COPERNICUS
(formerly GEOSS)

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Introduction: responding to global challenges

Scientific understanding of the Earth system and its physical, chemical and biological components continues to improve every year. But *more data is urgently needed for monitoring trends and predicting* how physical and ecological systems will evolve.

As humanity places ever greater demands on the Earth's resources over the coming years and decades, a greater ability to understand global change and predict how natural systems will respond to human activities and policies becomes ever more vital.

Recognizing the need for better environmental information, political leaders at the 2002 World Summit on Sustainable Development in Johannesburg called for urgent action on Earth observation.

Earth observation summits in Washington, Tokyo and Brussels and declarations by three of the annual Group of Eight (G8) summits built on this momentum.

Acting on a clear international consensus, Ministers established GEO in 2005 with a mandate to build a Global Earth Observation System of Systems, or GEOSS.

The cross-cutting data, decision-support products and end-to-end information services

that are increasingly available through GEOSS are improving the ability of governments to promote "green" economic growth, manage natural ecosystems and resources, ensure food security for a global population that may reach nine billion people by mid-century,

respond more effectively to disasters, and address climate change, biodiversity loss and other global challenges.

GEOSS
10-Year Implementation Plan

Agriculture.

Over the past three years, the Global Agriculture Monitoring Community of Practice has attempt to establish a **Global Agricultural Monitoring System of Systems.**

The GEO Joint Experiment on Crop Assessment and Monitoring (JECAM) has established seven pilot sites around the world to assess common data standards, cropland modeling methods, and future Earth observation requirements.

The Societal Applications in Fisheries & Aquaculture using Remotely Sensed Imagery (SAFARI) project has identified and promoted urgent actions to strengthen the application of satellite information to fisheries and aquaculture research and management.

Other information Products based on GeoBon:

visualization tool for African protected areas and a number of directories of global datasets on freshwater biodiversity and ecosystems.

GEO BON's role and importance have been recognized by the Convention on Biological Diversity, which has also requested that it prepare an evaluation of existing observation capabilities relevant to the targets contained in the Convention's Strategic Plan for 2011-2020.

Biodiversity.

Established in 2007, **the GEO Biodiversity Observation Network (GEO BON)** consists of dozens of government agencies and intergovernmental and international organizations.

Based on a regularly updated implementation plan, GEO BON coordinates the gathering of data and the delivery of information. One of
the first products was the Continuous Plankton Recorder Survey.

Climate.

The GEO Global Carbon Observation and Analysis System is now bringing together systems and experts that monitor carbon flows on land, in the oceans and in the atmosphere.

Particular progress has been made on establishing a Forest Carbon Tracking system, which has established at least 10 national or regional “demonstrators” with support from a coalition of governments and institutions.

Other important progress includes continued outputs by major data-reanalysis projects based in Europe, Japan and the USA; reinvigoration of efforts to reprocess various data, especially from space, into climate data records;

The 2010 update of the Global Climate Observation System (GCOS) Implementation Plan; the World Climate Research Programme's (WCRP) launch of two major modeling experiments (CMIP5 and CORDEX) to provide decade- and century-long climate predictions on global and regional scales; outputs from an intensive research programme to improve seasonal prediction worldwide; and the invigoration of the ClimDev Africa project with a $30 million grant from the African Development Bank.

Disasters.

A number of operational systems for supporting disaster response have made steady to strong progress. Collaborative ‘***’Supersites”*** have been established so that the scientific community can monitor and analyze volcanoes and earthquakes more rapidly and effectively; for example, Supersites have improved assessments of recent earthquakes in Haiti, China and Chile. SERVIR provides mapping and for disaster response and has assisted countries in Central America and the Caribbean to respond to hurricanes, earthquakes and other extreme events;

SERVIR is now in the process of expanding its support to other regions, notably Africa and the Himalayas.

Other advances include the development and contribution to GEOSS of global, regional and national early-warning and detection systems for forest fires;

improved access for GEO Members to the International Charter on Space and Major Disasters and the satellite data it provides for countries of South East Asia and Latin America and, soon, Africa; and ongoing observations and reports on floods, landslides and other disasters by Sentinel Asia.

Showcase: Better knowledge about geohazards

The Geohazard Supersites initiative is a global scientific collaboration that aims to improve scientific understanding of the risks of earthquakes and volcanic events in selected regions. The Supersites currently being addressed are L'Aquila, Chile, Etna, Haiti, Istanbul, Los Angeles, Naples (Vesuvius), Seattle/Vancouver and Tokyo.

