



GROUP ON  
EARTH OBSERVATIONS



# The First 100 Steps to GEOSS

Annex of Early Achievements to the Report on Progress 2007  
Cape Town Ministerial Summit

---

Earth Observations for Sustainable Growth and Development

30 November 2007

## Acknowledgements

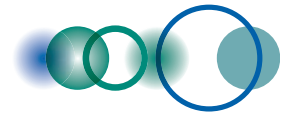
On behalf of the Group on Earth Observations, we would like to thank all the members of Task Force 2 as well as the many scientists and technical experts who contributed to the development of this document.

We are particularly grateful to David Grimes and Pontsho Maruping, the two co-chairs of Task Force 2, and to Kenneth Korporal, Michael Manore, Douglas Muchoney and Giovanni Rum, who coordinated the preparation of this document.

Jose Achache, GEO Secretariat Director

Published by:	GEO Secretariat, 7 bis, avenue de la Paix, CH 1211 Geneva 2, Switzerland
Editor:	The GEO Secretariat
Design and Layout:	Paf Munication
Copyright:	This document is in the public domain and may be reproduced without permission
ISBN:	978-92-990047-2-2

Printed in South Africa



## Preamble

Since its establishment two years ago, GEO Members and Participating Organizations have already taken essential and significant steps toward realizing the 10-year GEOSS implementation goal and have achieved early successes in many areas.

The activities and initiatives of the First 100 Steps to GEOSS, presented in this **Annex of Early Achievements to the GEO Report on Progress**, are examples of specific achievements and contributions of GEO Members and Participating Organizations and link their outputs to concrete benefits to society and to the progressive implementation of GEOSS.

## Section I: Introduction

Over the last two years GEO has been a catalyst for the development and implementation of numerous Earth observation systems, programmes and activities, for the integration and dissemination of data and information and for the development of applications and services in all Societal Benefit Areas (SBAs).

These GEO inspired activities have led to the progressive implementation of GEOSS. (Figure 1) The underlying technical and programmatic architecture of GEOSS was developed to enable users to locate, access, and share key data, information and applications through GEOSS components including the GEOPortal and the GEONETCast Systems.

## THE Global Earth Observation System of Systems



Figure 1 – The vision for GEOSS

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

GEO has also been a catalyst for the development of a number of partnerships at global and regional levels, for the creation of several 'Communities of Practice' and for the development of several applications relevant to all SBAs.

The current early achievements clearly show that:

- The majority of achievements reflect the *global* application of GEOSS components.
- Most achievements incorporate GEOSS *transverse* components including those developed by GEO committees on architecture and data, user needs, capacity building and science and technology.
- The majority of applications are *cross-cutting* with relevance to more than one SBA.
- There is a balanced progress of GEOSS development and applications in all the SBAs.
- GEOSS development is both geographically and SBA balanced.

#### **GEOSS Transverse Components**

- User Engagement
- Architecture
- Data Management
- Capacity Building
- Outreach

The progressive implementation of GEOSS includes developments initiated at national, regional and global scales. These initiatives provide improved access to GEOSS data and information for decision makers and front-line users.

## Section II: Presentation of the Early Achievements

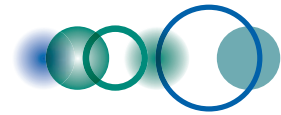
These *First 100 Steps to GEOSS* Early Achievements are contributions from GEO Members and Participating Organizations. Below is the format of each contribution:

- **Title:** Title of the achievement(s)
- **Brief description:** Objectives, methods, data, results, impact
- **Added value:** How will GEO help with this project, how will it impact GEOSS? How will it be impacted by GEO? What is the GEO added-value?
- **Relevance to GEO:** Relevance to SBAs or Transverse Components; socio-economic value; contribution to the GEO 10-Year Implementation Plan; GEO Work Plan reference (SBA, task, target)
- **Participants:** List of GEO Members and Participating Organizations involved
- **Current status and next steps:** Long term sustainability; identified gaps

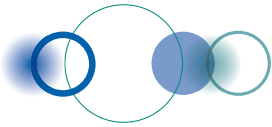
## Section III: GEO Early Achievements

Early Achievements are grouped according to their relevance in addressing a GEOSS Transverse Component or a particular SBA. When more than one SBA is addressed, the Early Achievement is associated to the primary SBA. They are presented in alphabetic order.





## List of Early Achievements



### **GEOSS Transverse Components**

- 1 APN Scoping Workshops on Global Earth Observations and Capacity Building Needs in Asia
- 2 Building GEOSS with modern Information and Communication Technologies: Contribution from FP7 & FP6 Community Research in Europe
- 3 ARGO
- 4 CBERS Data for Africa
- 5 Establishment of a U.S. National Land Imaging Program
- 6 GEO-BENE
- 7 GEO Web Portal and GEOSS Clearinghouse – Services demonstrated through the Architecture Implementation Pilot
- 8 GEO Grid
- 9 GEONETCast
- 10 GEOSS Guidance Documents
- 11 GEOSS Standards and Interoperability Forum (SIF)
- 12 GEOSS Standards and Interoperability Registry
- 13 GEOSS Interoperability Process Pilot Project
- 14 Global Geodetic Reference Frame
- 15 GMES
- 16 High Resolution Sea Surface Temperature
- 17 Implementation of the Center for Satellite Based Crisis Information
- 18 Interoperability - Expediting access to GEOSS components and services
- 19 Improved global land cover observations and assessment
- 20 INSPIRE
- 21 Introducing GEO Earth observation research activities in the 7<sup>th</sup> framework programme of community research
- 22 KMA Workshop on NWP Capacity Building
- 23 Multi-year GEO Global Workshop Series for GEOSS Users
- 24 NPOESS-GCOM cooperation
- 25 Space-based Data Quality Assurance Framework
- 26 SERVIR
- 27 SIASGE
- 28 Standards-based, All-Hazards, All-Media Public Warning
- 29 TerraSAR-X – a new system in the System of Systems
- 30 The ICARE and ETHER Thematic centers in France
- 31 The Global Space-based Intercalibration System (GSICS)
- 32 The Socio-economic and Environmental Benefits of a Revolution in Weather, Climate and the Earth-system Prediction
- 33 Virtual Satellite Constellations
- 34 Global Digital Elevation Model



## Disasters

- 35 GEO Coastal Zone Community of Practice (CZCP)
- 36 Global Wildland Fire Early Warning System
- 37 IFFI-Italian Landslides Inventory
- 38 IGOS-P Geohazards theme and Community of Practice
- 39 Improved use of Satellites for Risk Management
- 40 International Federation of Digital Seismograph Network:  
increased coverage and data availability for global earthquake monitoring
- 41 Sentinel Asia
- 42 The German Indonesian Tsunami Early-Warning System (GITEWS)
- 43 The Network of Centers of the Italian Civil Protection System



## Health

- 44 Air Quality and Health
- 45 European Space Agency GMES Service Element Project  
"PROtocol MOniToring for the GMES Service Element:  
Atmosphere (PROMOTE)"
- 46 Meningitis Warning System in Africa
- 47 Ozone-Web – Near Real Time Information on Ground Level Atmospheric  
Ozone Concentration for Europe
- 48 PREV'AIR : European air quality forecasting and mapping system
- 49 USGEO Program to Improve Air Quality Forecasts and Decision Support  
for Respiratory Health



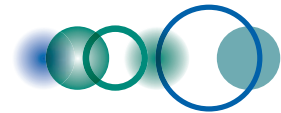
## Energy

- 50 Bioenergy resource assessment
- 51 Energy Community of Practice
- 52 ENVISOLAR – Space based environmental information  
for solar energy industries
- 53 Solar Data for Developing Countries
- 54 Solar Energy Data – Survey of User's Requirements
- 55 Wind Energy data-Survey of User's Requirements



## Climate

- 56 Anthropogenic Climate Change Research
- 57 APEC Climate Center for Information Services (APCC)
- 58 ClimDevAfrica Initiative
- 59 EuroCryoClim - European contribution to a global cryospheric climate  
monitoring system
- 60 Global Monitoring of Greenhouse Gases
- 61 Global Precipitation Climatology Centre (GPCC)
- 62 Improving projections of sea-level rise and variability
- 63 Network for the Detection of Mesopause Change (NDMC)
- 64 Ocean Surface Topography
- 65 Ozone Depletion and Recovery and Climate Change
- 66 Parasol, Calipso and the A-Train
- 67 Seasonal Climate Prediction
- 68 The Cryosphere Observing System:  
Legacy of the International Polar Year 2007-2008
- 69 The GCOS Upper-Air Reference Network, GRUAN
- 70 State of the Climate– A GEO Achievement
- 71 World Climate Research Programme and Droughts



## Water

- 72 Asian Water Cycle Initiative (AWCI)
- 73 Canada's National Land and Water Information Service (NLWIS)  
– Drought watch
- 74 Global Runoff Data Centre (GRDC)
- 75 Hydrometeorological ARray for ISV-Monsoon AUtomonitoring (HARIMAU)
- 76 North American Drought Monitor
- 77 The WISE (Water Information System for Europe) viewer



## Weather

- 78 Ensembles of Global Weather Forecasts (TIGGE)
- 79 Megha-Tropiques, GPM and the Precipitation virtual constellation
- 80 Sand and Dust storm monitor
- 81 Weather Demonstration Project for the Beijing 2008 Olympic Games
- 82 YEOS Yellow Sea Observation, forecasting and information System



## Ecosystems

- 83 Arctic Observing Network
- 84 Census of Marine Life
- 85 Continuous Plankton Recorder survey
- 86 European Marine Services MERSEA
- 87 Evaluating African Protected Areas
- 88 Large-Marine Ecosystem Indicators of Global Change
- 89 Indian National Centre for Ocean Information – INCOIS
- 90 POSTEL Land Surface Thematic Center in France
- 91 PUMA and AMESD: promoting the use of Earth Observation  
for Sustainable development in Africa
- 92 Smithsonian Institution Global Earth Observatory Initiative (SIGEO)
- 93 South African Environmental Observation Network (SAEON)



## Agriculture

- 94 Canada's National Land and Water Information Service (NLWIS)  
– Land Information
- 95 Canada's National Land and Water Information Service (NLWIS)  
– Crop conditions
- 96 ChlorOGIN Building a Chlorophyll Ocean Global Integrated Network
- 97 Satellite Land Cover Mapping of Canada's Forests



## Biodiversity

- 98 Global Invasive Species Information Network Pilot System
- 99 Interoperability Process Pilot Project (IP3): Biodiversity/Climate Change
- 100 Towards a global biodiversity observation network

# APN Scoping Workshops on Global Earth Observations and the Capacity Building Needs of the Region: Focus – Climate

## Description

Asia-Pacific Network for Global Change Research conducted two scoping workshops on global earth observations, held from 17-18 Nov. 2005 in Tokyo and from 19-21 Mar. 2006 in Bangkok. The key objectives of the workshops were to consider the capacity building necessary for research and monitoring related to climate change and its impacts, to discuss the role of APN in such research and underpinning systematic observations, and to create road maps for designing ideas appropriate for capacity building activities in the region.

### Observational Data Requirements for Advancing the Understanding of Climate Change:

Many existing data are not accessible to researchers in Asia and the Pacific, either nationally or internationally. Resolution of this barrier requires promoting political commitment to data sharing, removing practical barriers by enhancing electronic interconnectivity and metadata, and data rescue and digitization. It was deemed important to have a systematic observation of sensitive and fragile systems as detection of early warning indicators and for demonstrating the evidence of global warming to national leaders and society. Several hotspots in the Asia-Pacific region for which conventional and in situ and remotely sensed observational data are required for advancing the current understanding of climate variability and climate change. These hotspots include the Himalayan glaciers, high elevation areas of the Tibetan plateau, Mongolian tundra, desertification trends in arid/semi-arid areas of West Asia.

### Capacity Building Needs on Vulnerability and Adaptation to Climate Change for Sustainable Development:

The limiting factors to the technical and scientific capacity in the region and where capacity building is needed include: inadequate user involvement; scarcity of scientists, technical infrastructure and funding; limited research experience; lack of familiarity with methods and models; and weak or lack of collaboration among scientists of multiple disciplines. Meanwhile, food and fiber, biodiversity, water resources, coastal ecosystems, human health and settlements, and land degradation were identified as the region-specific sectors that are most vulnerable to climate change. The need for data and research on these vulnerable sectors was emphasized in enhancing the region's capacity to plan for adaptation strategies.

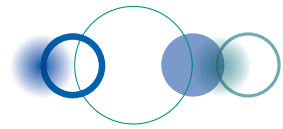
### Priority Actions:

Several priority actions were recommended to address the constraints in the capacity development of the Asia-Pacific and to achieve a comprehensive and sustained understanding of the Earth's processes. Communication was seen as an effective approach to address these issues, particularly on improving information sharing and promoting public awareness.

High priority was also given to:

- research on climate modeling and socio-economic impacts and adaptation;
- collection, rescue and analysis of historical data;
- detection of ongoing phenomena related to climate change and variability;
- and linking earth observations and climate modeling.

It is expected that the APN will play an important role in these endeavors through its continued support towards GEOSS related capacity building initiatives using its existing activities, such as the Annual Calls for Proposals and the CAPaBLE Capacity Development programme. Strengthening the roles of the APN members by seeking proposals from them in response to the identified needs and facilitating the improvement of access to data by developing metadata centers and database are some areas where the APN's role is also seen. A two-way dialogue between the APN and the GEOSS Sub-Committee on Capacity Building was felt as an important step in this capacity development objective.



## Added Value and Relevance to GEO

The workshops comprehensively analyzed earth observation related capacity building needs of the region focusing on climate. Since GEOSS intends to involve users (4.2, 10-Year Plan) and to build capacity (5.6), the outcomes of the workshops are to be fully taken into account when such activities are carried out by GEO.

## Participants

APN, Ministry of the Environment, Japan, National Institute for Environmental Studies, Japan, Ministry of Natural Resources and Environment, Thailand and US National Science Foundation organized the workshops. 56 experts from 18 countries including those from Ministry of Education, Culture, Sports, Science and Technology, Japan, IOC, Korea Meteorological Administration, and National Satellite Meteorological Center, China participated.

## Current Status and Next Step

The outcomes of the workshops were reported to the GEO as well as at such occasions as the International Workshop Earth Observation in Water Management Services (Sept. 2006, Bangkok) and the GEOSS Symposium on Integrated Observation for Sustainable Development in the Asia-Pacific Region (Jan. 2007, Tokyo). APN is planning a training based on the outcome of the workshops.

**APN's Capacity Building endeavour, in line with GEOSS principle "…to be driven by user needs"**

**OUTCOMES of the APN Scoping Workshops on Global Observations and Capacity Building Needs of the Region: Focus - Climate**

**Gaps Where Capacity Building is Needed**

- inadequate user involvement
- lack of access to data
- scarcity of scientists, technical infrastructure and funding
- limited research experience
- lack of familiarity with methods and models
- limited archived data and analytical interpretation
- weak/lack of collaboration among scientists of multiple disciplines

**Most Vulnerable Sectors**

- food and fibre
- biodiversity
- water resources
- coastal ecosystems
- human health and settlements
- land degradation

**Continuous Training and Capacity Development are needed to advance efforts towards a comprehensive and sustained understanding of Earth processes**

**Priority Actions**

- intensify communication and information sharing
- research on climate modeling and socio-economic impacts and adaptation
- promote public awareness
- collect, rescue and analyse historical data
- detect ongoing phenomena related to climate change and variability
- link earth observation and climate modeling

**Asia-Pacific Network for Global Change Research (APN)**

**Asia and the Pacific Region alongside Global Community**

The Scoping Workshops were co-organized by the Ministry of the Environment, Japan; US National Science Foundation; Ministry of Natural Resources and Environment, Thailand and the National Institute for Environmental Studies, Japan.

**For more information, please visit: [www.apn-gcr.org](http://www.apn-gcr.org)**

## European community research in support of building GEOSS with modern information and communication technologies

### Description

#### Objectives

The European Commission (EC), and in particular, its Directorate-General for Information Society and Media (DG INFSO), is triggering and co-funding Community research on ecoinformatics and, more widely, Information and Communication Technologies (ICT) for environmental management<sup>1</sup>. Research activities deliver systems, tools, protocols to notably enhance interoperability between geo-spatial information systems, to improve collection of, integration and access to harmonised environmental data, to strengthen monitoring capacities through the integration of advanced sensor networks, and to develop decision support systems as an aid to sound environmental management. This includes *new, smart monitoring capacities and open service oriented architectures of direct relevance to the design and implementation of a Global Earth Observation System of Systems (GEOSS)*.

#### Methods

The main instrument are multi-annual EU Framework programmes (FP7 in 2007-2013, FP6 in 2002-2006) for research and technological development to promote scientific excellence and innovation, to advance knowledge and understanding, and to support the implementation of related European policies. These FPs are implemented through calls for proposals<sup>2</sup> and typically cover activities such as coordination and support actions as well as collaborative research projects.

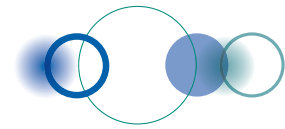
Where appropriate, the FP calls for proposals managed by DG INFSO include direct references to the GEO initiative. GEO-relevant projects are informed about the GEO Work Plan 2007-2009, the related GEO Calls for Proposals (CFPs), GEO Requests for Information (RFIs) and other GEO surveys. They are invited to sign-up GEO tasks on a voluntary basis.

### Added Value

The following early achievements can be listed with direct relevance to GEO. They belong to different categories ranging from direct contributions by ongoing research projects, to the inclusion of specific GEO references in calls for proposals, to dissemination activities from GEO towards European research consortia and vice-versa.

