the support necessary to execute the GEOSS 10-Year Implementation Plan;

Resolve to meet again, before the end of 2007, to take stock of progress and provide further guidance towards the successful implementation of GEOSS; and

Resolve to conduct a mid-term assessment of GEO by 2010.

*(Adopted in Brussels on 16 February 2005)*

## Resolution of the Third Earth Observation Summit



We, the participants in the Second Earth Observation Summit held in Tokyo, Japan, on 25 April 2004:

## Communiqué of the Second Earth Observation Summit

Recalling the Declaration of the first Earth Observation Summit, held in Washington, D.C., on July 31, 2003,

Building on the commitment made at that Summit to move toward a comprehensive, coordinated, and sustained Earth observation system or systems, and;

Remaining cognizant of the fact that what we are designing will change and improve how we perceive and understand the Earth system – its weather, climate, oceans, land, geology, natural resources, ecosystems, and natural and human-induced hazards – and that such understanding is crucial to enhancing human health, safety and welfare, alleviating human suffering including poverty, protecting the global environment, and achieving sustainable development;

We affirm our support to the process underway, recognizing the increased attention to our initiative with more countries and organizations participating since the first Summit;

We acknowledge with appreciation the work of the ad hoc Group on Earth Observations thus far to begin to develop a 10-Year Implementation Plan, based on user requirements and building on existing systems, for a comprehensive, coordinated, and sustained Earth observation system of systems.

We adopt with satisfaction the Framework Document, describing principal benefits of Earth observations to a broad range of user communities and the fundamental elements to be included in the 10-Year Implementation Plan for what will henceforth be called a Global Earth Observation System of Systems (GEOSS);

We approve the way forward for the development of the 10-Year Implementation Plan as described in the Framework Document;

We note with appreciation the “GEO Subgroup Reports to the Second Earth Observation Summit,” and

We commission the ad hoc Group on Earth Observations to take those steps necessary to have in place for our review a draft Implementation Plan before the third Earth Observation Summit to be hosted by the European Union in early 2005.

We renew our invitation to other governments to join us in this initiative. We also invite the governing bodies of international and regional organizations sponsoring existing Earth observing systems to support our action.

*(Adopted in Tokyo on 25 April 2004)*



## From Observation to Action

### Achieving Comprehensive, Coordinated, and Sustained Earth Observations for the Benefit of Humankind

#### Framework for a 10-Year Implementation Plan

*As adopted by Earth Observation Summit II  
25 April 2004*

Understanding the Earth system – its weather, climate, oceans, land, geology, natural resources, ecosystems, and natural and human-induced hazards – is crucial to enhancing human health, safety and welfare, alleviating human suffering including poverty, protecting the global environment, and achieving sustainable development. Data collected and information created from Earth observations constitute critical input for advancing this understanding. In 2003, a consensus emerged among governments and international organizations that, while supporting and developing existing Earth Observation systems, more can and must be done to strengthen global cooperation and Earth observations. This Framework Document, while not legally binding, marks a crucial step in developing the 10-Year Implementation Plan for the creation of a comprehensive, coordinated, and sustained Earth Observation system or systems as envisioned by the Washington Declaration adopted at the Earth Observation Summit of 2003.

**2.1** Observing and understanding the Earth system more completely and comprehensively will expand worldwide capacity and means to achieve sustainable development and will yield advances in many specific areas of socio-economic benefit, including:

- 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.

**2.2** Globally, these benefits will be realized by a broad range of user communities, including (1) national, regional, and local decision-makers, (2) relevant international organizations responsible for the implementation of international conventions, (3) business, industry, and service sectors, (4) scientists and educators, and (5) the general public. Realizing the benefits of coordinated, comprehensive, and sustained Earth observations (i.e. the improvement of decision-making and prediction abilities)

## 1 Introduction

## 2 Benefits of Comprehensive, Coordinated and Sustained Earth Observations

represents a fundamental step toward addressing the challenges articulated in the declarations of the 2002 World Summit on Sustainable Development and fulfilling the Millennium Development Goals agreed at the Millennium Summit in 2000.

2.3 Full participation of developing country members will maximize their opportunities to derive real benefits in the above socio-economic areas. Such participation is supported as it enhances the capacity of the entire Earth Observation community to address global sustainable development challenges.

### 3 Key Earth Observation Areas

3.1 Coordinated and sustained global cooperation on Earth observations is well established in the crucial area of weather. The World Meteorological Organization's World Weather Watch demonstrates the value of international collaboration in this arena. Improvements in observation networks are still needed and will yield further success through improved accuracy in weather information and long-term prediction.