The geohazard community is also working on establishing an earthquake Supersite for the disastrous 2008 earthquake in Wenchuan, China, to better understand China's worst disaster in the last 30 years.

The Supersites partnership consists of the providers of ground-based geophysical data, such as seismic and GPS data; space agencies, which provide satellite radar and other Earth observation data; along with scientists and decision makers who use and analyze these data.

The initiative provides a cyber-infrastructure platform with a single web entry point that allows fast, easy and free-of-charge access to a complete satellite and ground-based geophysical data set derived from diverse sources and geophysical disciplines.

The Supersites complement the International Charter on Space and Major Disasters, which provides imagery for search and rescue operations.

Ecosystems

- **Ecosystems. GEO has made important progress on developing a standardized, robust and practical classifica- 19**
- tion and map of global ecosystems for terrestrial, marine, and freshwater environments. Ecosystem maps for
- South America, the US and Sub-Saharan Africa have been completed and are available as a framework for
- both researchers and managers. Global tree cover maps at 250m resolution are under development, and nearly
- 14,000 Landsat samples from 1990, 2000, and 2005 are being analyzed to detect changes in forested area
- for the benefit of forest resource managers. Other ecosystem mapping projects continue to advance, such as
- one on ecosystem vulnerability to climate change, which includes the vulnerability of sea basins (notably the
- EnviroGRIDS project on the Black Sea) and of mountain regions.

Energy

- A number of data bases providing information on solar resources have been developed, including
- the European Solar Radiation Atlas, SoDa and Envisolar; efforts are ongoing to make these data bases fully
- comparable. A service for siting solar power plants has been established to provide data on time-averaged values
- of solar irradiance from which basic economic assessments can be made; in particular, the service supports the
- site selection process for large solar energy systems such as photovoltaic installations placed on open land. The
- EnerGEO project is using satellite data and environment and energy models to make a global assessment of
- the current and future impact of the exploitation of energy resources on the environment and on ecosystems.
- Other energy initiatives, such as those for wind power and carbon-capture-and-storage, have been launched.

Health

- Working through local, regional, and international partners, the GEO community is developing a
- portfolio of services to help decision-makers use Earth observation data and information to prevent diseases
- and improve public health. Some of these services involve supporting a meningitis vaccination and control
- effort in Africa (MERIT) by linking forecasts of an extended dry season in the Sahel with disease outbreaks;
- monitoring global atmospheric mercury to establish a forecasting and alert system on health problems related
- to mercury; providing air-quality forecasts using on-the-ground monitoring stations, currently for 300 US cities,
- Shanghai (China), and soon for other cities; and using open-source software and space imagery to track
- potential outbreaks of epidemics.

Water

- GEO has advanced the integration of observations from satellites and in-situ instruments, strengthened
- collaboration within and between the water research and management communities, and promoted capacity
- building. The Asian Water Cycle Initiative has boosted regional cooperation on water monitoring, and the
- model is now being extended to Africa. The Latin American & Caribbean Community has launched a capacity
- building program to demonstrate the value of Earth observations in water resource management and to
- develop tools for applying remote sensing data. The North American Drought Monitor has generated improved
- regional drought assessments. The United States and Canada have inaugurated pilot drought monitoring test
- bed projects as a first step towards a Global Drought Early Warning System. The TIGER program is realizing
- improvements in the use of Earth observation data for water-resources management in Africa. The Coordinated
- Energy and water cycle Observations Project has improved access to integrated observational and model data
- through 50 reference sites around the world.

Weather

- Weather monitoring and forecasting, which is traditionally the most mature sector for operational
- information based on Earth observations, continues to make important advances under the leadership of WMO.
- Collaboration through GEO has focused on improving the prediction of severe weather conditions. In particular,
- the THORPEX Interactive Grand Global Ensemble, or TIGGE, has advanced its goals of improving the accuracy
- of high-impact weather prediction. Based on ensembles containing more than 100 model outputs, TIGGE
- aims to make predictions available to decision makers in user-friendly formats with minimum time delay. The
- next step is to develop a common toolbox that can be used to develop probabilistic tropical-cyclone warning
- services, extreme-precipitation forecasts and other products.

Critical next steps for seeing GEOSS through to the end of the GEOSS 10-Year Implementation Plan for2005 – 2015 and beyond are:

- **Continue to engage policymakers and managers in using and guiding GEOSS. The true value**
- of GEOSS is its ability to support decision-making. As a key user group, senior policymakers can help to
- ensure that GEOSS addresses the UN's Millennium Development Goals and other priority issues facing
- the global community.