- Two FP6-IST projects<sup>3</sup> are official contributors to GEO Task DA-07-04 on Sensor Web Enablement (SWE): *«(...) With advances in communications technology and ground-based in-situ technologies it is now feasible to consider webs of sensors on all types of platforms with rapid access for observations. This technology has been developed under the names of Sensor Webs and Sensor Networks»*.
- Three FP6-IST projects<sup>4</sup> have responded to the Call for Proposals for a GEOSS Architecture Implementation Pilot. They are willing to contribute to the global definition of a GEOSS architecture, especially regarding the key aspects of accessibility, flexibility, autonomy, interoperability and standardization. They could also contribute to the definition of pilot demonstration scenarios especially for the reduction and prevention of disasters.
- Several ongoing FP6-IST projects<sup>5</sup> have expressed their interest for future voluntary contributions to the GEO initiative in the coming years. Their interest is mainly in producing practical strategic and tactical guidance document on how to converge disparate systems to a higher degree of collaboration and interoperability under GEOSS. They belong to three clusters of ongoing ICT projects in the fields of 1. innovative in situ monitoring systems, 2. service oriented architectures, or 3. tools for public safety communication, including integrated alert systems and rapidly deployable emergency telecommunications systems.





- The recent FP7-ICT call for proposals<sup>6</sup> is specifically calling for a Coordination and support action for «*the rapid adoption of standards, protocols and open architectures, in support of the INSPIRE, GMES and GEOSS initiatives in a holistic way*».
- Dissemination at programme level is also happening. Lessons learnt so far from the FP6 IST Programme in the field of Service Oriented Architectures for the Environment were presented on the occasion of the GEOSS workshop «Implementing a System of Systems» organised by IEEE in Honolulu April 15th, 2007, as well as in front of the ADC Committee on 1 March 2007.

## Relevance to GEO

The FP7 cooperation Theme «ICT» aims at developing the next generation of Information and Communication Technologies and to stimulate innovation in ICT to address societal challenges. This is of direct relevance to the GEO technical challenge of building a sustained and coordinated Global Earth Observation System of Systems (GEOSS). This worldwide effort requires modern ICT to link disparate observation systems under a common interoperability frame and to facilitate exchange and processing of multiple data into information.

GEO represent a unique international dissemination platform of Community research knowledge, notably in the fields of system architecture and all-hazards information systems. The GEOSS has the potential to implement ICT solutions at global level across systems, applications, organisations and borders in the field of Earth observation.

## Participants

The projects involve multi-disciplinary teams from different European Member States, sometimes with organisations located in countries associated to the Framework Program of Community Research or third countries in the case of international cooperation research activities.

## Current Status and Next Steps

Depending on the outcome of the second FP7 ICT call<sup>6</sup> for proposal in 2007, a significant coordination effort is foreseen in 2008 to review the state-of-the-art in the field of open reference system architectures, to mainstream the outcome of this review notably in the GEO context and to identify future ICT research topics that are susceptible to contribute to future versions of the initial GEOSS from an architectural point of view.

Moreover, ongoing FP6 projects in the field of ICT for disaster management are expected to end and deliver within the period 2007-2010, hence providing significant opportunities to contribute to the GEO Work Plan 2007-2009 and the Disaster Management societal benefit.

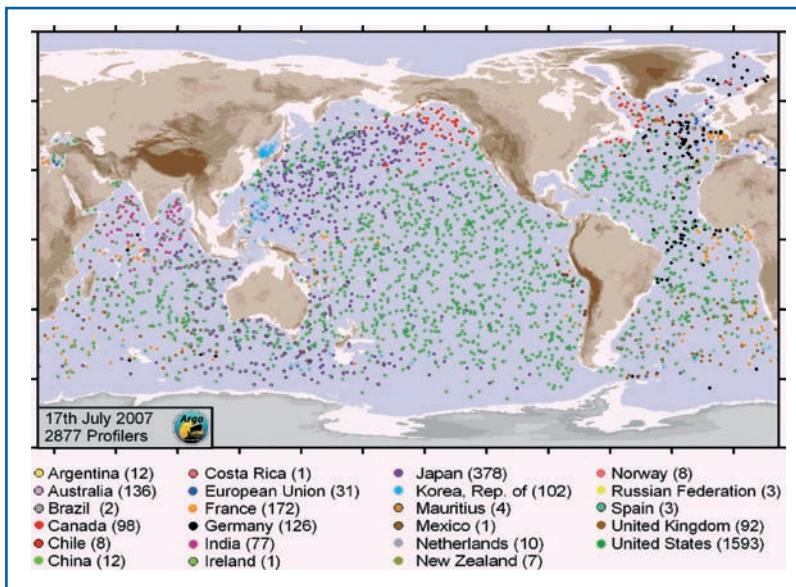
1. [http://cordis.europa.eu/fp7/ict/sustainable-growth/environmental\\_en.html](http://cordis.europa.eu/fp7/ict/sustainable-growth/environmental_en.html)
2. FP6 Information Society Technology (IST) Programme (2002-2006) and FP7 Information and Communication Technology (ICT) Cooperation Theme (2007-2013)
3. OSIRIS project: <http://www.osiris-fp6.eu>, and SANY project: <http://www.sany-ip.eu/>
4. ORCHESTRA project: <http://www.eu-orchestra.org>, OSIRIS project: <http://www.osiris-fp6.eu>, and SANY project: <http://www.sany-ip.eu/>
5. For more information, email to [INFISO-ICTforSG@ec.europa.eu](mailto:INFISO-ICTforSG@ec.europa.eu)
6. Call FP7-ICT-2007-2 (June-October 2007), see [http://cordis.europa.eu/fp7/home\\_en.html](http://cordis.europa.eu/fp7/home_en.html)

## Argo

### Description

Climate and weather affect all of the GEO Societal Benefit areas and improving predictions and forecasting will benefit everyone on the planet. Mostly humans care about the climate where they live, in the atmosphere. However, when we try to make a forecast of conditions over the next season or two, more than 90% of the information we need is in the oceans where until recently information on heat and its movement were available only at great cost and effort. Argo is a global array of profiling robotic floats being deployed to supply global maps of the climatic state of the ocean and so correct the problem outlined above. Each float drifts at depth (1000 to 2000 metres) and every 10 days adjusts itself so that it rises to the sea-surface measuring a profile of ocean properties on its way up that is transmitted to a satellite before returning to depth to start a new 10-day cycle. Uniquely in oceanography, all member nations have agreed to near real-time access without any constraint on data use. Thus, though 23 wealthy nations are deploying instruments, the benefits of the global array are already being used by scientists in developing countries.

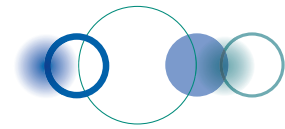
Further, we have established two global data centres allowing, for example, a scientist in Ghana to access the global data base within 24 hours of profiles being acquired, all he/she needs is internet access. Data are in a consistent format from all member nations and in a format that allows easy use with free software, such as Ocean Data View. But the overwhelming purpose of Argo is to feed data into a new generation of forecast models that will supply accurate forecasts of seasonal weather and climate variability and more accurate forecasts of the movement and evolution of severe weather systems.



*This shows where Argo floats are at the time of writing, colour coded by the country launching each float. On July 17<sup>th</sup> 2007 we were closing in on the target of 3000 floats and have floats deployed by scientists from 23 nations.*

Though we have not quite reached the originally-advertised target of 3000 floats operating at one time, this will be achieved during autumn 2007, but irrespective of that, in late 2006 we did achieve a global array that allowed mapping of ocean properties in all ocean basins with almost equal accuracy and precision.

Argo was designed with the needs of operational agencies in mind and is now operational and being used aggressively by agencies such as the UK Met Office, NOAA climate forecasting, the European Centre for Medium Range Weather Forecasting, CSIRO and JMA for enhanced long-term forecasts. This is still in the development stage, but the recent accurate forecast of conditions for the UK in the winter of 2006/07 was a great success attributable to the Argo array.

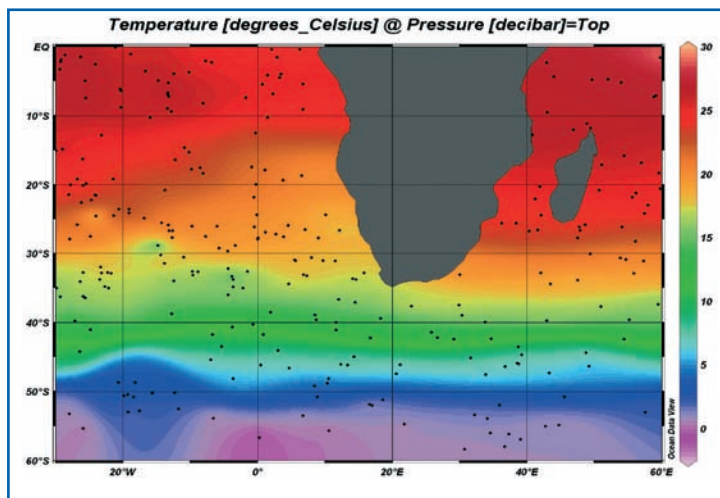


## Added Value

Any large multi-national project like Argo needs international coordination. Specifically we need the assistance of GEO to express the need for international coordination through the Argo Information Centre or project office as stated in Work Plan CL-06-06. We also need aid in securing long-term secure funding as Argo moves from the developmental stage to the demonstration and operational phase, where the operational agencies show success in seasonal climate forecasting. Secure funding exists for some countries but not others. GEO will benefit from interaction with Argo as a mature project that has moved from development to the sustaining phase.

## Relevance to GEO

- SBA 4.1.1 Improved sea surface temperatures derived from the Argo array will improve the trajectory and intensity forecasts for tropical cyclones and hurricanes, relevant to loss of life and property.
- SBA 4.1.2 Improved weather and seasonal climate forecasting, particularly rainfall forecasts, will improve predictions of events that affect human health. (Example, intense rainfall events in equatorial regions are predictors of epidemic malaria events.)
- SBA 4.1.3 Improved seasonal climate forecasts will permit better use of energy resources.
- SBA 4.1.4 Argo was designed to allow the development of ocean data assimilation models thus allowing a large improvement in the seasonal climate forecasts. This will have economic value worldwide.
- SBA 4.1.6 Argo is already supplying improved sea surface temperatures as in 4.1.1 above.
- SBA 4.1.7 Argo is already being used to monitor changes in large ocean ecosystems for the benefit of fisheries in, for example, Alaska.



*This picture shows the distribution of surface temperature around Africa in July 2007, south of the equator. No oceanographic project before Argo has been able to monitor northern and southern hemispheres equally. The data used in this plot are freely available to anyone and the plot was created using Ocean Data View, which is free software, available to anyone. This type of mapping of ocean properties can be done by anyone, anywhere.*

## Participants

Countries currently deploying Argo floats and meeting all of the constraints of the Argo data policy are as follows, in alphabetical order: Argentina, Australia, Brazil, Canada, Chile, China (PRC), Costa Rica, EU, France, Germany, India, Ireland, Japan, Korea, Mauritius, Mexico, New Zealand, Norway, Russia, Spain, UK and USA. Note that member countries are listed separately from the EU where separate funding agencies are involved. In many countries there are multiple participating agencies, e.g. UK, USA, Chile and Japan.

## Current Status and Next Steps

- This is a mature project that is moving from development to demonstration of benefits and use by operational agencies.
- Funding for international coordination is insecure, promotion and awareness within GEO will be of great value.
- There remains a N/S hemispheric imbalance in float distribution and hence data outputs that is smaller than any other previous global oceanography project but which requires further attention. Promotion by GEO of the benefits of the global array will materially benefit Argo here.
- Many developing countries remain unaware that they can use Argo, hence development, education and outreach are a high priority, GEO assistance for such capacity building will greatly facilitate progress.

## CBERS-2B For Africa

### Description

CBERS-2B is the third satellite of the CBERS program, a partnership between Brazil and China, which will include CBERS-3 and 4 to be launched in 2010 and 2012. The satellite is very similar to its predecessors (CBERS-1 and 2). Its payload comprises three imaging cameras. WFI (Wide Field Imager) is a two bands (red and NIR), 260 m pixel size, and 890 km swath camera. CCD (High Resolution Imaging Camera) is a camera with five bands from blue to NIR, 20 m pixel size, 113 km swath, 32° across-track viewing capability. The new HRC (High Resolution Panchromatic Camera), which replaced the scanner that flew into CBERS-1 and 2, is a panchromatic sensor, 2.7 m pixel, and 27 km swath. The nominal revisiting time for CBERS-2B is 26 days, at 778 km altitude, sun-synchronous, near-polar orbit, crossing the Equator at 10:30.

### Added value

The data policy established by Brazil and China is a public good policy, distributed free of charge global land cover satellite imagery to end-users. Only in Brazil, more than 300.000 scenes were distributed in the last 3 years, making it an unprecedented success. In the context of need of increasing international cooperation in sharing Earth Observation data, which is a foundation of GEOSS, China and Brazil agreed to extend their data policy and make CBERS program a member of what one could call a Global Public Good Remote Sensing Data program with emphasis on the south-south cooperation for sustained development. As such, using the GEO framework, China and Brazil are working with South Africa, Spain and Italy to sign three parties Memorandum of Understanding for distribution of CBERS satellites imagery, starting with CBERS-2B, using ground stations owned by African partners.

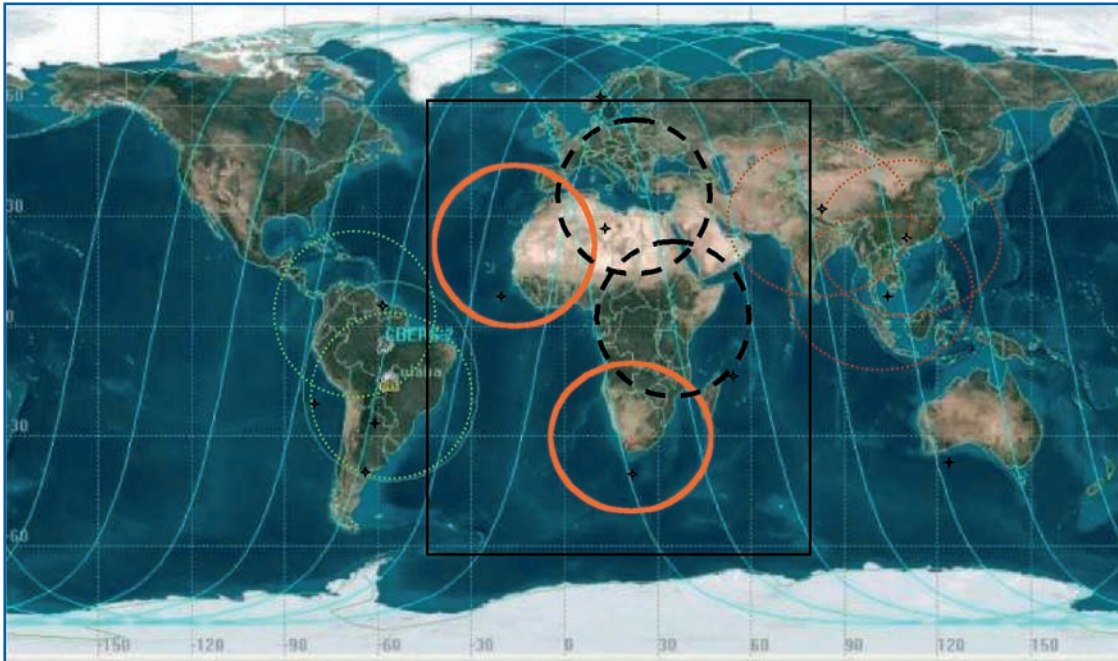
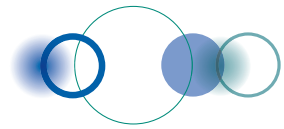
China and Brazil grant free downlink licenses and upgrades of the ground stations, which receive, process, store and distribute the imagery free of charge to all interested African countries inside the footprints of their receiving antennas. The figure below shows all covered African regions. The ground stations are located in Canary Islands (run by INTA for Spain), Hartebeesthoek (run by CSIR for South Africa), Malindi in Kenya and Matera in Italy (both run by Italian Space Agency). China and Brazil intend to use the onboard recorder to cover for the missing areas under request of the concerned regions.

### Relevance to GEO

CBERS for Africa is very much relevant to GEO, in the building of GEOSS. This is the first time in the history of orbital Remote Sensing that multi-spectral 20 m resolution is down linked to ground stations through a zero fee license. This would then be the first time that satellite imagery that are crucial in many societal benefit areas, such as agriculture, biodiversity, land use cover change, are distributed to the end users as soon as they are processed. This is at the heart of the data sharing principles of GEO in its 10 years implementation plan of GEOSS.

Besides providing the satellite imagery to African countries as they are acquired by the orbiting sensors, which can be understood as a transverse area task or infrastructure capacity building, Brazil has also offered to provide its mature Spring software (Image processing and GIS with more 50.000 copies distributed in-country and around the world), as well its open source software GIS for general purpose use and on-demand GIS tools. As part of its commitments assuming a leading role in capacity building, Brazil also intends to offer the job training on these techniques.





*Running (Green for Brazil, red for China) and planned Ground Stations for Africa. The locations of the ground stations are Canary Islands (Spain), Hartebeesthoek (South Africa), Malindi (Kenya) and Matera (Italy).*

## Participants

The participants of this enterprise are the satellite owners, Brazil and China, and the countries owning the ground stations, Spain, South Africa and Italy. The inspiration is the idea of cooperation in facilitating earth observations data access by in the developing world, which is central to GEOSS. GEO provides the Web Portal and GEONETcast to facilitate data access to end-users.

## Long term

Brazil and China agreed that the CBERS program, a major model of successful “South-south Cooperation” in space technology for global land cover remote sensing program, will keep a data police based on public good and data continuity until 2015. This is to say that we intend to provide CBERS data for as long as the satellite family exists. We expected the partnership with the ground stations countries remains in place.

