Recognising the need to improve our understanding of the Earth system and enhance our ability for informed decision making for the benefit of our planet and the sustainability of our societies, over 130 governments and leading international organisations are participating in the Group on Earth Observations, or GEO, to coordinate the construction of a Global Earth Observation System of Systems (GEOSS) by the year 2015.

This series of brochures provides a snapshot of the process developed by the GEO to build the GEOSS taking advantage of the international framework of cooperation and of the common vision to share and integrate information with a view to serving nine Societal Benefit Areas.

Examples of contributions from European and the European Commission-funded projects benefiting to the specific societal area or to the GEOSS building blocks are presented in each thematic brochure:

- GEOSS for Disasters
- GEOSS for Health
- GEOSS for Energy
- GEOSS for Climate
- GEOSS for Water
- GEOSS for Weather
- GEOSS for Ecosystems
- GEOSS for Agriculture
- GEOSS for Biodiversity

Architecture and Data Management within GEO
Capacity Building within GEO
Science and Technology within GEO
User Engagement within GEO

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GEOSS - A GLOBAL EARTH OBSERVATION SYSTEM OF SYSTEMS

The Group on Earth Observations (GEO) is coordinating efforts to build a Global Earth Observation System of Systems (GEOSS). GEO was established in February 2005 by the Third Earth Observation Summit in Brussels in response to calls for action by the 2002 World Summit on Sustainable Development and the Group of Eight (G8) leading industrialised countries. GEO is a voluntary partnership of governments and international organisations. It provides a framework within which these partners can develop new projects and coordinate their strategies and investments. www.earthobservations.org.

GEOSS will simultaneously address nine Societal Benefit Areas (SBA) of critical importance to people and society. It aims to empower the international community to protect itself against natural and human-induced disasters, understand the environmental sources of health hazards, manage energy resources, respond to climate change and its impacts, safeguard water resources, improve weather forecasts, manage ecosystems, promote sustainable agriculture and conserve biodiversity. GEOSS coordinates a multitude of complex and interrelated issues simultaneously.

This cross-cutting approach avoids unnecessary duplication, encourages synergies between systems and ensures substantial economic, societal and environmental benefits.

Many efforts are oriented towards solving the standardisation of data and interoperability issues within GEO.

GEO is also building on its Data Sharing Principles (DSP) agreed by its members to develop a consistent data sharing implementation plan at international level.

The vision for GEOSS is to realise a future wherein decisions and actions for the benefit of humankind are informed by coordinated, comprehensive and sustained Earth observations and information. GEOSS will work with and build upon existing national, regional, and global systems to provide comprehensive, coordinated Earth observations from thousands of instruments worldwide and to transform the data they collect into vital information for society.
**Target 2015**

The GEOSS Strategic Target for Architecture is the following:

Before 2015, GEO aims to:

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 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.

The GEOSS Strategic Target for Data management is the following:

Before 2015, GEO aims to:

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 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.

**ARCHITECTURE & DATA MANAGEMENT WITHIN GEO**

**GEO Work Programme relating to Architecture & Data management**

Under the current GEO Work-Plan 2009-2011, the Architecture issue is addressed in different tasks:

**AR-09-01** GEOSS Common Infrastructure (GCI)

Address the core architectural principles in GEOSS as a function of user needs. Provide useful guidelines and tools to GEO Members and Participating Organisations in the establishment and operation of GEOSS.

**AR-09-02** Interoperable Systems for GEOSS

Address the various interoperability aspects of contributing systems, including observing, modelling and information systems.

**AR-09-03** Advocating for Sustained Observing Systems

Establish actions for the maintenance and expansion of GEOSS-underpinning observing systems, including atmospheric, terrestrial, oceanic, both in-situ and space-based. Promote stable, reliable and long-term operations of Earth observing networks within the framework of national policies and international obligations.

**AR-09-04** Dissemination and Distribution Networks

Develop and foster synergies between diverse communication networks established to distribute and disseminate GEOSS data, information and products.

**AR-06-11** Radio Frequency Protection

Recognising the fundamental importance of radio-frequencies necessary for all GEOSS components, in particular in-situ, ground- and space-based observations, as well as the increasing economical and political pressure on corresponding parts of the spectrum, undertake appropriate coordinated advocacy activities in association with Member countries, including representations to the International Telecommunication Union (ITU) and other bodies in charge of frequency management.