- **Ensure that environmental experts come to consider GEOSS and its Common Infrastructure**
- **as a unique and essential tool for accessing Earth observations. Strong, high-level support from**
- governments and leading organizations is vital for maintaining the momentum generated by GEO and
- ensuring that GEOSS becomes recognized as a vital infrastructure that serves the global public good.
- Building the capacity of users to exploit GEOSS is also essential.

- **Develop a longer term strategy for sustaining GEOSS by attracting resources from public and**
- **private sources, supporting capacity-building, strengthening national Earth observation programs,**
- maintaining the GEOSS shared architectural and information infrastructure components, and nurturing
- the collective spirit.

- **Establish a governance structure for the post-2015 period. Early guidance in Beijing will help to**
- ensure a smooth transition to a longer-term approach to global cooperation on Earth observation.

Operational View

How users access GEOSS data and information via the GEO Portal

- The “GEOSS Common Infrastructure” consists of a dedicated web portal, a clearinghouse for
- searching data, information and services, and a registry containing information about GEOSS. It
- provides a “one-stop shopping” portal to help the users of Earth observations access and search
- for information more easily. After almost two years of development, in July of this year the GEO
- community formalized the arrangements by which leading institutions will operate and sustain
- the GEO Portal and its underlying clearinghouse and registry.

Making the System of Systems interoperable

- **The observing, modelling and other systems that contribute to GEOSS must be interoperable so that the data and information they generate can be used effectively. The Committee on Earth Observation Satellites is promoting interoperability through the Virtual Constellations concept.**

- **Another initiative seeks to integrate via the Sensor Web approach, while yet another aims to facilitate model interoperability and access via the Model Web concept. The World Meteorological Organization Information System (WIS) uses interoperability standards that are also specified in the GEOSS 10-Year Implementation Plan; this enables GEOSS and WIS to leverage each other's components to their mutual benefit.**

Advocating for sustained global observing systems

- To achieve its goal of providing integrated information on the entire Earth system, GEOSS depends
- on the health and vitality of major global observing systems. For this reason, GEO actively advocates
- for sustaining major observing systems for climate, oceans, land, weather and polar regions.

- Four major UN-sponsored global observing systems provide a critical underpinning for GEOSS. They are the:

- Global Climate Observing System (GCOS), the Global Ocean Observing System (GOOS), the Global Terrestrial
- Observing System (GTOS) and the WMO Global Observing System (GOS). Their work is complemented by
- the International Polar Year 2007-2008 (IPY) legacy project, with a focus on the cryosphere,
- and the Global Geodetic Observing System (GGOS). Strengthening the linkages amongst these systems and raising their overall visibility will support the efforts of researchers and decision makers in all nine of the GEOSS societal benefit areas.

Establishing the GEONETCast Global Data Dissemination System

- Reliable access to environmental data is critical for decision making. GEONETCast assures this
- access by broadcasting data from dozens of leading data providers to decision makers around the
- world. The data are transmitted via advanced communications satellites to thousands of low-cost,
- off-the-shelf receivers. GEONETCast also provides dedicated training and alert channels for capacity
- building and risk reduction, particularly in developing countries.

Protecting radio frequencies for Earth observations

- Growing demand on radio spectrum by telecommunications, the automotive industry and other
- users of radio frequencies has raised the specter of competition over limited bandwidth. GEO
- members are therefore continuously working through national and international bodies in charge
- of frequency management to ensure the long-term availability of frequencies for terrestrial, oceanic,
- air-borne and space-based observations. This is absolutely vital to the success of GEOSS.

Implementing the GEOSS Data Sharing Principles

- **Recognizing the importance that full and open access to data has for the success of GEOSS, the GEOSS 10-year Implementation Plan established a visionary set of Data Sharing Principles. These**
- **Principles aim to ensure that the data and information developed and disseminated through GEOSS**
- **yield significant benefits for a broad range of users around the world. Over the past five years,**
- **substantial progress has been made, not only in reaching a consensus on how best to implement**
- **the Data Sharing Principles, but also in demonstrating how full and open data sharing can help**
- **the GEO community to achieve its goals in the nine societal benefit areas.**

From observations to information products and services

- Observation data provide great value, but combining data from different sources and then
- analyzing and modelling them can greatly enhance their usefulness for decision making. GEO has
- made significant progress in bringing together many diverse datasets and engaging scientific and
- technical experts to generate this added value. Continuing progress will require more and more
- agencies and organizations to work together to adopt common standards for integrating and
- analyzing all types of data.