## Report prepared by

João Viane Soares - Director For Earth Observations and GEO Capacity Building co-chair  
José Carlos Epiphânio - CBERS Applications Manager  
Gilberto Câmara – General Director

Instituto Nacional de Pesquisas Espaciais

## Establishment of a U.S. National Land Imaging Program

### Description

In August 2007, the United States (U.S.) announced a new National Land Imaging Program (NLIP), to be managed by the U.S. Department of the Interior (DOI), devoted to addressing the civil-operational land imaging needs of the Nation. This announcement followed a nearly two-year review of the future of moderate-resolution land imaging. The review assessed benefits and uses, U.S. and foreign plans, and management models needed to ensure stability and continuity in the area of satellite remote sensing technology.

The new program will consolidate responsibility for user needs assessment, satellite and data acquisition, technology advancement, data archiving and distribution, and advanced applications development for needs, long-standing policies assuring non-discriminatory access to data by the U.S. and international governments and commercial users will be maintained. Current U.S. policies related to overflight broadcast of satellite land imagery to international cooperator stations throughout the world will also be continued. In addition, current modernization of DOI's Earth Resources Observation and Science (EROS) Center at Sioux Falls, South Dakota will enable the U.S. Government to distribute standardized land imagery low-cost products to all users over the Internet.

The U.S. is currently developing the Landsat Data Continuity Mission (LDCM) to be launched in 2011. The LDCM is the latest satellite in the Landsat series that includes the operational Landsat 5 and 7 missions. U.S. mission capabilities will be augmented by U.S. commercial and foreign government and commercial satellite resources under partnership agreements and other arrangements. It is anticipated that these agreements will fulfill data-sharing and open data distribution policies consistent with Group on Earth Observations (GEO) objectives.

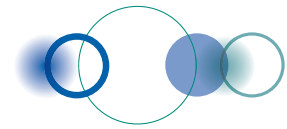
The DOI's U.S. Geological Survey (USGS) maintains the National Satellite Land Remote Sensing Data Archive, which contains the United States' historical satellite land imagery records of the Earth. The NLIP is critical to the continuity of the 35-year Landsat archival data record of the Earth's global land surfaces. This high quality record is continually used by U.S. and international scientists and research centers for a wide range of applications, including monitoring the effects of global climate change and human effects on Earth's natural resources. Landsat, along with other U.S. and International land imaging systems, play a critical role across the GEO societal benefit areas, particularly those related to sustainable development; climate, land, and water management; protection of Earth's natural ecology and biodiversity; disaster and risk management; and monitoring of conditions related to human health and well-being.

NLIP operates on behalf of U.S. Government agencies to ensure the availability of land observing technology that serves the science, policy and economic interests of the U.S. While this program is dedicated to serving U.S. interests, its program of open collaboration with other sources of data will make NLIP a cornerstone program within the Global Earth Observation System of Systems (GEOSS).

### Added Value

Land imaging is essential to governments throughout the United States and the world. The recent U.S. Future of Land Imaging Interagency Working Group found that land imaging affects every level of government in the United States and plays a key role in supporting the land and natural resource management functions across the government including operational, research, and science work in all areas of Government doing land management, agronomy and forestry, mapping and surveying, coastal resource management, mining and energy, transportation and urban planning, rural economic development, property valuation and risk management, and disaster management and relief. The new U.S. land imaging program will ensure the future continuity of moderate-resolution land imaging resources for U.S. and global economic, environmental, and scientific purposes. This program reflects the long-standing U.S. commitment to maintaining the U.S. land imaging satellite capabilities on behalf of the international climate research community.





The U.S. is already working with GEO and Committee on Earth Observation Satellites (CEOS) partner agencies and nations about arrangements for exchanging land imaging data. These discussions are in their early stages, but represent a commitment by the U.S. to seek economical approaches to achieving GEO data-sharing and technical collaboration agreements. Coordination of future U.S. and international civil land imaging satellite plans and how they can be integrated with U.S. and international science, economic, and environmental needs and campaigns is a very important future GEO contribution.

**Relevance to GEO**

U.S. operational land imaging capabilities will provide frequent, high quality, multispectral imagery data to the world’s scientists and nations. This is an essential building block for science, research, and applications that will allow greater stewardship of the Earth. NLIP and GEO can advance these aims by continuing to bring the world’s political, economic, and environmental leadership together with the world’s scientists, academics, and international organizations to bring Earth observation, science, and research applications to bear on some of the world’s most vexing societal problems; Table 1 provides a list of areas in which land imaging is used to understand and solve societal issues.

The U.S. DOI will advance the interests and capabilities of the GEOSS through the development of an operational land imaging capability and by its strong partnerships with foreign governments and U.S. and foreign commercial firms.

**Contribution to 10-year plan**

The NLIP is a directly contributes to GEOSS through delivery of satellite capabilities, imaging data, private and public partners and capabilities, and U.S. data policies related to the full and open exchange of scientific and environmental data among all the world’s nations.

**GEO Work Plan reference**

The NLIP will contribute to many existing GEO tasks as defined in the GEO 2007-2009 Work Plan. Some of the most relevant tasks include: Forest Mapping and Monitoring (AG-06-04), Agricultural Risk Management (AG-07-02), Operational Agriculture Monitoring System (AG-07-03), GEOSS Components Commitment (AR-07-04), Biodiversity Observation Network (BI-07-01), Key Terrestrial Observations for Climate (CL-06-03), Global Land Cover (DA-07-02), Virtual Constellations (DA-07-03), Use of Satellites for Risk Management (DI-06-09), Use of New Observation Systems of Energy (EN-06-04), and Satellite Water Quality Measurements and Integration with In-situ Data (WA-07-02).

**Participants**

The NLIP is in the process of initiating partnership discussions with governments around the world, working directly with U.S. and international scientists, academics, and, non-profit research and assistance programs.

**Current Status and Next Steps**

On August 14, 2007, the Executive Office of the President of the United States announced the release of a plan for a U.S. National Land Imaging Program, to be managed by the U.S. Department of the Interior. The DOI is currently working to establish a national operational land imaging program.

<p>Commerce and Earth Resource Management</p> <ul style="list-style-type: none"> <li>• Agriculture, Forestry, and Sustainable Development</li> <li>• Water Resource Assessment and Management</li> <li>• Energy Resource and Mineral Wealth Assessment and Management</li> <li>• Foreign Agricultural Assessment</li> <li>• Insurance Risk Management</li> </ul> <p>Environmental Monitoring and Assessment</p> <ul style="list-style-type: none"> <li>• Land Use Change</li> <li>• Climate Variability and Change</li> <li>• Habitat and Wetlands Management and Ecological Forecasting</li> <li>• Sea Ice, Glaciation, and Snow Pack Assessment</li> <li>• Erosion Control and Hydrological Assessment</li> <li>• Deforestation, Desertification, and Salinization</li> <li>• Urban and Rural Geography and Human Ecology</li> </ul>	<p>Civil Operations and Applications</p> <ul style="list-style-type: none"> <li>• Land Use Planning and Management</li> <li>• Resource Conservation and Management</li> <li>• Wildfire, Coastal Zone, and Flood Plain Assessment</li> <li>• Natural Disasters Mitigation and Response</li> <li>• Human Health and Well-Being</li> <li>• Physical Infrastructure Assessment and Operation</li> <li>• Navigation and Transportation Planning and Management</li> <li>• Property Valuation and Assessment</li> </ul> <p>National Security</p> <ul style="list-style-type: none"> <li>• Intelligence and Information Gathering</li> <li>• Homeland Security</li> <li>• U.S. Military Operations</li> <li>• Health and Productivity of the U.S. Aerospace Industry</li> </ul> <p>Treaty and Legal Compliance</p> <ul style="list-style-type: none"> <li>• Boundary Control</li> <li>• Property Rights and Assessment</li> <li>• International Conventions and Treaty Management</li> <li>• Tax Base Assessment</li> <li>• Land Use Regulation</li> </ul>
--	---

## **GEO-BENE - Global Earth Observations – Benefit Estimation: Now, Next and Emerging**

### **Description**

The GEO-BENE project's objective is to develop methodologies and analytical tools to assess societal benefits of GEO and to perform benefit assessments on global, regional and local levels. It assesses the value of information delivered by GEOSS using geographically explicit integrated assessment models. Benefits arise from improved decision making in view of the Millennium Development Goals.

### **Value added**

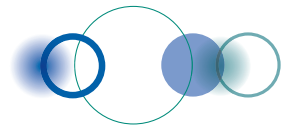
GEO-BENE contributes to policy processes, policy formulation and implementation in sectors of the nine socio-economic benefit areas of GEO. Global earth observation systems have and will considerably increase mankind's capability to understand the physical world which surrounds us. New information technology coupled with data from a system of systems of earth observations will help mankind to shape the future of global society. GEOSS appears as a promising means to contribute to managing welfare arising in the nine benefit areas.

Our understanding of human preferences has also helped us understand ways in which citizens perceive threats and opportunities and manage it in their lives and provide normative guidance on increasing the effectiveness and efficiency of management. Yet the increasing complexity of modern life in a globalized world is going to require new and different ways to share burdens of managing risks and opportunities ex ante – on the national and international level. GEO information will be crucial in accompanying these processes by providing direct and indirect utility in terms of improved understanding and better planning. Likewise the efficiency and effectiveness of ad hoc intervention measures adapting to global risks associated with the nine benefit areas can considerably be enhanced based on more knowledge and real time data support.

### **Relevance to GEO**

Scientists and practitioners around the globe are searching for options to perfect management systems and decision making processes on various levels in the nine benefit areas identified by GEO. At the same time many of the decision support tools in use are severely constraint by data paucity. There is a shortage of analytical tools to quantify reliably – based on solid and readily available data - and in an integrated manner economic, social and environmental effects of global, regional and local decision making. GEOBENE quantifies the value of information of various constellations of GEOSS.

Therefore, the impact of this project on both long- and short-term planning of Earth system policies can be considered substantial. It is thus the prime objective of the research to develop an operational cluster of models to support the international policy processes associated with the nine benefit areas. The application and the development of the models should directly lead to robust policy conclusions pertinent to measures, in particular their implementation schedule, in the affected economic and social sectors vis-à-vis measures taken to improve earth system management based on an improved GEOSS. Likewise, GEOBENE will identify areas within the GEOSS, where the highest socio-economic returns on new earth observation information can be expected.



## Participants

- International Institute for Applied Systems Analysis, International
- University of Bodenkultur/Institute of Sustainable Development, Austria
- Swiss Federal Institute for Environmental Science and Technology, Switzerland
- University Freiburg, Germany
- Vrije Universiteit Amsterdam, Netherlands
- Public Health Institute of Finland, Finland
- Potsdam Institute for Climate Impact Research, Germany
- Soil Science and Conservation Research Institute Slovakia
- University Bratislava, Slovakia
- University of Hamburg, Germany
- National Institute for Environmental Studies, Japan

Funding: EU FP6, Priority Area 1.1.6.3

## Current Status and Next Steps

GEOBENE has build three operational clusters of models covering and integrating all nine SBAs. The largest gaps were identified in the area of geographically explicit socio-economic and health data. A long-term strategy to build such global socio-economic data infrastructure is yet to be built

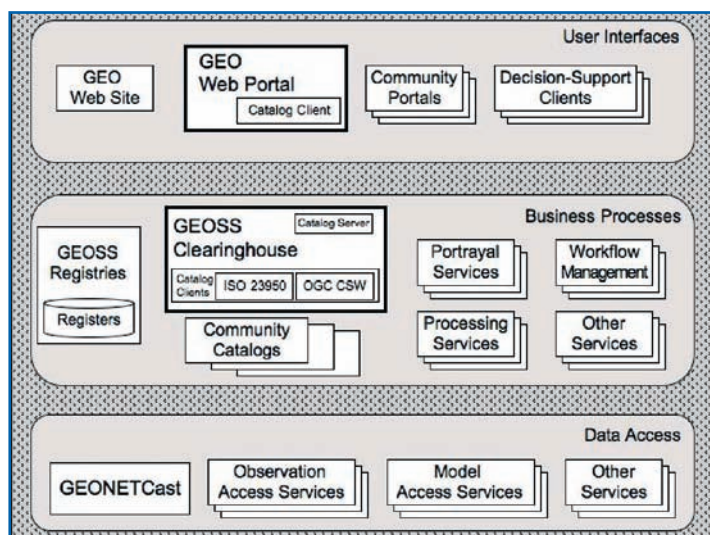
## GEO Web Portal and GEOSS Clearinghouse – Services demonstrated through the Architecture Implementation Pilot (GEO Task AR-07-02)

### Description

Lead the incorporation of contributed components consistent with the GEOSS Architecture using a GEOSS Web Portal and a GEOSS Clearinghouse search facility to access services through GEOSS Interoperability Arrangements in support of the GEOSS Societal Benefit Areas.

A summary of the AI Pilot: <http://www.ogcnetwork.net/Alpilot>

A key element of the architecture description for the AI Pilot is an Engineering Viewpoint (see Figure below). This figure from the Engineering Viewpoint shows engineering components in three layers: User Interfaces, Business Process, and Data Access. Communications between components in the engineering viewpoint are achieved using a service-oriented computing architecture using GEOSS Interoperability Arrangements and special arrangements using international standards.

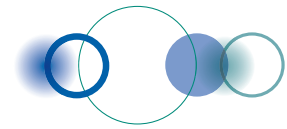


### Added Value

Without the GEO structure, the AI Pilot could not have developed. The AI Pilot is the result of a process by the GEO Task Team AR-07-02 as part of the GEO Architecture and Data Committee. The process included two Request for Comments (RFCs) followed by a Call for Participation (CFP). The CFP sought participants in the AI Pilot – a collaborative effort to apply open standards for interoperability to achieve user objectives in an environment representative of operational use. The CFP – issued in April 2007 - resulted in 35 responses representing a total of 105 organizations.

### Relevance to GEO

The AI Pilot will provide core components of an Initial Operation Capability (IOC) for the exchange and dissemination of observational and predictive model data. The Pilot is based upon the GEOSS architecture principal of Interoperability Arrangements. The Pilot IOC is planned for October 2008. As part of the Pilot, several candidates for a GEO Web Portal will be evaluated and demonstrated for consideration by the GEO ADC and GEO Secretariat. A GEOSS Clearinghouse will be demonstrated as part of the IOC. The IOC will be demonstrated using several Societal Benefit Area scenarios. The demonstration scenarios will be captured and made available for the Summit video.



## Participants

A total of 105 organizations responded to the AI Pilot CFP.

For a summary of the response to the CFP is here: <http://www.ogcnetwork.net/node/260>

Mailing lists for the AI Pilot Plenary and 10 Working groups.

Currently, 130 persons are registered in the mailing lists: <http://www.ogcnetwork.net/AIPilotLists>

Graphic logos from the lead organizations responding to the AI Pilot CFP are shown below.



## Current Status and Next Steps

A Kickoff Meeting for the AI Pilot was held on 5&6 June 2007 at the ESRIN Facility of the European Space Agency. The Kickoff Meeting began the Execution Phase of the Pilot. During the Kickoff meeting detailed plans and designs were developed along with the identification of user scenarios suitable for demonstration.

Currently AI Pilot development activities are progressing via e-mail communications by the Working Groups and via weekly Plenary teleconference.

A Scenario Integration and Demo Capture event is planned for September 2007. During this event, screen captures of the client applications will be made for the various scenarios. The resulting video will be made available to the Communication Task Force for the Ministerial Summit.

## GEO Grid

### Description

The “GEO (Global Earth Observation) Grid” is aiming at providing an E-Infrastructure to understand our Earth more insightful and more precisely, but faster and easier to worldwide Earth Sciences community. On the E-Infrastructure we are able to share data, application programs, and scientific workflows without knowing deep knowledge in IT where the grid technology is provisioned. GEO Grid provides large archives of earth observation satellite data securely and rapidly, integrated service with wide variety of geo-scientific information and GIS data, and assembles them easy-to-use formats for potential stakeholders in the several Societal Benefit Areas.

### Added Value

The rich concept of GEOSS is encouraging and accelerating the GEO Grid project successfully, and in particular GEO recommends the linkage and strong cooperation with other GEO related projects such as Web Portal and Global DEM.

### Relevance to GEO

GEO Grid contributes to several GEO tasks (DI-06-03, 06-05, EN-06-04, 07-01, 07-02, 07-03, EC-06-01, 07-01, AR-06-09, 07-01, 07-02, 07-03, DA-06-04, 06-06, 07-01, 07-02, 07-03, and 07-04), and potentially contributes to provide IT as software package and large-scale of archived data related to the earth observation. The former enables to support securely for publishing data with incoherent owners’ policy, easy access, and distributed data provider. The latter contains the all ASTER archives and geological maps. In other words, GEO Grid has the capability to generate high-level data products (accurate geometric-, radiometric- and atmospheric-corrected, and 30-meter and/or higher resolution DEM globally) by the Computing Grid.

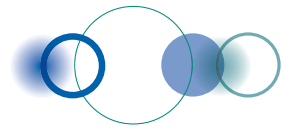
### Participants

Participation includes more than 10 organizations in different Countries and Regions (Japan, US, Korea, Thailand, India, Vietnam, Chinese-Taipei, etc.) as well as international organizations.