Under the current GEO Work-Plan 2009-2011, the Data management issue is addressed in different tasks:

**DA-06-01** GEOSS Data Sharing Principles

Identify steps required to further the practical application of the agreed GEOSS Data Sharing Principles: [1] There will be full and open exchange of data, metadata, and products shared within GEOSS, recognising relevant international instruments and national policies and legislation; [2] All shared data, metadata, and products will be made available with minimum time delay and at minimum cost; [3] All shared data, metadata, and products being free of charge or no more than cost of reproduction will be encouraged for research and education.

**DA-09-01** Data Management

Identify and implement recommendations for best practices of Earth Observation data and information life-cycle management. Improve data discovery, availability, near real-time access and traceability including data tagging for citation tracking.

**DA-09-02** Data Integration and Analysis

Coordinate data management approaches for data modelling and information products. Enable users to (i) more effectively define processes to efficiently generate information products through modelling and analyses and (ii) utilise large volumes of data from heterogeneous data sources.

**DA-09-03** Global Data Sets

Provide a suite of global datasets based on improved and validated data sources. Initiate regular analysis and reporting. Facilitate interoperability among data sets using the framework, structure and methodologies of the GEO Architecture. Register the global data sets in the GEOSS registries and where new approaches are developed, contribute new best practices and interoperability arrangements to the GEOSS registries.
Examples of the European Projects and national initiatives

The GEOSS Common Infrastructure provides clearinghouses and portals that allow discovery and visualisation of data in an integrated way. GeoViQua will extend the GEOSS Common Infrastructure by adding well-defined data quality indicators and quality-enabled search and visualisation tools. GeoViQua components will be implemented so they can be accessed based on existing geo-portal standards and in the mass market “Google-like” map tools and other 3D viewers, as well as on mobile devices. The design and development of GeoViQua components will be undertaken in collaboration with the relevant GEO committees, the Open Geospatial Consortium Architecture Implementation Pilots and other relevant standards committees. (www.geoviqua.org).

The EuroGEOSS project, a European approach to GEOSS, is building a multidisciplinary operating capability for a European Environmental Earth Observation System in the three strategic areas of biodiversity, forestry and drought. It demonstrates the added value to the scientific community and society of making existing systems and applications interoperable and used within the GEOSS and INSPIRE frameworks. A key result will be an increased capacity for scientists from different disciplines to work together, sharing data, models and processes to develop better understanding and predictions of environmental phenomena and social impacts. (www.eurogeoss.eu).

The Genesis project aims at providing those involved in environment management and health services in Europe with an efficient, web-based solution for monitoring air quality, fresh and coastal water quality and their impacts on health. The advanced, ICT-based solution that will result from this research and development will combine open, collaborative information networks while integrating systems which already exist in Europe. This simple yet innovative objective is in keeping with the goals set out in the EU 2010 Lisbon Agenda for Europe to become the most dynamic world economy. The initiative not only promotes an open and competitive digital economy, but also sets out to improve the quality of life in Europe. (www.genesi-fp7.eu).
The GIGAS project (Geoss, Inspire and Gmes an Action in Support) promotes the coherent and interoperable development of the GMES, INSPIRE and GEOSS initiatives through their concerted adoption of standards, protocols, and open architectures. Given the complexity and dynamics of each initiative and the large number of stakeholders involved, the key added value of GIGAS is bringing together the leading organisations in Europe able to make a difference and achieve a truly synergistic convergence of the initiatives. They include the Joint Research Centre as the technical coordinator of INSPIRE and the European Space Agency (responsible for the GMES space component). A third partner, is the Open Geospatial Consortium and together they play a leading role in the development of the GEOSS architecture and components. This core group is supported by key industrial players in the space and geographic information sectors under the scientific leadership of the Fraunhofer Institute (www.thegigasforum.eu).

Digital Earth is a visionary concept for the virtual representation of the Earth that is spatially referenced, interconnected with the world’s digital data repositories, and encompassing all its systems and forms, including Earth Sciences, Natural Resources Management, Environmental Monitoring system and human society dimensions. GENESI-DEC (Ground European Network for Earth Science Interoperations – Digital Earth Community) will establish open data and services access, allowing Digital Earth Communities to seamlessly access, produce and share data, information, products and knowledge. This will create a multi-dimensional, multi-temporal, and multi-layer information facility of huge value in addressing global challenges such as biodiversity, climate change, pollution and economic development. The project evolves and enlarges the platform developed by the predecessor GENESI-DR project by federating to and interoperating with existing infrastructures. GENESI-DEC will provide seamless and semantically enhanced discovery and access to scattered and heterogeneous data including satellite data, aircraft data, in-situ data, and model results. Furthermore, GENESI-DEC will provide access to computing resources and processing services for generating new products and extracting information starting from discovered data. (www.genesi-dec.eu).