3.2 Cooperation is less advanced in the areas of land, water, climate, ice, and ocean observation. Nevertheless, some important work and guidance for future action has been developed in a number of areas, for example:

- (a) Natural hazard understanding through a range of international observing and early warning systems consistent with the International Strategy for Disaster Reduction (ISDR);
- (b) Climate understanding and research through the World Climate Research Program (WCRP), and climate monitoring consistent with the Global Climate Observing System (GCOS) in support of the Conference of Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC);
- (c) Ocean monitoring, modelling and forecasting through the Global Ocean Observing System (GOOS);
- (d) A range of observation themes addressed by the Integrated Global Observing Strategy Partnership (IGOS-P) including oceans; carbon; water cycle; solid earth processes, coastal zone (including coral reef); atmospheric chemistry; and land/biosphere.

3.3 In each of these areas, observation efforts to understand dynamic Earth processes have been identified and should be expanded to support action-oriented solutions in the areas of key socio-economic benefit.

### 4 Shortcomings of Current Observation Systems

4.1 Human knowledge of the Earth system, although advanced in certain areas, is far from complete. Current efforts to observe and understand the Earth system must progress from the separate observation systems and programs of today to coordinated, timely, quality, sustained, global information - developed in accordance with compatible standards - as a basis for future sound decisions and actions.

4.2 Many international organizations and programmes are working to sustain and improve the coordination of Earth observations. However, current efforts to capture Earth observation data are limited by (1) a lack of access to data and associated benefits especially in the developing World, (2) eroding technical infrastructure, (3) large spatial and temporal gaps in specific data sets, (4) inadequate data integration and interoperability, (5) uncertainty over continuity of observations, (6) inadequate

user involvement, (7) a lack of relevant processing systems to transform data into useful information, and (8) insufficient long-term data archiving.

**5.1** To achieve the many benefits of coordinated Earth observations and to move from principles to action, governments adopting this Framework Document set forth the primary components of a 10-Year Implementation Plan for establishing the Global Earth Observation System of Systems (GEOSS). GEOSS will be:

- *comprehensive*, by including observations and products gathered from all components required to serve the needs of participating members;
- *coordinated*, in terms of leveraging resources of individual contributing members to accomplish this system, whose total capacity is greater than the sum of its parts;
- *sustained*, by the collective and individual will and capacity of participating members.

**5.2** GEOSS will be a distributed system of systems, building step-by-step on current cooperation efforts among existing observing and processing systems within their mandates, while encouraging and accommodating new components. Participating members will determine ways and means of their participation in GEOSS. The 10-Year Implementation Plan for GEOSS will be based on the following considerations:

- (a) With the socio-economic benefits identified in Section 2 as the roadmap, the 10-Year Implementation Plan will identify, document, and prioritize actions to address user requirements for current and future Earth observations. This process will be based on appropriate dialogue and procedures, taking advantage of and building upon the experience of existing initiatives and infrastructures.
- (b) The architecture model will build incrementally on existing systems to create a distributed system of systems, incorporating an observation component, a data processing and archiving component, and a data exchange and dissemination component.
- (c) The 10-Year Implementation Plan will elucidate practical methods for filling critical gaps in, *inter alia*, observation parameters, geographical areas, observation specifications, and accessibility.

**5.3** The GEOSS will address key challenges of data utilization, including the need for:

- Full and open exchange of observations with minimum time delay and minimum costs, recognizing relevant international instruments and national policies and legislation;
- Assured data utility and usability (including thresholds for validation, calibration, and spatial and temporal resolution);
- Assured continuity and availability of the many observations and products in place or planned;
- A robust regulatory framework for Earth observations (e.g. through protection of radio frequency bands that are uniquely essential for Earth observations).

**5.4** The plan will facilitate both current and new capacity building efforts, particularly in developing countries, across the entire continuum of GEOSS activities,

## 5 What is Needed: The 10-Year Implementation Plan for Earth Observations (2005-2014)

which will include education, training, institutional networks, communication, and outreach as fundamental to those efforts. Building on existing local, national, regional, and global capacity building initiatives, GEOSS will:

- (a) Focus on training and education for the development and/or utilization of existing human, institutional, and technical capacities for data utilization;
- (b) Develop the infrastructure resources necessary to meet research and operational requirements;
- (c) Build on globally accepted sustainable development principles – most notably those outlined in the World Summit on Sustainable Development Plan of Implementation.