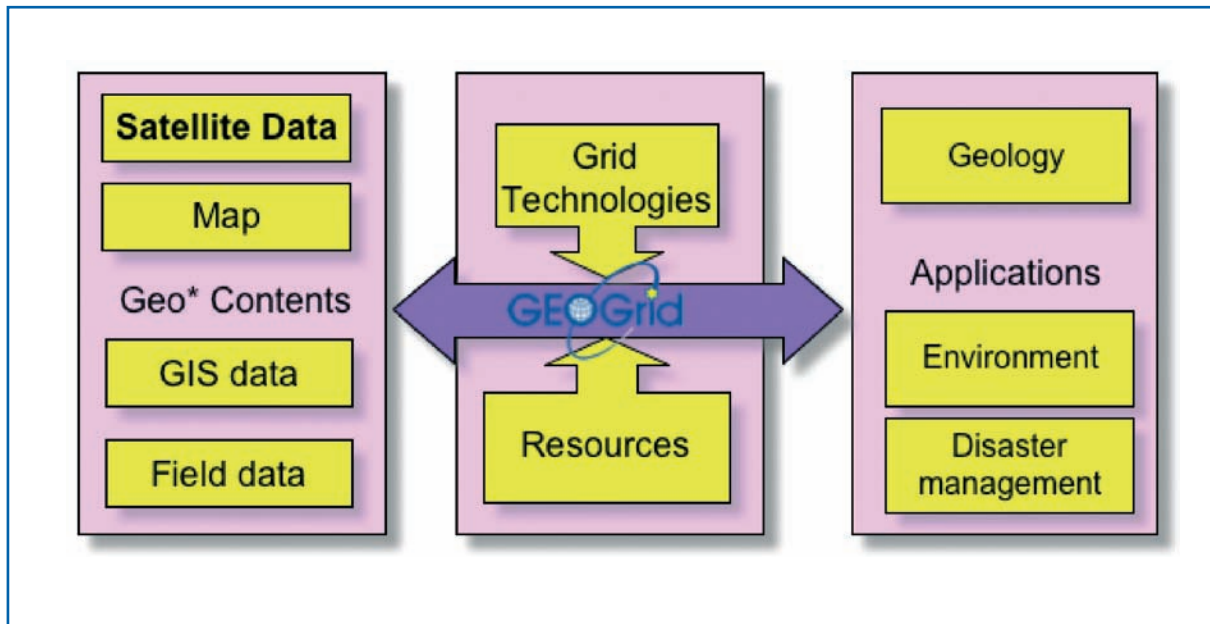
### Current Status and Next Steps

GEO Grid prototype has been operational since 2006. With the full set of ASTER archive, we have been re-designing the entire architecture to deliver preliminary software in '07Q4. For broader user community, - prototype will be available by '08H1.

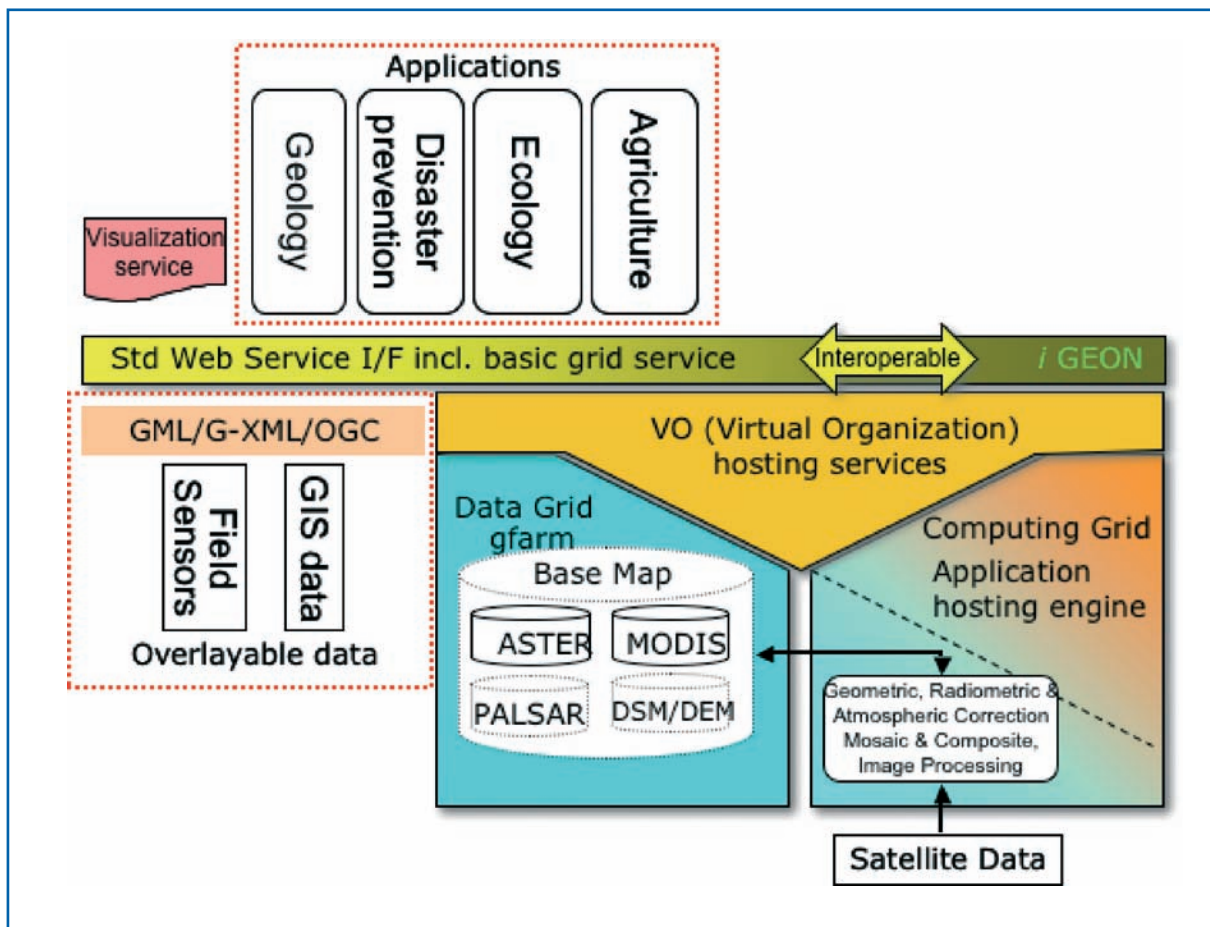




### GEO Grid Concept



### GEO Grid Architecture



## **GEONETCast: a Global Environmental Information Delivery System**

### **Description**

GEONETCast is a near real-time, global, environmental information delivery system by which in situ, airborne, and space-based observations, products, and services from GEOSS are transmitted to users through communication satellites, using a multicast, access-controlled, broadband capability. An initial technical capability has been demonstrated, and near-global coverage by GEONETCast is expected in 2007. The communication satellite costs for each sector of the globe are funded by one or more partners in GEONETCast, and the day to day management of each sector is their responsibility.

Communication satellite providers broadcast using a standard protocol interface, such as used for Direct to Home Television transmission. Different data streams or products could be available on separate channels. The user decides which data are to be received, managed, and saved locally. Reception equipment is generic, off-the-shelf equipment and is relatively inexpensive.

### **Added Value:**

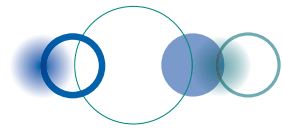
The GEOSS 10-Year Implementation Plan affirms that GEOSS will meet the need for timely, quality long-term global information as a basis for sound decision making and that it will enhance delivery of benefits to society. The plan also recognizes that these benefits cannot be achieved without data sharing.

At its second plenary in December 2005, GEO adopted the concept in principle of GEONETCast, as presented by EUMETSAT and NOAA. It was recognized that GEO could add value to existing operational and prototype technological efforts underway to enhance the delivery of data and information to users, particularly those in developing countries, at reasonable cost to both providers and users. Furthermore, it could expand access to additional data and products by broadcasting the information of complementary delivery systems and thereby extending the reach of those systems, e.g., GOOS, IGDDS, RANET, RARS, Sentinel Asia, SERVIR. Data access and utilization are key issues to every Member of GEO. Without improved access, delivery, and sharing of Earth observation data and products, the intended applications for enhanced benefits to society will not materialize, particularly in developing countries.

GEONETCast has significant potential to enhance access to a wide range of information to users, who may not have previously had access to such resources -- both from the diversity of data perspective, as it will deliver information on all nine societal benefit areas of GEO, and from the technical disparities perspective, as GEONETCast will be able to reach developing country users with limited or no access to high speed Internet. The GEO Capacity Building Strategy identifies GEONETCast as a significant technology to enable sustainable infrastructure capacity building efforts.

### **Relevance to GEO**

All GEO Societal Benefit Areas are impacted by this effort, as well as cross-cutting themes such as the sensitivity of the environment to socio-economic wellbeing. It is a task, CB-06-04, in both the GEO 2006 Work Plan and the 2007-2009 Work Plan. The initiative is a major component of GEOSS, reporting to the GEO Architecture and Data Committee, but coordinating closely with both the Capacity Building Committee and the User Interface Committee. GEONETCast has participated in meetings of all three committees.



## List of GEO Members and Participating Organizations Involved

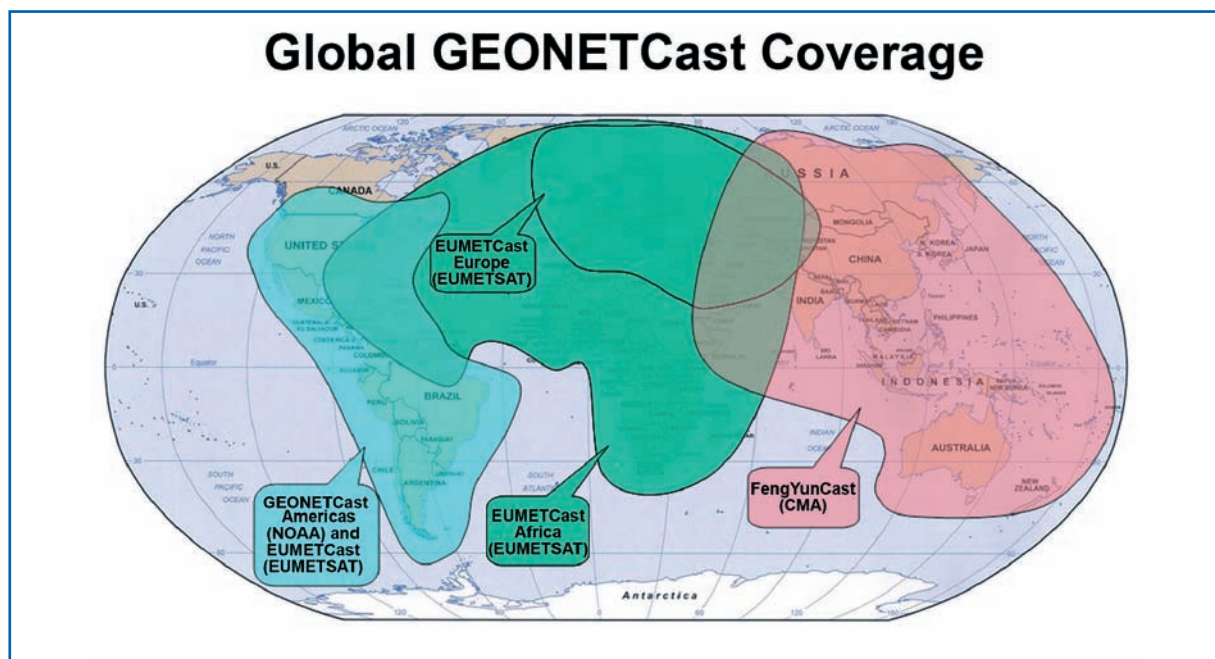
- Argentina
- Australia
- Brazil
- China (co-lead)
- European Commission
- Finland
- Germany
- Greece
- Japan
- Korea
- New Zealand
- Russia
- South Africa
- United Kingdom
- United States (co-lead)
- African Association of Remote Sensing of the Environment (AARSE)
- Committee on Earth Observation Satellites (CEOS)
- European Space Agency (ESA)
- EUMETNET
- EUMETSAT (co-lead)
- Federation of Digital Broadband Seismographic Networks (FDSN)
- International Institute of Space Law (IISL)
- Open Geospatial Consortium (OGC)
- World Meteorological Organization (WMO) (co-lead)

## Current Status

The greatest initial challenges have been to work towards global coverage, engage users to identify needs, expand data and products being transmitted beyond meteorology, and demonstrate an initial technical capability. With EUMETSAT broadcasting to Europe, Africa, and much of the Americas, with the US/NOAA putting processes in place to take over coverage of the Americas and much of the Pacific, with China expanding its broadcast to cover most of Asia, Australia, New Zealand and surrounding ocean areas, and with Russia as an additional prospective contributor, GEONETCast is expected to reach near global coverage in 2007. Outreach to the GEO Capacity Building and User Interface Committees, as well as to regional user communities and thematic user communities, to further identify user needs has begun, and effort to develop a wider set of data providers is a continuing enterprise.

## Next steps

Continuing user involvement; developing linkages to other dissemination systems; working with infrastructure contributors to build a global system and transmit data/products across regions; incorporating data/products from multiple sources to serve all GEO societal benefit areas.



## GEOSS Guidance Documents

### Description

AR-06-02 task was established to produce practical strategic and tactical guidance documents on how to converge disparate systems to a higher degree of collaboration and interoperability under GEOSS including its roadmap. The readership for which are the GEO Members and Participating Organizations or potentially new ones – for them to USE in practice to instruct them how to go about evolving or adapting their systems to work in line with GEOSS needs. As such, the documents have a marketing role to encourage new entrants, agencies and systems into the GEOSS process and family.

#### *Strategic Guidance Document*

The document is perceived as the material each participating or potential agency might take to their ministries or government leaders. It gives a short explanation of the GEOSS and the principles that countries need to apply in their planning in order to contribute effectively and benefit suitably from involvement - over the long term.

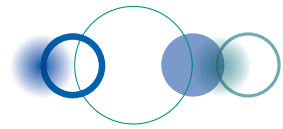
#### *Tactical Guidance Document*

This is more for technical managers to ensure that they leverage developments in GEO and that their system can interface correctly to the GEOSS components. The technical document will be used like a procedure manual for information systems or data centre managers to ensure that means are clearly identified for making their systems compatible and suitably interfaced to the GEOSS.

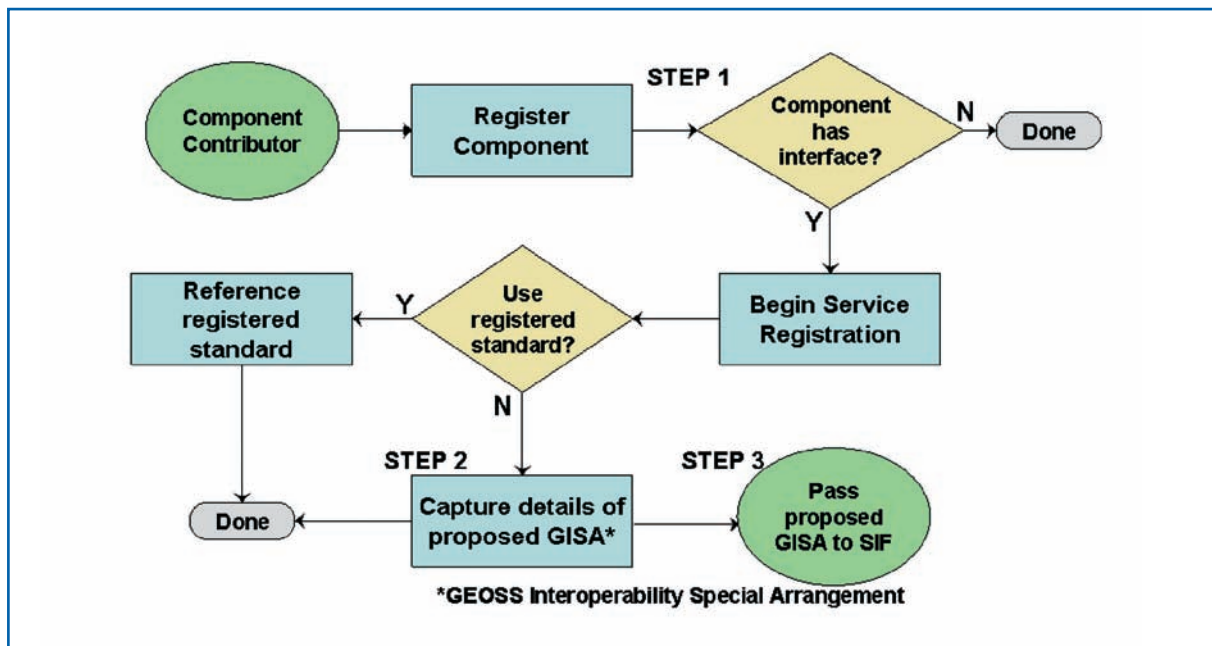
### Added Value

The Strategic Guidance Document describes how GEOSS contributes to the Societal Benefits and how contributing Member countries and Participating Organizations can benefit from their involvement in GEOSS. The strategic document describes how GEOSS achieves a “System of Systems”. The GEOSS Data Sharing Principles is a key for enabling full and open data exchange of data, metadata, and products shared within GEOSS. Any new GEOSS component is bound by the GEOSS interoperability arrangements which are based upon non-proprietary standards. Interoperability will be focused on interfaces, defining how system components interface with each other.

The Tactical Guidance Documents provides detailed procedures for registering contributed components and their services which is shown in Fig. 1. In registering services, standards or GEOSS Interoperability Special Arrangement(GISA) will be referred. The Standard and Inteoperability Forum (SIF) will help the identification and promotion of standards and GISA for GEOSS by providing access to experts and internationally recognized standards organizations. The component contributor is encouraged to make test for verification of the interoperability of the proposed component for contribution to GEOSS. Overall monitoring and guidance for evolution of GEOSS will be provided by the GEO Committees with reference to the 2 year, 6 year and 10 year targets of the GEOSS 10 Year Implementation Plan Reference Document. The Tactical Guidance Document also describes approaches for establishing a “System of Systems” through converging observation systems, integrating observation, modelling and data management systems, and coordinating among societal benefit areas.