The main focus of the Plan4all project is the harmonisation of spatial planning data in line with the INSPIRE Directive based on existing best practices in EU regions and municipalities and the results of current research projects. The expected results are European forums for SDI in spatial planning, a database of best practices and analysis of best practices in terms of organisation, sharing, harmonisation and SDI recommendations for spatial planning. The Plan4all project which was funded under the EC’s eContentplus initiative is focused on seven INSPIRE Spatial Data Themes from the INSPIRE Directive including Land cover, Land use, Utility and Governmental services, Production and industrial facilities, agricultural and aquaculture facilities, area management/ restriction/regulation zones and reporting units and natural risk zones. Created metadata profiles, data models and networking architecture based on the INSPIRE mechanisms for data sharing should enable the publishing of spatial planning data from our pilot regions on the Plan4all geoportal. The whole sector should profit from the availability of understandable and more transparent planning information across Europe. (http://portal.plan4all.eu).
Soil texture of the terrain units in the Central European window of e-SOTER.

The Chinese e-SOTER window area (Hainan Island) where urbanisation and soil loss are clearly visible.

The Morocco e-SOTER window area (Marrakech region) with salinisation in an olive plantation.

e-SOTER aims to contribute to a global soil observing system and to overcome technical barriers. In particular e-SOTER will enable (1) quantitative mapping of landforms; (2) soil parent material and soil attribute characterisation and pattern recognition using satellite images and sensors; (3) standardisation of methods and measures of soil attributes and conversion of data collected by earlier surveys. Two major research outputs are the improvement of the existing Soil and Terrain (SOTER) methodology at scale 1:1 million; and the development of remote sensing applications within 1:250,000-scale pilot areas.

e-SOTER will create a web service to deliver soil information that can be used directly by policy makers and managers; the web service will also publish the methods and techniques that have been used. (www.esoter.net).

The Black Sea hydrological catchment is a case study to test the capacity of integrating large datasets to assess vulnerability and sustainability issues related to freshwater resources at various scales. The Black Sea region is internationally known for its ecologically unsustainable development and inadequate resource management which have led to several environmental, social and economic problems. EnviroGRIDS aims to assemble an observation system of the Black Sea catchment that will address several GEO Societal Benefit Areas. This system will incorporate a shared information system that operates on the boundary of scientific/technical partners, stakeholders and the public. It will contain an early warning system able to inform decision-makers and the public about risks to human health, biodiversity and ecosystem integrity, agriculture production or energy supply caused by climatic, demographic and land cover changes with a 50-year time horizon. (www.envirogrids.net).

OneGeology’s aim is to create dynamic digital geological map data for the world. Nations which have the capacity to serve digital geology are teaming up with nations which do not, but have geological data that they want to serve. This is reflected in the project’s 4 key aims, one of which is to “transfer know-how to those who need it, adopting an approach that recognises that different nations have differing abilities to participate”. Training has been provided and is being offered to others. There is a great deal of documentation and online help available (the cookbooks). Outreach is central to the project. There are as of August 2010, 116 countries participating in OneGeology, more than 40 of which are serving data using a web map portal and protocols, registries and technology to “harvest” and serve data from around the world.

OneGeology-Europe is a natural offshoot of the global OneGeology initiative while extending the use of technological standards to promote interoperability and harmonisation specifically for the European realm. It consists of a consortium of European geological surveys and representatives from the user community. (http://www.onegeology.org/) (http://www.onegeology-europe.org/).
GIIDA is a CNR (Italian National Research Council) initiative aiming at designing and developing a multidisciplinary infrastructure for the management, processing and evaluation of Earth and environmental data. The project’s mission is to implement the Spatial Information Infrastructure (SII) of CNR for Environmental and Earth Observation data. It collaborates closely with European FP7 projects and contributes to the GEOSS. (www.dta.cnr.it/content/view/2735/2735/lang,en/).

The African-European Georesource Observation System (AEGOS) will be capable of hosting and providing access to Africa’s underground natural resources information, including mineral resources, building materials, groundwater and geothermal energy. It will strengthen the capacity of African countries to promote and develop the use of its valuable georesources in an environment-friendly and sustainable manner with a view to meeting the Millennium Development Goals. AEGOS is the pan-African spatial data infrastructure of public, interoperable geology-related data as well as user-oriented products and services. This observation system will provide support to a wide range of end-users: policy-makers at all geographic levels, development agencies, private sector actors, educational and research geoscientific communities as well as civil society. (www.aegos-project.org).

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