Promoting “data democracy” around the world

- The term ‘data democracy’ was coined in 2008 by the South African Council for Scientific and
- Industrial Research (CSIR) as the title of a special project during its year as Chair of the Committee on
- Earth Observation Satellites (CEOS). It has since become a mantra among research and development
- communities in the Earth observation domain. In 2009, Data Democracy was approved as a new
- GEO Task in the framework of GEO’s work on capacity building, infrastructure development and
- technology transfer.

- The data democracy theme calls for:
- • Unhindered access to Earth observation information;
- • Reliance on Open Source Software and open systems;
- • Recognition of the realities of bandwidth limitations in many developing countries; and
- • Promotion of locally initiated cross-border collaborative projects and intensive capacity building and
- training programs.

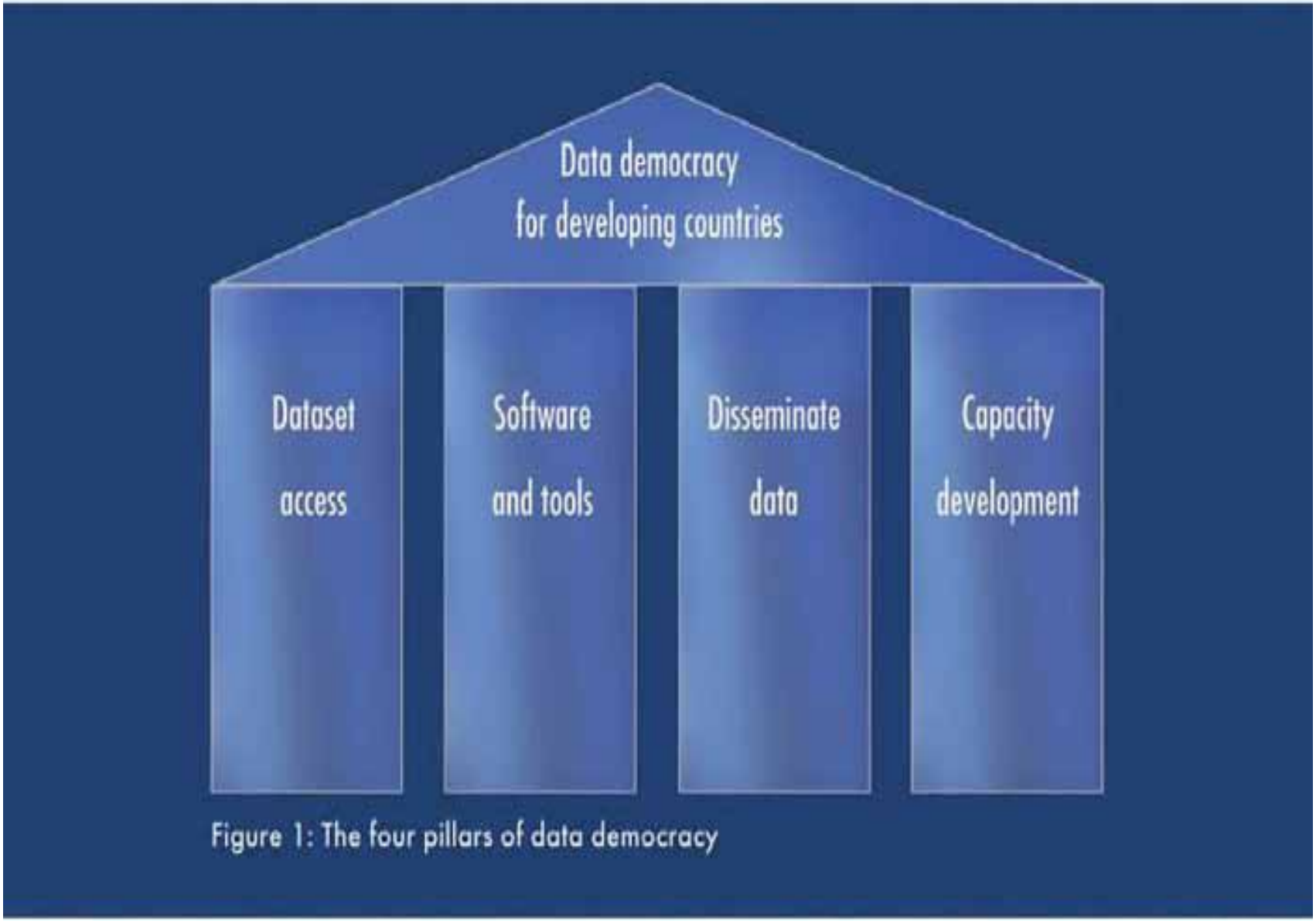

Figure 1: The four pillars of data democracy