## GEOSE component registration process



### Relevance to GEO

These Guidance Documents are direct products from the task AR-06-02: GEOSS Guidance Documents. In developing the guidance documents, references were made to other related tasks AR-06-01(Process for interoperability arrangement), AR-06-03(Consensus on Architecture) and AR-06-04(Process to commit systems).

### Participants

A total of 20 Members and Participating Organizations contributed to developing the GEOSS Guidance Documents. The documents are developed under guidance of the GEO Architecture and Data Committee.

### Current Status and Next Steps

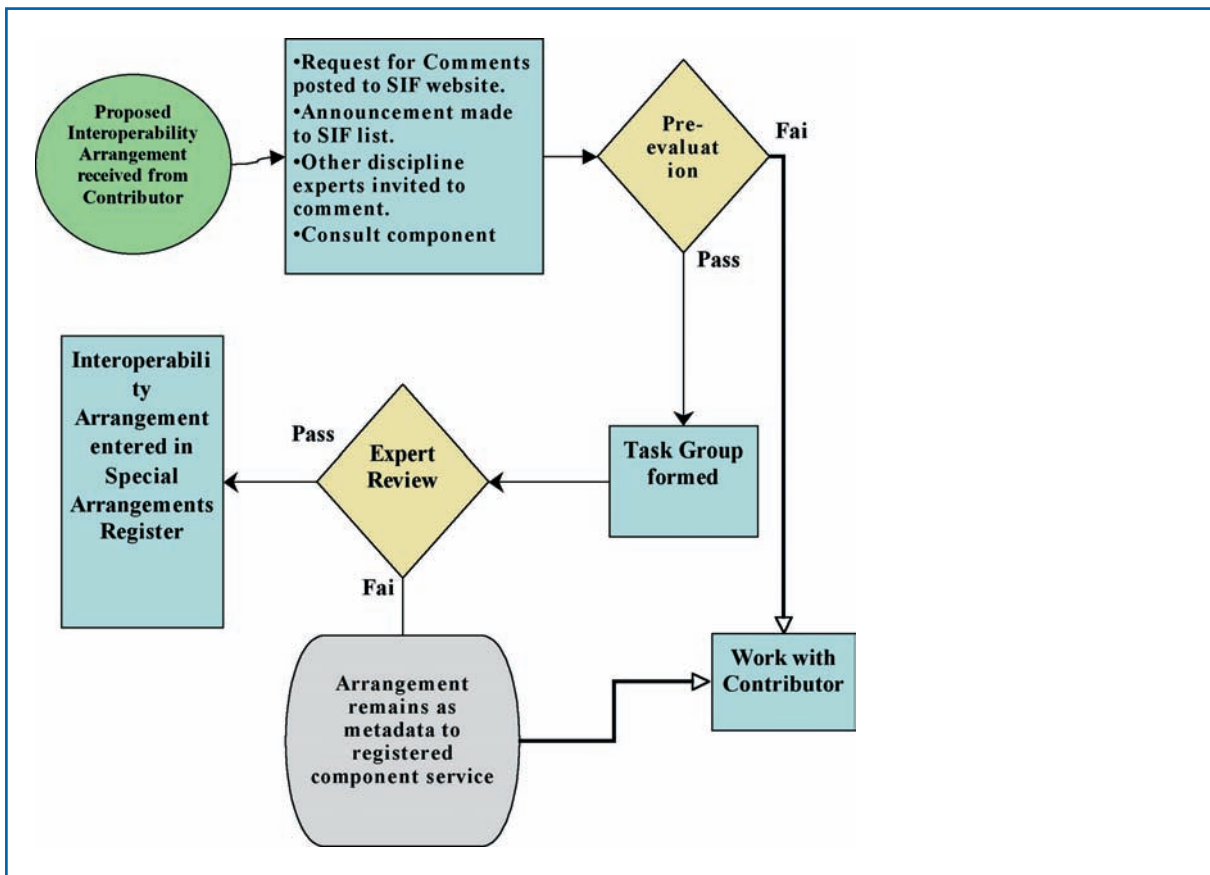
The Strategic Guidance Document was completed and waits for approval of the GEO Plenary for publishing. The Tactical Guidance Document is a living document and being constantly revised, reflecting latest development of GEOSS Architecture and Data process. A roadmap for implementing 2 year, 6 year and 10 year targets of the GEOSS 10 Year Implementation Plan Reference Document was also developed. It is being planned to transfer the responsibility of maintaining and revising these two Guidance Documents to the GEO Secretariat.



## GEOSS Standards and Interoperability Forum

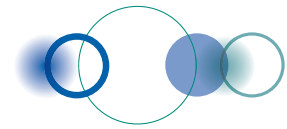
### Description

To support the critical need for interoperability among systems within GEOSS, the Standards and Interoperability Forum (SIF) was created under the leadership of the IEEE. The SIF provides advice, expertise and impartial guidance on issues relating to standards and interoperability for GEOSS. Its membership is composed of experts nominated by GEO Members and Participating Organizations. The SIF also draws on subject matter experts globally to support its objectives and goals. The SIF works by consensus of its participants and maintains a publicly-accessible data base of SIF actions and their status. The SIF also supports education and outreach to increase awareness of standards used in GEOSS.



*Illustration of the process for evaluation of proposed Special Arrangements by the Standards and Interoperability Forum. The Operations Procedures of the SIF are still under development*





## Added Value

GEOSS is being built from a great diversity of contributed systems. In order for GEOSS to become more than the sum of its parts, a synergy among its components must be achieved. The purpose and design of the GEOSS architecture is focused on this goal of promoting and enabling synergy, or in other words, interoperability, among the diverse and independent systems of GEOSS. This synergy is how GEOSS will make Earth observation data and information more accessible, useful and understandable. The SIF's goal is to enable ever greater degrees of interoperability among GEOSS components through facilitation, technical analysis, advocacy and education.

## Relevance to GEO

Because there are only a few standards for interoperability referenced in the GEOSS Plan itself, a process is needed for acknowledging additional standards and interoperability arrangements required for GEOSS. The GEO Architecture and Data Committee established its Standards and Interoperability Forum to facilitate interchange of information and development of recommendations for standards and interoperability. The SIF helps to maintain content of the GEOSS Standards and Interoperability Registry, which is the repository of information on the interoperability arrangements employed among GEOSS components. The GEOSS Standards and Interoperability Registry is described elsewhere in this Annex.

Although GEO encourages the use of open international standards, GEOSS must also accommodate the use of non-standard practices. Thus, the Standards and Interoperability Registry also contains information on these non-standard practices, or "special arrangements." The process for entering special arrangements into the Standards Registry is handled by the Standards and Interoperability Forum. Figure 1 portrays the process.

## Participants

- CNES
- CSIR
- ECJRC
- ESA
- GBIF
- IEEE
- IFREMER
- IHO
- ISPRS
- IUGS
- Japan
- KMA
- OGC
- OGCii
- USA(US-GEO)

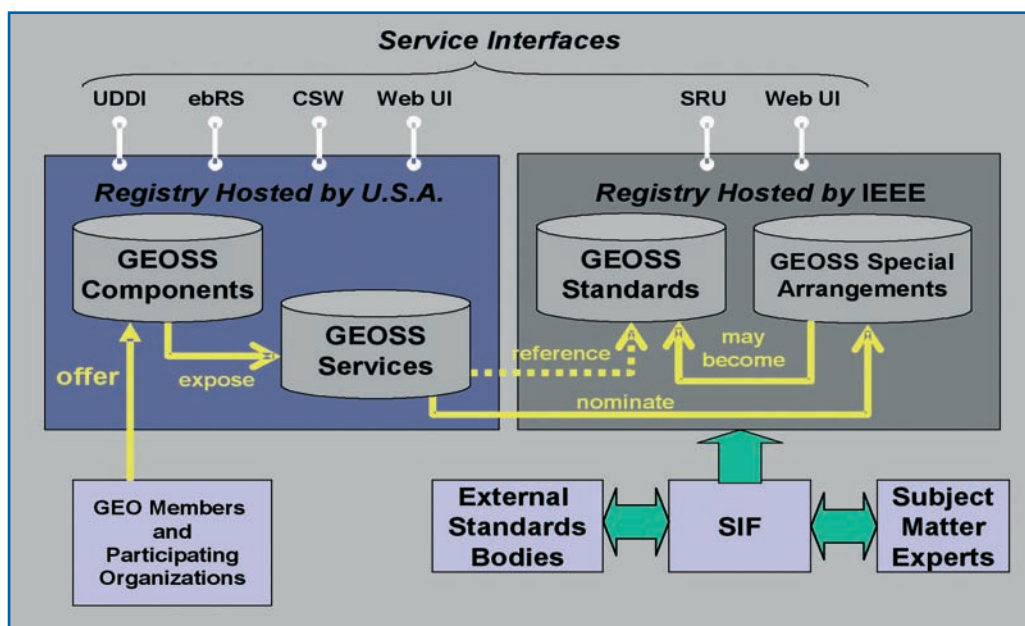
## Current Status and Next Steps

July	SIF Kickoff Meeting (organizational)
August	Second meeting of SIF (draft Terms of Reference)
September	First Working Meeting, Washington, D.C.
September	SIF Outreach, Magaratiba, Brazil
October	Working & Outreach Meeting, Xi'an, China

## GEOSS Standards and Interoperability Registry

### Description

Interoperability between contributed systems is a key to the success of GEOSS. An interoperability interface and the register for storing GEOSS standards and other interoperability arrangements has been developed and is being operated as a GEOSS resource contributed by the Institute for Electrical and Electronic Engineers, or IEEE. In addition, the associated registry serves as an educational resource and forum for discussion on matters related to interoperability for GEOSS.



*Illustration of the principal GEOSS registers and their interactions.*

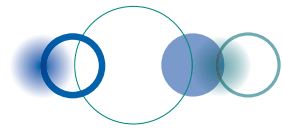
*The service interfaces through which the registers may be accessed are illustrated along the top.*

*The organizations providing content for the registers are portrayed at the bottom.*

### Added Value

Understanding the scope and complexity of the Earth system demands the formation of distributed, multidisciplinary collaborative teams. The information systems used by different disciplines are characterized by heterogeneous and distributed data and metadata models, different semantics and expertise, diverse protocols and interfaces, and different data policies and security levels. GEOSS must facilitate the formation of these distributed, multidisciplinary and collaborative efforts through a carefully crafted process for achieving interoperability.

In GEOSS, interoperability happens at the points where the GEOSS component systems interact, i.e. at the interfaces that the components present to the rest of GEOSS. Isolating the interactions of systems to well-defined interfaces minimizes the impact to the component systems participating in GEOSS. This significantly reduces the cost of participation in GEOSS for contributed systems. Thus the goal is to define and record precisely how these systems function at their interfaces, and for interactions to take place according to well-defined standards, preferably open, international standards. This is made possible through the GEOSS Registries.



## Relevance to GEO

GEOSS provides significant benefits through contributed systems working together to provide vital information in the nine societal benefit areas. The GEOSS Components and Services Registers, accessible through the GEOSS Clearinghouse, are a critical part of system interoperability allowing users to identify and more easily use GEOSS components. These GEOSS Standards and Interoperability Registers contains authoritative information on those standards or other “special arrangements” (i.e. non-standard practices) which allows users, data providers and system architects to fully utilize GEOSS resources. This includes information on service types, access protocols, data formats, schemas, and other standards in use. A web-based user interface allows users to browse or perform detailed searches on the registry’s holding. The registry may also be accessed via standard search protocols. The relationship of these registries is illustrated in the attached figure.

(Insert Figure 1 – GSIR\_Fig1.ppt)

Figure 1. Illustration of the principal GEOSS registers and their interactions. The service interfaces through which the registers may be accessed are illustrated along the top. The organizations providing content for the registers are portrayed at the bottom.

## Participants

- IEEE

## Current Status and Next Steps

Date	Milestone
May '07	Standards Registry Availability Announced
July '07	Website improvements: form for proposing addition to Register, discussion forums
Nov '07	Demonstration at GEO Summit

Planned enhancements to the GEOSS Standards and Interoperability Registries include a refined standards classification system, a database of standards development organizations and improved help and discussion forums.

## GEOSS Interoperability Process Pilot Project

### Description

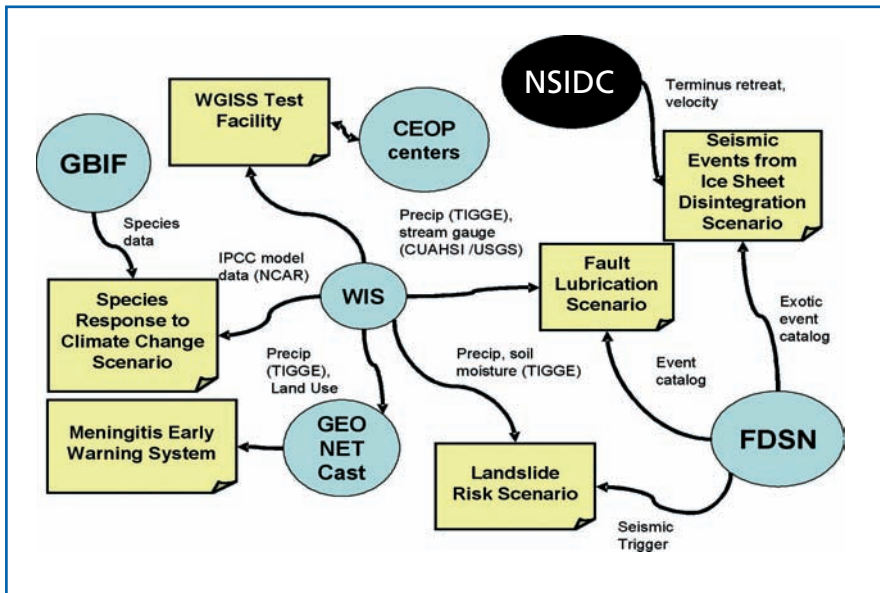
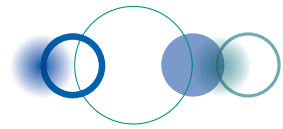
Details of GEOSS architecture and processes are emerging as the GEO Architecture has evolved to its initial operating capability. In an effort to begin implementing the infrastructure and testing the processes for achieving interoperability, the GEO Architecture and Data Committee initiated the Interoperability Process Pilot Project, or IP3, involving different Societal Benefit Areas (SBAs). The project confronts and addresses the challenges GEOSS will encounter as it brings normally independent disciplines together, to create new synergies. Thus, the IP3 created use case scenarios that required the exchange of data and information between disparate systems that had not yet established a mechanism for such an exchange. The systems initially chosen covered the fields of biodiversity, weather and climate, seismology, and water cycle. Figure 1 shows the selected use case scenarios, almost all of them cover more than one SBA; the related data and service resources are reported, as well. Demonstrations are planned for the GEO Summit in November. Figure 2 depicts a first analysis conducted for the GBIF IP3 demo: the range of the “common roadside skipper” butterfly (*Amblyscirtes vialis*) will move about 300 kilometers northwards by the year 2050 under the most conservative climate change scenario (IPCCB1).

### Added Value

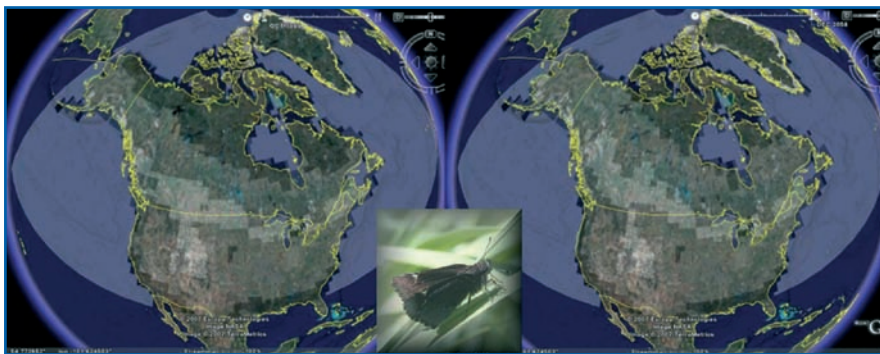
The GEOSS architecture needs to be robust and useful to a broad range of Earth observation users. The IP3 is a test and demonstration program for the architecture, which is driven primarily by specific interoperability requirements as applied within and among Societal Benefit Areas. The intent is to leverage existing programs and established standards wherever possible, and to broaden convergence of systems based on agreed interoperability arrangements. Systems contributed to GEOSS are built to serve particular needs, but those systems should also be designed or adapted so their inputs and outputs support interoperability with other systems. Consequently, the focus of the IP3 was on interoperability situations that are surfaced by actual requirements to interface with GEOSS-affiliated systems through what are termed GEOSS “interoperability arrangements.”

### Relevance to GEO

Through the efforts the IP3 the GEO Architecture and Data Committee gained valuable practical experience that is helping to define and refine the process for reaching interoperability arrangements and the functioning of the Standards and Interoperability Forum as a facilitating mechanism for interoperability. This project is also contributing to the design of the GEOSS Standards and Interoperability Registry, which is the repository of information on the interoperability arrangements employed among GEOSS components, in addition to providing initial content for the Components and Services Registers



The IP3 selected use case scenarios and the related resources



GBIF IP3: Canadian butterfly (i.e. amblyscirtes vialis) distribution projected for the year 2050 under the IPCC B1 climate change scenario

## Participants

- WMO
- FDSN
- Japan
- IEEE

## Current Status and Next Steps

Date	Milestone
Feb '07	Draft scenarios delivered
May '07	Standards Registry Availability Announced
Sept '07	IP3 Demonstration to ADC
Nov '07	Delivery of IP3 documents

Activities in 2008 are anticipated to include further development of the landslide risk and meningitis early warning system scenarios, and exercising more completely the capabilities of the protocols and interfaces used in the scenarios. The IP3 will also begin to address semantic interoperability.