**5.5** The development of GEOSS should take maximum advantage of developments in research and technologies. Conversely it will enable the global scientific community to address key scientific questions concerning the functioning of the Earth system.

## 6 Outcomes

**6.1** The success of the 10-Year Implementation Plan will be measured by the operational achievement of GEOSS. Specific outcomes for GEOSS, both short and long-term, will be elaborated in the 10-Year Implementation Plan, including but not limited to the following:

- (a) Enabling global, multi-system information capabilities for each of the following:
  - disaster reduction, including response and recovery;
  - integrated water resource management;
  - ocean monitoring and marine resources management;
  - air quality monitoring and forecasting;
  - biodiversity conservation;
  - sustainable land use and management.
- (b) Global tracking of invasive species.
- (c) Comprehensive monitoring of global and regional climate on annual, decadal, and longer time scales, and enabling information products related to climate variability and change.
- (d) Improving the coverage, quality, and availability of essential information from the *in situ* networks and improving the integration of *in situ* and satellite data.
- (e) Involvement of users from developed and developing countries, monitoring their needs and fulfillment over time.
- (f) An outreach mechanism to actively demonstrate the usefulness of Earth observation to decision makers in key user communities.

## 7 The Way Forward

**7.1** The adoption of this Framework Document indicates a decision to proceed with the elaboration of the GEOSS 10-Year Implementation Plan along the lines set forth in this Document and a willingness to cooperate on, and participate in, the implementation of the plan. At present, the *ad hoc* Group on Earth Observations (GEO) is a “best efforts” activity with voluntary input from States and advice and support from international organizations.

**7.2** For 2005 and beyond, the implementation of the “10-Year Implementation Plan” will require a ministerial-guided successor mechanism with maximum flexibility - a single intergovernmental group for Earth observations drawing on the experience of the *ad hoc* GEO, with membership open to all interested governments and the European Commission, and with representatives of relevant international organizations taking part.

**7.3** The GEOSS 10-Year Implementation Plan will elaborate details for this Group, which will provide generally for:

- (a) Coordination and planning of GEOSS implementation (*in situ* and remotely sensed).
- (b) Opportunities for engagement of all members and relevant international and regional organizations.
- (c) Involvement of user communities.
- (d) Measuring, monitoring, and facilitating openness of GEOSS to improve cross-flow of observations and products.
- (e) Co-ordination and facilitation of the development and exchange of observations and products between members and relevant international and regional organizations.



We, the participants in this Earth Observation Summit held in Washington, DC, on July 31, 2003:

## Declaration of the First Earth Observation Summit

Recalling the World Summit on Sustainable Development held in Johannesburg that called for strengthened cooperation and coordination among global observing systems and research programmes for integrated global observations;

Recalling also the outcome of the G-8 Summit held in Evian that called for strengthened international cooperation on global observation of the environment;

Noting the vital importance of the mission of organizations engaged in Earth Observation activities and their contribution to national, regional and global needs;

Affirm the need for timely, quality, long-term, global information as a basis for sound decision making. In order to monitor continuously the state of the Earth, to increase understanding of dynamic Earth processes, to enhance prediction of the Earth system, and to further implement our environmental treaty obligations, we recognize the need to support:

- (1) Improved coordination of strategies and systems for observations of the Earth and identification of measures to minimize data gaps, with a view to moving toward a comprehensive, coordinated, and sustained Earth Observation system or systems;
- (2) A coordinated effort to involve and assist developing countries in improving and sustaining their contributions to observing systems, as well as their access to and effective utilization of observations, data and products, and the related technologies by addressing capacity-building needs related to Earth observations;
- (3) The exchange of observations recorded from *in situ*, aircraft, and satellite networks, dedicated to the purposes of this Declaration, in a full and open manner with minimum time delay and minimum cost, recognizing relevant international instruments and national policies and legislation; and
- (4) Preparation of a 10-year Implementation Plan, building on existing systems and initiatives, with the Framework being available by the Tokyo ministerial conference on Earth observations to be held during the second quarter of 2004, and the Plan being available by the ministerial conference to be hosted by the European Union during the fourth quarter of 2004.

To effect these objectives, we establish an *ad hoc* Group on Earth Observations and commission the group to proceed, taking into account the existing activities aimed at developing a global observing strategy in addressing the above. We invite other governments to join us in this initiative. We also invite the governing bodies of international and regional organizations sponsoring existing Earth observing systems to endorse and support our action, and to facilitate participation of their experts in implementing this Declaration.

*(Adopted in Washington, DC on 31 July 2003)*