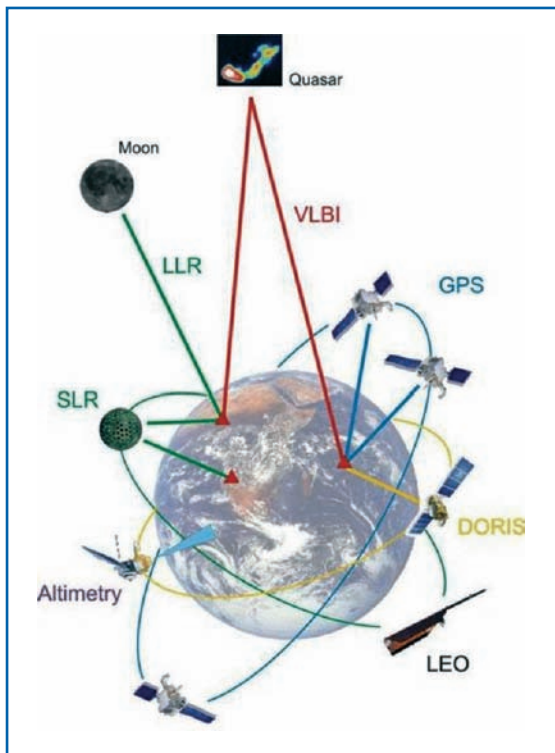
## Global Geodetic Reference Frame

### Description

With the *International Terrestrial Reference Frame* (ITRF), the *International Celestial Reference Frame* (ICRF), and the *Earth Rotation Parameters* (ERP), the *Global Geodetic Observing System* (GGOS) provides the metrological basis for all Earth observations independent of the specific Societal Benefit Area (SBA). These reference frames depend on considerable global infrastructure comprising not only the global in situ networks of several space-geodetic techniques (with up to 400 stations in more than 80 countries) and gravimetric techniques, but also the Global Navigation Satellite Systems and, increasingly, dedicated satellite missions (see the Figure below).

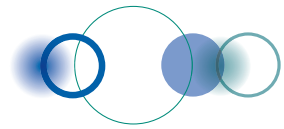
Maintaining a terrestrial reference frame at the level necessary to meet the user requirements, for example, with respect to the determination of global sea level changes, seismic displacement fields associated with large earthquakes, timely early warnings for earthquakes, tsunamis, landslides, and volcanic eruptions, as well as the monitoring of mass transport in the Earth system (in particular, the global and regional water cycle), requires an Earth system approach encompassing all Earth sciences.

In the frame of GEO, GGOS carried out a strategy process (denoted as GGOS 2020) with the goals (1) to establish the relevant user requirements across the nine SBAs, and (2) to provide the basis for the implementation of a geodetic observing system that will meet the requirements of the society at large and the SBAs of GEO in particular.



*Infrastructure contributing to GGOS. The combined infrastructure allows the determination and maintenance of the global geodetic reference frames, and the determination of Earth's gravity field and rotation. The ground networks and navigation satellites (currently in particular GPS) are crucial in positioning, with applications to all SBAs. In particular, they allow the monitoring of volcanoes, earthquakes, tectonically active regions and landslide-prone areas. The Low Earth Orbit (LEO) satellites monitor sea level, ice sheets, water storage on land, atmospheric water content, high-resolution surface motion, and variations in the Earth's gravity field. The latter are caused, to a large extent, by regional and global mass transport in the hydrological cycle.*





### **Added value**

GEO is an appropriate forum for the dialog on the development of an intergovernmental approach to the implementation of the infrastructure, in particular the operational core, required for maintenance of the global geodetic reference frames in a way appropriate for maximum benefit of GEO. The GEO Committees and Tasks foster new links between GGOS and Participating Organizations and institutions in Member Countries that are stakeholders in geodetic observations, products, and applications. GEO also provides for the links to users in a wide range of applications across all SBAs.

### **Relevance to GEO**

Geodetic observations and products are relevant at least for the GEO SBAs of Water, Disasters, Energy, Weather, Climate, Health, and Agriculture. Thus, GGOS is a major component in the architecture of GEOSS. The GGOS 2020 process, which is integrated in the Task AR-07-03, facilitated the assessment of the cross-cutting GEO requirements for the reference frames and for monitoring of mass transport particularly in the water cycle (including sea level, ice sheets, water storage on land, and atmospheric water content). The process also provided an assessment of the status of GGOS and the identification of current and potential future gaps (particularly in the sea level, ice sheets, and water cycle monitoring system).

### **Participants**

- IAG (represented by GGOS)
- CEOS (represented by CNES)
- Germany
- Italy,
- South Korea
- EC

### **Current Status and next Steps:**

After completion of the GGOS 2020 process, the next steps are (1) to enter a dialog concerning the appropriate intergovernmental frame for the implementation of the recommendations, (2) to discuss with the space agencies steps towards implementation of the recommended space components, and (3) to reach out to the SBAs to ensure maximum benefit of the geodetic observations and products for the users. A major goal will be on the stability of an operational core infrastructure and the closure of spatial gaps in the global *in situ* networks.

## GMES

### **Preliminary comment:**

GMES is a European Programme led by the European Commission and developed jointly with the European Space Agency. This initiative is not a GEO early achievement per se. However the combined efforts developed by the member states of the European Union and of ESA are an important contribution to the GEO objectives. It is widely recognised that a subset of relevant GMES capabilities, still to be defined, should be made available to GEO and that a proper coordination between the two initiatives would bring mutual benefits.

### **Description**

GMES is the European solution responding to the needs of citizens in Europe to access reliable information on the status and evolution of their environment and to ensure an improved security.

The purpose of GMES is to deliver Information Services which:

- are based on Earth observation data, collected from space (satellites), air (airborne instruments, balloons to record stratosphere data, etc.), water (floats, ship-borne instruments, etc.) or land (measuring stations, seismographs, etc.)
- result from data processing through an added value chain (processing and analysis, expertise, assimilation or integration techniques) producing output services in the form of e.g. maps, gridded datasets and products, reports, targeted alerts, etc.
- correspond to identified user needs.

#### GMES Earth Observation Infrastructure

- NON-SPACE DATA are generated by infrastructure ensuring data collection over land, ocean and in the atmosphere, mostly owned and operated at national level by different EU Member States.
- SPACE DATA are generated from satellite instruments and received by the corresponding ground stations. As many of these systems already exist at national or European level, GMES is meant to make best use of the existing capabilities. Additionally, a gap analysis has been performed (data potentially generated by existing and planned satellites as compared to the data needs of planned services). Part of the identified gaps will be bridged through a constellation of GMES-dedicated satellites to be developed by ESA, called "Sentinels".

GMES information services can be split into:

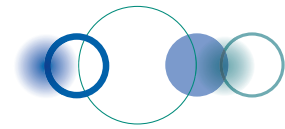
- CORE SERVICES which are relevant at European level, and that by consequence could represent a common basis of multi-purpose information, and
- DOWNSTREAM SERVICES, developed on the basis of the core services, that are more specific and that should be tailored to particular uses and user communities.

### **Added value**

GMES is not limited to the boundaries of the European Union, but is foreseen to support the implementation and monitoring of Europe policies with global reach too. Europe's commitment to international aid in case of crises and natural disasters, its contribution to environment protection worldwide, the fighting of famine and poverty in remote regions of the globe can be done more efficiently using data provided also by GMES.

GMES will be seeking to pursue international cooperation both at bi-lateral, regional and global (multi-lateral) level. At the same time, it will foster cooperation at global and regional levels to fulfil its objectives and GEO will be one key vehicle for concerted actions amongst worldwide players.

The EU's participation in the GEOSS will facilitate data exchange with international partners and will encourage the increased use of Earth observation, as well as the development of a system of worldwide observation systems. At the same time, GMES involvement in GEO will help the identification of global opportunities for European stakeholders and will catalyse cooperation at international level on actions of mutual interest along complementary and coherent work programmes.



Ensuring a harmonious cooperation between GMES and GEO is therefore an issue of key mutual importance: In particular:

- GMES will represent in GEO a coherent position of all GMES stakeholders regarding the contribution of Europe to GEOSS.
- The involvement of GMES in GEO will help to leverage other contributions to GEO at European and National level.
- GEO and GMES will cooperate in the identification of complementary capabilities, and will pursue complementary actions at global level to avoid duplication and to fill gaps.
- GMES will contribute to GEOSS based on a system-of-systems philosophy. It will, namely contribute to the long-term availability of a set of interoperable European capabilities with both European and global reach;
- GMES will foster the development of value-added services including a combination of global data and service elements, leveraging on its international participation in GEO.
- GEO will promote international cooperation aiming at:
  - Identification of cooperation opportunities also in the frame of GMES
  - Identification of requirements for world-wide or regional services where GMES can contribute (eg. GMES/IEOS combined infrastructure for services in ACP countries)
  - Promoting sharing of data and services and cooperation at global level

### Relevance to GEO

In the frame of GMES, existing European capabilities of Earth Observation will be coordinated and new ones will be developed and deployed to fill existing gaps. At the same time, data policies for Earth observation in Europe will be set, where the INSPIRE directive will have a prominent role.

The different services developed under GMES and its underlying infrastructure are relevant to most SBAs in the GEO 10-year implementation plan and to the four horizontal activities covered by the specific GEO Committees (ADC, UIC, CBC, S&TC). Conversely, GEO activities are relevant for the GMES international strategy in particular regarding cooperation at global level.

A mutual exchange of information of data and information produced in the frame of GMES and by GEOSS will be ensured. A deeper reflection will be necessary to identify which subset of services will be made available to GEOSS.

Relevance of GMES services to GEO Societal Benefit Areas *(number of starts correspond to level of relevance)*

	Disasters	Health	Energy	Climate	Water	Weather	Ecosystems	Agricult.	Biodiv.
Land	*	*	*	*	*		**	***	**
Emergency	***	*							
Marine	*	*	*	*	**	*	**		**
Atmosphere	*	**	*	***		**			

### Participants

GMES is a European initiative led by the European Commission where the European Space Agency is charged with the coordination of the Space Component. Several other European actors are involved in the development of this initiative such as EU and ESA Member States, institutional actors, entities and agencies at national or European level, European Industry, communities of users and other players.

### Current status

Development phase: The first services during the operational phase will be available by end of 2008.

Operational phase: Programmatic, governance and financial solutions for the long term sustainability of the services and for supporting space and non-space observation infrastructures needs to be in place by 2012.

### Details on GMES Information services

## GMES Emergency Response Core Service (ERCS)

### Purpose:

The objective of the Emergency Response Core Service (ERCS) is to reinforce the European capacity to respond to emergency situations associated with meteorological driven-hazards (e.g. storms, fire, floods), geophysical hazards (e.g. earthquakes, tsunamis, volcanic eruptions, landslides), and deliberate and accidental man-made disasters and humanitarian disasters.

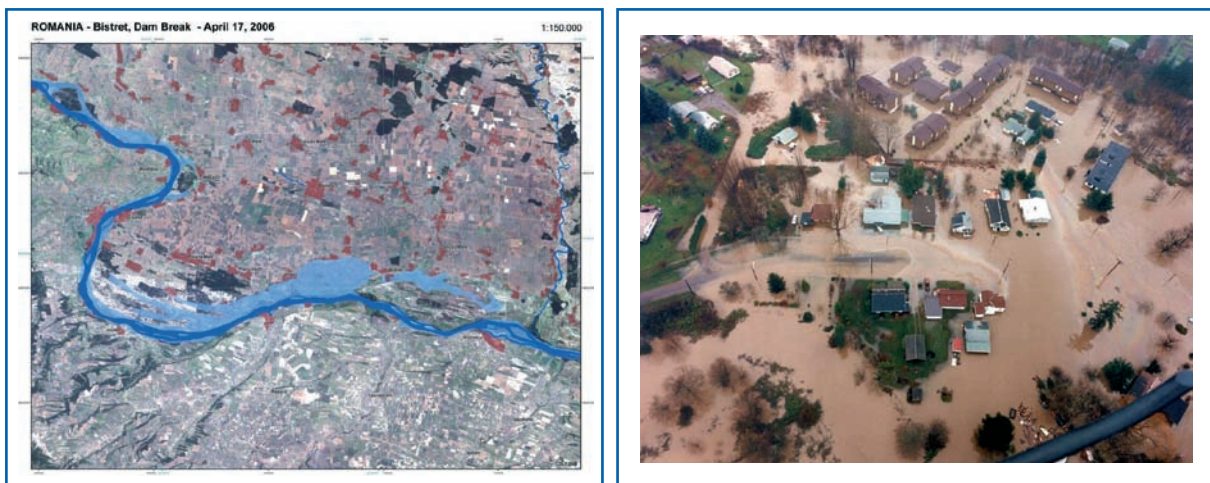
### Products:

The highest priority of the service is to improve an immediate response to disastrous events through the robust rapid mapping capacity. It encompasses acquisition and maintenance of reference maps (including the enrichment with various thematic maps – e.g. population maps, assets maps, historical damage maps, etc.), and consequently delivery of assessment mapping services providing timely information on extent of emergency event, severity of event, etc. A set of specific toolboxes will allow the integration of Earth observation data with thematic and in-situ information which will result in complete service package to help responsible authorities (especially National Civil Protection Agencies) to plan rescue actions in real time, to improve efficiency of means used, and to protect citizen's lives and properties. The next logical step is to address the pre-disaster and post-disaster parts of emergency in course of the service evolution. The service will evolve to cover crisis prevention and early warning systems as well as post crisis reconstruction, situation assessments and monitoring of post crisis development – this is particularly relevant to the scope of the service outside the EU. The ongoing documentation of the risk vulnerabilities and development of harmonized risk level nomenclature is another benefit of the service evolution process.

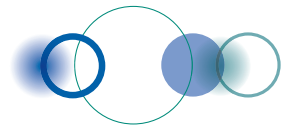
### Progress:

ERCS is gradually built upon the existing operational capacities and experiences gained from a number of R&D projects financed by the Commission and European Space Agency. Among others, the know-how coming from PREVIEW, RISK-EOS, RESPOND or TERRAFIRMA projects becomes a corner stone of the Emergency Response Core Service. A follow-up project to develop operational emergency services is currently being evaluated under FP7. By the same token, the service development is constantly accompanied with user consultations at national as well as European level in order to deliver reliable, operational and user-driven service portfolio by 2012.

Example: Support to civil protection – rapid mapping



*With GMES, European civil protections will have access to a 24/7 service delivering very good overview as well as a detailed view capability which – when coupled with positioning services and satellite communications – facilitates the interventions of civil protection units and contributes to the safety of the citizen and saving of lives during more extreme events, in Europe and in the world.*



## GMES Land Management Core Service (LMCS)

### Purpose:

It is the goal of the GMES Land Monitoring Core Service (LMCS) to provide timely, continuous and independent observations about the use of soil and other land resources and the changes of the land environment for responsible and farsighted policy-making at all levels (European to local).

### Products:

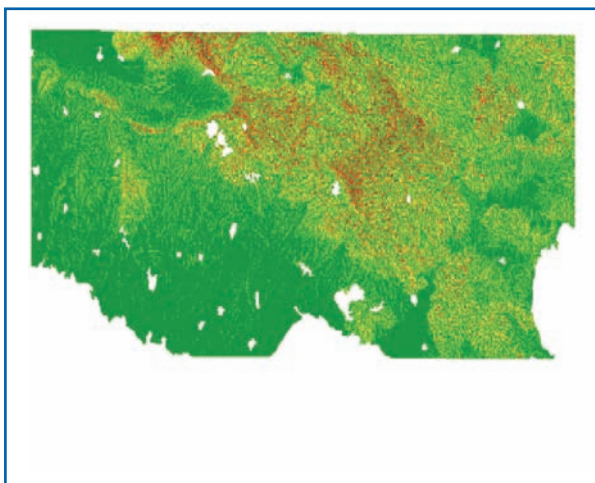
The central part of the service portfolio lays upon the pan-European classification capacities in order to interpret at various levels (local, European, global) the land cover and to define major anthropogenic activities carried out within an area (land use). In order to capture trends in the domain, a set of toolboxes providing comparative analyses will become entire component of the service tracing changes over a period. In addition, further elaboration and integration of above-mentioned "generic" products (based predominantly on Earth observation data) with another sources of information will give birth to specific information services aiming at monitoring of various human activities and environmental aspects related to an area. The scope of the service will, for example, provide a number of information in the field of agriculture describing crop patterns and yield forecasts or impacts of farming practices on environment through a set of agri-environmental indicators. Furthermore, the specific products focusing on water quality modelling, forest biodiversity monitoring, spatial planning and development or even models addressing biospheric carbon fluxes are other examples of the service modus operandi.

### Progress:

A number of specific R&D activities paved the long way towards current sophisticated applications targeting interpretation of land cover/use data and its assimilation with other data sources in order to develop reliable tools for Land Monitoring Core Service. The service will be built on the assets of previous or ongoing projects funded under Framework Programme (e.g. Geoland, Boss4GMES), by ESA (e.g. Land, Forest Monitoring, GMFS, SAGE, or Urban Services) and European Environmental Agency (CLC/FTS 2006).

Targeting wide scale of terrestrial variables combined with other information, the service will address number of GEO Societal Benefit Areas such as climate, water, ecosystems, agriculture and biodiversity.

### Example: Land cover/land use for agriculture



*Land use information gathered at parcel level could be combined with agronomic models and diagnostic tools. The result would be a more targeted service that could be provided to farmers in order to optimise, for example, the fertilizers or pesticides input and, in general, to better organise the land management and prevent soil degradation.*



## GMES Marine Core Service (MCS)

### Purpose:

The Marine Core Service (MCS) aims to produce regular and systematic reference information on the sea state and dynamics of known quality and accuracy for the global and regional European seas

### Products:

The most basic service of the MCS is the transformation of raw data into quality controlled data sets and products. Marine core products include all real-time and archived observational data. Derived products include relevant variables needed to describe sea state and dynamics (e.g. geophysical variables such as 3D fields of ocean currents, temperature, salinity..., biogeochemical variables such as chlorophyll, dissolve inorganic nutrients,..) and the primary ecosystem (e.g. surface phytoplankton, primary production). The marine core service includes assimilation and modelling capacity based on a global and several regional models. The MCS will systematically deliver forecasts (from one day nowcasting to one month seasonal forecasting), re-analysis (time series) and scenario simulations (for climate change issues)

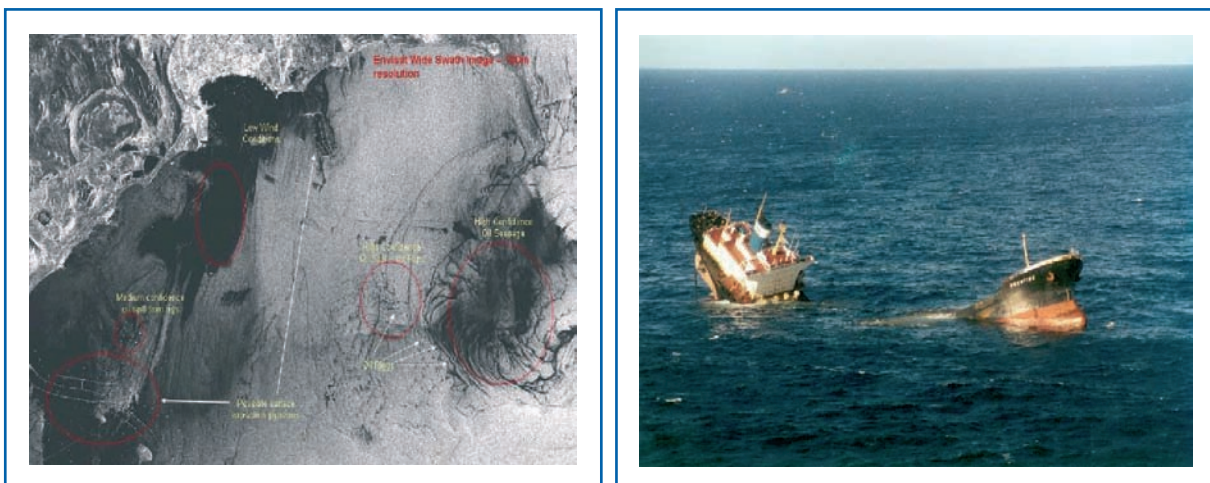
Several relevant areas stand to benefit from an operational MCS:

- Disasters (e.g. oil spill discharge, sea ice forecasting, search and rescue, drifting objects management, extreme wave forecasting and marine navigation)
- Energy (e.g. safety issues at off shore oil and gas production installations)
- Climate (e.g. variables regarding the ocean's influence on atmosphere composition and climate)
- Water, Biodiversity (e.g. state and impact & associated indicators of the marine environment)
- Health, Ecosystem (Toxic Algal Blooms)
- Weather (e.g. initial ocean conditions & reanalysis data gives input to seasonal forecasting and extended weather forecasts)

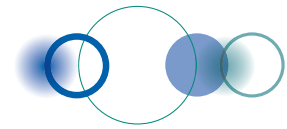
### Progress:

The MCS is being built with existing pre-operational capacities and experiences gained from a number of R&D projects financed by the Commission and the European Space Agency. The main project precursors of the MCS are the FP6 MERSEA project, as well as the GSE-projects MARCOAST and Polarview. A follow-up project to develop operational oceanographic services is currently being evaluated under FP7.

Example: Oil spill/discharge detection & monitoring



Near-real time radar imagery from satellites enables early detection of oil spills or illicit oil discharge in order to allow a quick and adequate response. When combined with oceanographic & weathering models, these data allow monitoring and forecasting drift, enabling best-available location and drift information to aid the response teams (prevention, remediation).



## GMES Atmospheric Service.

### Purpose:

The GMES Atmosphere Core Service will deliver standard European and Global information products and information services that support European policies and information on global issues linked to the processes in the atmosphere and their effects.

### Products:

The Atmosphere service includes three main areas:

1. Air quality: will provide global and European air quality analysis and forecasting as well as historic records of atmospheric composition
2. Climate forcing: improved monitoring of the state of the climate system as well as global and European regional concentration fields of key greenhouse gases (to identify sources and sinks)
3. monitoring of status and trends in stratospheric ozone depletion; routine provision of updated ozone, UV and solar radiation maps and forecasts as well as historic European UV and solar radiation mapping.

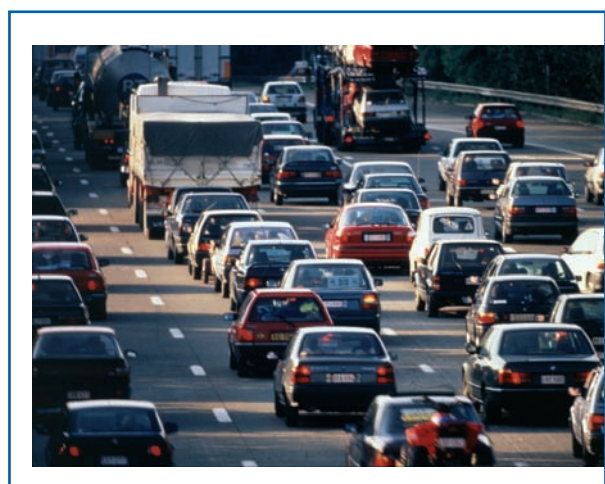
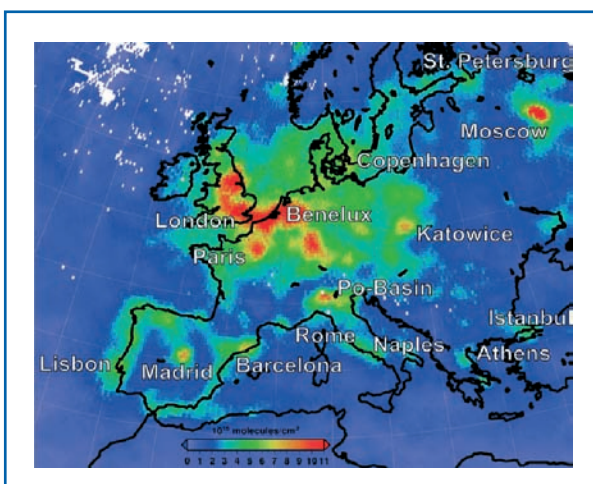
Several relevant areas stand to benefit from an operational Atmospheric service:

- Disasters (e.g. forecast extreme pollution events and identify relevant sources)
- Energy (e.g. solar energy exploitation improved through radiation forecasting)
- Climate (e.g. climate essential variables, clarify missing parameters in climate change)
- Health (e.g. applications to address skin radiation exposure, improved pollen forecasting, epidemics tracking, improved chronic pulmonary disorder forecasting)
- Weather (e.g. better weather forecasting through mapping of clouds, aerosols, ...)

### Progress:

The atmosphere service is being built with existing pre-operational capacities and experiences gained from a number of R&D projects financed by the Commission and the European Space Agency. The main project precursors are the FP6 GEMS project, as well as the GSE-projects PROMOTE. A follow-up project to develop pre-operational atmospheric services is currently being evaluated under FP7.

### Example: air quality monitoring



*Air pollution is rapidly increasing and macroscopic effects are already evident at global level and affect the health of the world population, in particular in urban areas. Keeping air quality records and developing air quality forecasts will enable local authorities to timely alert in case of health risks. More in general, observation and assessment of gas emission and air pollution will help to propose environmental targets and monitor their progress and implementation.*

## The GHRSSST-PP Multi Product Ensemble (GMPE)

### Description

The world's ocean and the global atmosphere influence the environment in all regions of the Earth and have an impact on the lives of people in all countries. Between them the ocean and atmosphere provide thermal regulation of the planet, transporting heat from the tropics to the poles, and control the hydrological cycle which supports life by redistributing water over the land surface. The dense ocean serves as a reservoir for heat and for gases such as CO<sub>2</sub>, helping to moderate climate variability and ultimately it is the ocean's behaviour that is fundamental to understanding the long-term trends in the climate. Therefore from the perspective of the GEO/Global Earth Observation System of Systems (GEOSS) communities the interface between the ocean and atmosphere is evidently a boundary of great importance. Its temperature, the Sea Surface Temperature (SST) is a key variable for understanding the fluxes of heat, momentum and gases which determine the complex interactions between atmosphere and ocean.

These manifest themselves on a variety of scales, from the ocean gyres and atmospheric circulation cells, though large atmospheric depression systems, storms and hurricanes, to smaller scale phenomena such as the local production of clouds and the generation of ocean waves. Accurate global SST is required by ocean and atmospheric forecasting systems on a daily basis to constrain the forecasting systems at their boundaries.

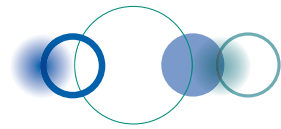
The main aim of this task is to demonstrate the application of the next generation of satellite derived sea surface temperature (SST) observations provided by the Global Ocean Data Assimilation Experiment (GODAE) High Resolution SST Pilot Project (GHRSSST-PP) particularly for climate monitoring, weather and ocean forecasting. Activities include:

- Use multi-product ensemble techniques investigate SST analysis uncertainty estimates (both analyses and observational products) and use data assimilation techniques to assimilate GHRSSST-PP products and improve output from ocean and atmospheric forecast systems;
- Apply ensemble techniques to improve climate monitoring using global and regional SST data sets;
- Initiate and sustain an in-depth, continuous scientific and technical dialogue between the ocean/weather/climate modelling community and other scientific communities – potential users and/or developers of ensemble techniques. Promote the development of these activities through advocacy for international collaboration at organization-, government-, and/or agency- level to help connect most relevant entities and communities for project implementation.

At the 8th international Global Ocean Data assimilation Experiment (GODAE) High Resolution SST Pilot Project (GHRSSST-PP) the GEO task was reviewed in detail and a team established to develop an operational Multi-Product Ensemble (GMPE) system and experiment. An SST ensemble system has been developed at the Met Office, United Kingdom in collaboration with other operational agencies in the USA, Australia, France, Denmark, Japan. The ensemble allows centres to assess the relative performance of their SST product against a 'consensus' standard product.

Each day this GHRSSST-PP Multi-product Ensemble experiment produces an ensemble SST map using all of these SST inputs and an associated standard deviation map using SST analysis data collected over the last 24 hour period (i.e. yesterday). Thus, the nominal analysis time for the GMPE median ensemble SST is 12:00Z for the previous day (i.e., T-1). The GMPE median ensemble SST map is computed as a median average using a variety of GHRSSST-PP L4 analysis products after their differing analysis grids have been homogenised by area averaging onto a standard 0.5° lat/lon grid. Where an input analysis product indicates sea ice but provides no SST value, a default value of -1.8°C has been substituted. The associated standard deviation map provides the standard deviation of all input data sets for each grid square used in the median ensemble SST map. Figure 1 shows an example of the GMPE outputs.

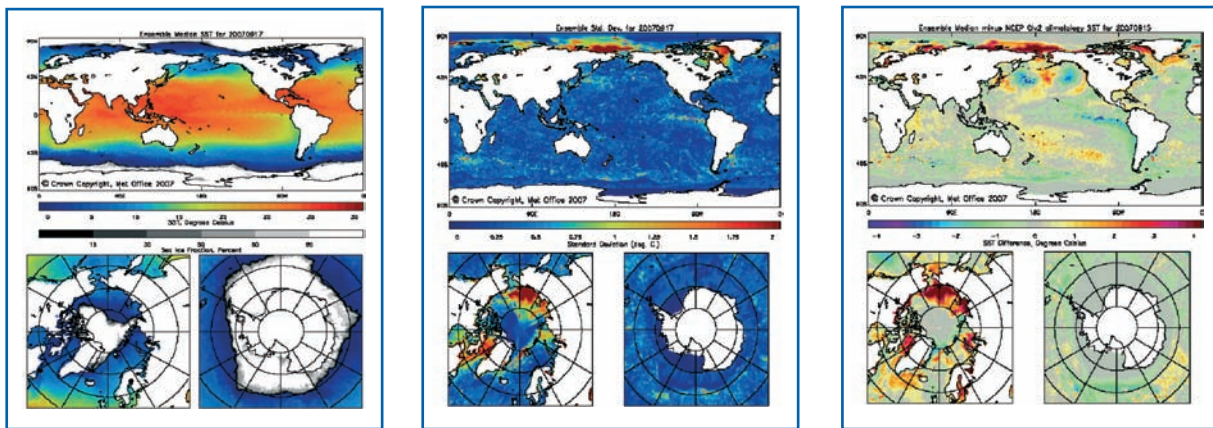




The image data sets are updated each day ~13:30Z. Output data sets are available on a daily basis (T0-24) at <http://www.ghrsst-pp.org/Todays-global-SST.html> and include:

- Foundation SST ensemble, global, 1/2 degree, daily.
- SST ensemble standard deviation, global. 1/2 degree, daily
- 7-day animations of SST and STD fields
- SST anomaly based on Reynolds Olv2 climatology (1985-2001)
- Input analysis anomaly plots based on the SST ensemble SST

Currently only web plot files are available but in the near future data sets will be created in a GHRSS-PP netCDF L4 format for applications development purposes.



(a) Example GMPE ensemble SST and (b) associated standard deviation of the ensemble. (c) Difference between GMPE SST and Reference climatology (1985-2001) for 15th August 2007. Data have been interpolated to a common 1/2° grid. Clearly seen is the obvious and large warm SST anomaly in the Arctic Ocean. Closer inspection of this figure reveals many other features including coherent meso-scale structures in western boundary current regions associated with the higher resolution and richer input data of OSTIA, the eastern Tropical Pacific Ocean associated with the current La Nina condition, differences in the N American Great Lakes and upwelling signatures off the NW African coast.

Associated ensemble standard deviation fields are derived to provide a coarse estimate of errors from the different analysis techniques and input data sets. Some outputs use in situ and infrared satellite data whereas others use both infrared and microwave satellite data. In one case (OSTIA, see <http://ghrsst.metoffice.gov>), the ENVISAT AATSR is used to provide a reference data set for bias correction of all other satellite data streams building on the high-accuracy strength of this particular data set. Sea ice concentration data sets from the EUMETSAT Ocean and Sea Ice Satellite Application Facility (OSI-SAF) are used to specify the ice edge in the ensemble and a future area for further research is the use of multiple sea ice concentration data sets in an ensemble mode.

## Applications

This activity serves the GEO Climate Change and Weather forecasting benefits. The unprecedented retreat of sea ice in the Arctic region since June 2007 and the large open water area in the Chuckchi and Beaufort Seas have resulted in unprecedented SST values in this region (>10K above the 1985-2001 climatology computed using Reynolds Olv2.0 SSTs) which are shown in Figure 1(c). The GMPE ensemble SST anomaly map is derived from NCEP/NOAA (Reynolds) Olv2. This climatology was formed from the weekly SST analysis performed by Reynolds et al. The climatology for the current week was computed from a daily climatology, which in turn was computed using an average of all weeks between 1985 and 2001 containing that day of the year. The analysis resolution is 1 degree spatially. More detail can be found on the NOAA Optimum Interpolation home page.

The GMPE outputs show significant differences between many input data sets in the Arctic region (based on anomaly plots) that are currently being investigated. Initial results suggest that in some cases, quality control thresholds may have rejected the extremely warm SST's as errors in operational systems to the detriment of some NWP and Ocean forecasts. Based on this work, the full operational implementation of the Met Office OSTIA system has been accelerated so that the full impact of GHRSS-PP and the satellite infrared and microwave SST blending techniques that the project has developed have been pulled through to operations.

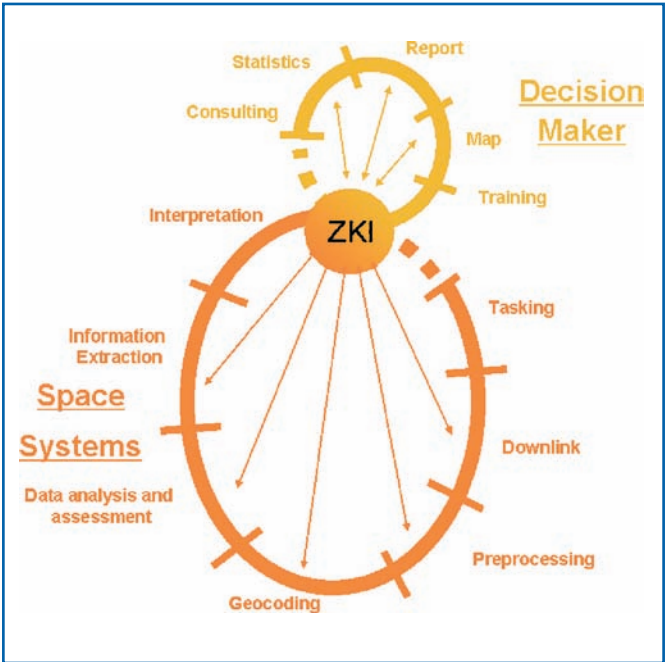
# Implementation of the Center for Satellite Based Crisis Information

## Description

The «Center for Satellite Based Crisis Information» (ZKI) is a service of DLR's German Remote Sensing Data Center (DFD). Its function is the rapid acquisition, processing and analysis of satellite data and the provision of satellite-based information products on natural and environmental disasters, for humanitarian relief activities, as well as in the context of civil security. The analyses are tailored to meet the specific requirements of national and international political bodies as well as humanitarian relief organizations.

ZKI operates in national, European and international contexts, closely networking with German public authorities at national and state levels (crisis centers, civil security, environmental protection), nongovernmental organizations (humanitarian relief), satellite operators and space agencies.

The main objectives of ZKI are to set up structures and operational service lines providing satellite based crisis information to support civilian disaster management, humanitarian relief operations and civil security operation. Therefore ZKI uses methods like accessing, (pre-) processing, integrating and analysing satellite imagery/geoinformation to provide information on specific crisis situations as well as civil security analysis tasks. ZKI has available operational access to a wide variety of EO and geodata from archives as well as from new acquisitions. The results of the ZKI work are mapping and analysis services and products. Various examples are published on ZKI website ([www.zki.dlr.de](http://www.zki.dlr.de)). Through the provision of Earth Observation derived products and services ZKI supported various national, European and international relief operations. The services include situation analysis, operations overview and decision support mapping.



## Added Value

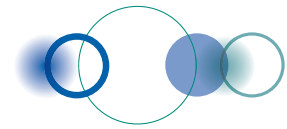
How GEO aids the implementation and work of ZKI:

GEO provides a framework to integrate ZKI work beyond the national, European and UN frame into the global context of satellite based disaster response. Successful implementation of the virtual constellation concept for disaster management (task DI-06-09) will increase the ability of ZKI to produce relevant information products to its users in a timely fashion.

How ZKI impacts on GEO:

ZKI provides the link between fundamental observation systems and key users in emergency response activities. Thus it helps raising the profile of earth observation by providing highly visible examples. Also, ZKI capacity building activities in the context of emergency response contribute to the objectives of GEO task CB-07-02.





## Relevance to GEO

ZKI is directly relevant to the "Disaster" SBA and task DI-06-09 in particular. The highly visible demonstration of applications of earth observation based information products in the context of disaster response contributes to the aims of the GEO capacity building targets; the specific capacity building elements of the ZKI activities, including workshops and training, are in line with and contribute to CB-07-02 specifically. Furthermore, ZKI established capacities in providing information in the context of risk modelling and vulnerability assessment, which is relevant to various activities and programmes.

## Participants

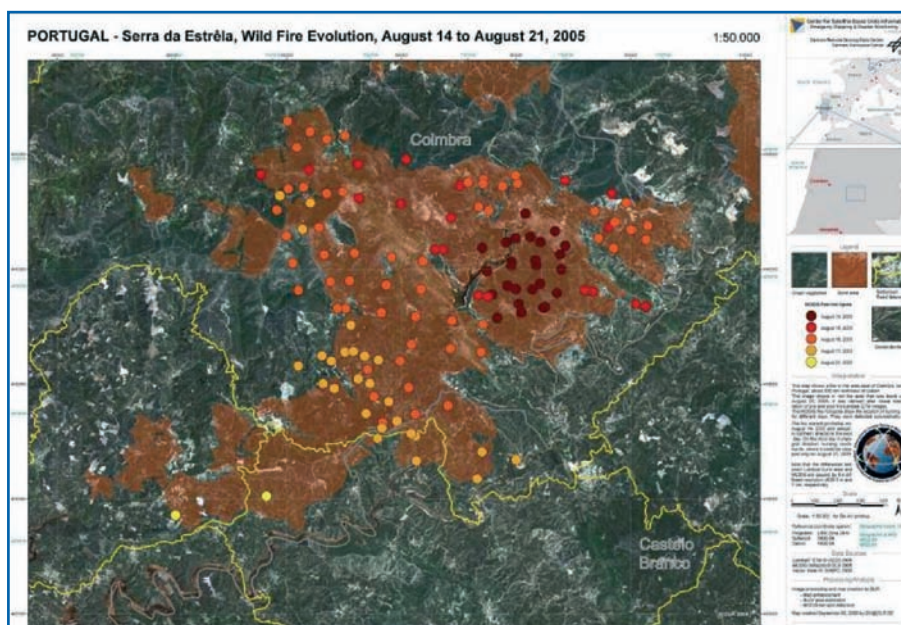
ZKI is usually active in internationally coordinated context, including the International Charter Space and Major Disasters, the European GMES Service Elements, the EU research programmes or the UN-SPIDER program, which are intimately linked to GEO. ZKI cooperates with, and delivers products to several UN, EU and national organisations (e.g. UNOOSA, UNOCHA, WMO, WFP, EU commission, EU-MIC, German foreign ministry and Non-governmental relief organisations).

## Current Status and Next Steps

ZKI is a long term service structure established at DLR and interlinked with national and international disaster response and relief capacities. The aims are:

- Combining existing DLR technical and scientific resources and expertise for effective and coordinated crisis management,
- Developing and establishing methods to generate customized information products and services for disaster management, humanitarian relief and civil security,
- Designing appropriate information technologies and infrastructure,
- Providing advice on establishing crisis information centers, and
- Developing and setting up distributed European and international networks for satellite-based civil crisis information
- Define and develop further thematic topics in the context of the full crisis management cycle (e.g. preparedness, early warning and mitigation)
- Establishing capabilities defining methods in vulnerability assessment and risk modelling using earth observation data and additional geo-information.

ZKI is currently implemented in an early operational mode, based on institutional as well as third party R&D funds. Future steps should aim at implementing the operation on user based funds.



*DLR-ZKI Map  
for the forest fires  
in Portugal/Serra  
da Estrêla,  
August 2005*

## Interoperability - Expediting access to GEOSS components and services

### Description

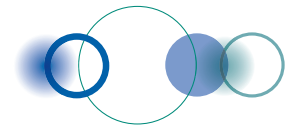
The implementation of GEOSS architecture activities has improved access to contributed earth observation systems and their services through the development of a common architecture, creation of interoperable online registries and catalogues, and publication of strategic and tactical guidance documents for use by GEO Members and Participating Organizations. Through GEO participant contributions, an online “yellow pages” of organizations and web-based services has been established, and continues to be populated with links to dynamic earth observation services. This GEOSS Registry system is being used by a variety of software clients for data discovery, visualization, and analysis, the results of which will be shown at the GEO-IV Plenary and Ministerial exhibition in Cape Town, South Africa. A Standards and Interoperability Forum has also been established to register and promote the adoption of additional earth observation standards within the GEOSS community.

### Added Value

The GEOSS architecture and standards framework facilitates the publishing of earth observation services and capabilities to enable just-in-time analysis of earth observation data. The GEOSS Registries provide a single point of access to worldwide collections of earth observation data and services, not previously available. The GEOSS Standards Registry promotes the contribution of standards-based solutions (services, data, and applications) that can be more readily integrated and applied.

### Relevance to GEO

These capabilities are being implemented through the GEO AR-07-01 task, “Enabling Deployment of a GEOSS Architecture,” one of the core Architecture and Data Committee tasks.



## Participants

- OGC
- Argentina
- Australia
- Canada
- CEOS
- EC
- EEA
- ESA
- EUMETSAT
- FAO
- DSN
- France
- Germany
- GOOS
- GSN
- GTOS
- IEEE
- IGOS-P
- IIC
- INCOSE
- INTERMAGNET
- IOC
- Italy
- Japan
- JCOMM
- Netherland
- Norway
- POGO
- Portugal
- Republic of Korea
- Russia
- South Africa
- Spain
- USA
- WCRP
- WMO

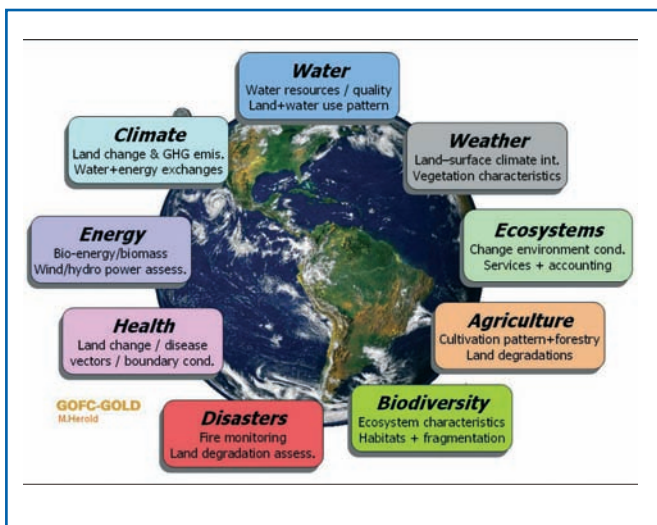
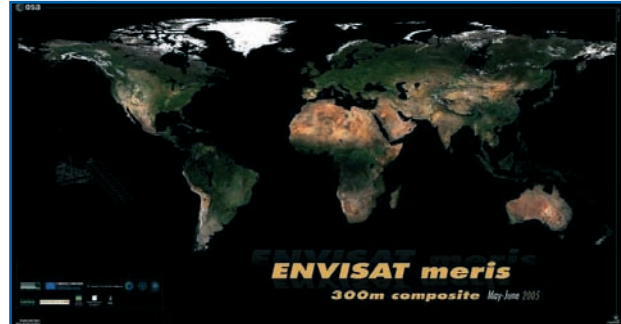
## Current Status and Next Steps

- |           |  |
|-----------|--|
| April     | Interoperability Process Pilot Project (IP3):<br>registration of components and services for all projects  |
| May       | Accept GEOSS Components and Services Registrations,<br>Components and Service Register, associated registry services Open<br>of Initial GEOSS Components and Services Registration |
| May – Jun | Use the Web Form version of the GEOSS Components/Services Registration,<br>Components/Services Register, associated registry service   |
| Sep       | Demonstration the Interoperability Process Pilot Project (IP3) to ADC  |

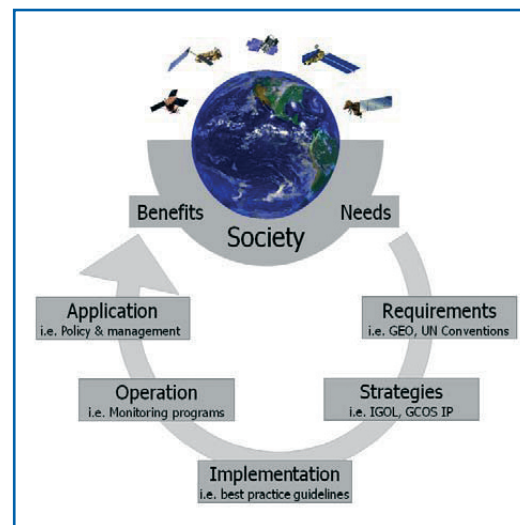
## Improved global land cover observations and assessments

### Description

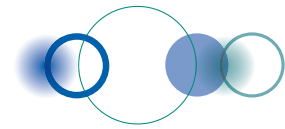
1. Completion & presentation of the *Integrated Global Observations for Land (IGOL)* document to the IGOS-P plenary as first comprehensive and integrated observation strategy for the land domain.
2. Release of ESA's *GLOBCOVER* product based on 2005/06 ENVISAT MERIS data as highest resolution (300 m) consistent global land cover map (see mosaic "Tapisserie de Montreux" to the right) fully compliant with international standards for land cover characterization (UN Land Cover Classification System) and validation (CEOS best practices). Additional progress can be reported for national and regional high-resolution land cover mapping programs including CORINE/GMES service, US National Land Cover Database, and new products evolving in countries like Canada and China, and as part of the UN Global Land Cover Network.
3. *Developments towards high-resolution (Landsat-type) land cover change dataset:* NASA and the U.S. Geological Survey have been making progress acquiring high resolution imagery for the Mid-decadal Global Land Survey that will provide a consistent, preprocessed, global, free-of charge Landsat data for 2005 that extends the 1990 and 2000 Geocover Landsat global dataset. This should be highlighted as major contribution of basic data support for any global and regional land mapping activity where nearly all user communities are asking for land change information at least every 5 years.
4. *GEO global land cover dataset:* the international community has produced a first "best available" global land cover dataset that could evolve to a "GEO global land cover product". Starting with existing moderate resolution global land cover datasets, the community harmonizes existing data to derive the best land cover estimate for each location worldwide.



Information needs and observation requirements for all GEO SBA's emphasize the multitude of benefits from continuous and consistent global land cover observations



Framework highlighting GEO's role for defining requirements and fostering improved observation strategies and implementation guidelines towards operational land cover observations



## Added value

GEO has been the one of the main drivers for achieving the progress reported; GEO has:

- Highlighted the societal needs and relevance of land observations,
- Provided the forum for advocating global land cover and change observations as key issue,
- Fostered integrated perspectives for continuity and consistency of land observations,
- Helped to evolve and apply international standards for land cover characterization and validation,
- Improved a shared vision within the land observation community and involved global actors,
- Advocated joint participation in ongoing global mapping activities, regional networking and capacity building in developing countries ,
- Helped to develop international partnership involving producers, users and the scientific community to better produce and use existing datasets

## Relevance to GEO

SBA's and 10 year work plan On page 119, the GEO 10 year reference document states that all areas of societal benefits require land cover observations. The figure below links the GEO SBA's key land cover observation needs The 10 year reference plan recognizes the importance of the IGOS-P Land Theme (IGOL), the Land Cover Classification System, and Global Observation of Forest and Land Cover Dynamics (GOFCC/ GOLD) to provide guidance and observation plans for GEO implementation.

GEO task reference The progress has been achieved as part of the GEO task DA-07-02 dealing with "global land cover". The overall goal of this task is to provide a suite of global land cover datasets, initially based on improved and validated moderate resolution land cover maps and eventually including land-cover change at high resolution.

## Participants

- Martin Herold & Chris Schmullius (Global Observations of Forest Cover and Land Dynamics)
- Michael Brady (Natural Resources Canada)
- Tom Loveland (US Geological Survey),
- Olivier Arino (ESA),
- Garik Gutman (NASA)
- Chris Justice & John Townshend (University of Maryland),
- Curtis Woodcock (CEOS Working Group on Calibration and Validation, land subgroup)

## Current status and next steps

### Linking IGOL and GEO

The completion of the IGOL document necessitates the integrating the strategies into specific GEO implementation, i.e. individual GEO tasks. This process is ongoing.

### Decadal survey (2010)

For 2010, the availability of Landsat data is tenuous and the community is asking GEO to help with ensuring that the decadal global high resolution satellite mosaic will be produced. There is no lack of observation since many countries have Landsat-type satellite assets and it would be an international coordination task to ensure this global mosaic is produced – this could be a major GEO achievement.

### Operational land cover observations

GLOBCOVER and version 1 of the GEO global land cover map could be presented at the ministerial level meeting. Following the overall goal of GEO task DA-07-02 to develop new global high-resolution (change) product, it is important to emphasize that an operational land cover observation and validation system is needed to fully achieve the societal benefits. Emphasizing progress made at the ministerial summit would likely get more people/countries to sign up for this process and jointly participate in continuous and consistent global land cover observations based on achievements with GEO involvement.



# INSPIRE: an Infrastructure for Spatial Information in Europe

## Description

INSPIRE is a European directive (2007/2/EC) establishing the legal framework for setting up and operating an Infrastructure for Spatial Information in Europe based on infrastructures for spatial information established and operated by the European Member States. The purpose of such infrastructure is, in the first instance, to support the formulation, implementation, monitoring, and evaluation of Community environmental policies, and to overcome major barriers still affecting the availability and accessibility of pertinent data, which include:

- inconsistencies in spatial data collection with gaps and duplications
- lacking or incomplete documentation of available spatial data;
- incompatibility of spatial data sets and services which cannot be integrated;
- lack of interoperability of the infrastructures to find, access and use spatial data;
- cultural, institutional, financial and legal barriers preventing or delaying the sharing of existing spatial data.

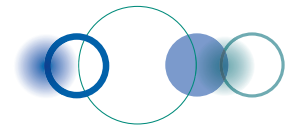
The key elements of INSPIRE to overcome these barriers include:

- metadata to describe existing information resources so that they can be more easily found and accessed;
- harmonization of key spatial data themes needed to support environmental policies in the European Union;
- agreements on network services and technologies to allow discovery, viewing, download of information resources, and access to related services;
- establishment of a European geo-portal providing access to services operated by Member States;
- policy agreements on sharing and access, including licensing and charging;
- coordination and monitoring mechanisms;
- implementation process and procedures.

From the outset of the INSPIRE initiative in 2001 it was recognized that to overcome some of the barriers highlighted above it would be necessary to develop a legislative framework requiring Member States to coordinate their activities and agree on a minimum set of common standards and processes. This in turn requires the wide support of the Member States to the objectives of INSPIRE. Therefore, a very collaborative process was put in place to formulate the INSPIRE proposal. This process in particular involved the establishment of an expert group with official representatives of all the Member States, and working groups with expertise in the fields of environmental policy and geographic information to formulate proposals and forge consensus. From this process, it was agreed that the key principles of INSPIRE should be:

- that spatial data should be collected once and maintained at the level where this can be done most effectively;
- that it must be possible to combine seamlessly spatial data from different sources across the EU and share it between many users and applications;
- that it must be possible for spatial data collected at one level of government to be shared between all the different levels of government;
- that spatial data needed for good governance should be available with conditions that do not restrict its extensive use;
- that it should be easy to discover which spatial data is available, to evaluate its fitness for a purpose and to know which conditions apply for its use.





## Added Value

The GEO 10-Year Implementation Plan Reference Document advocates the use of existing Spatial Data Infrastructure (SDI) components as institutional and technical precedents in areas such as geodetic reference frames, common geographic data, standard protocols, and interoperable system interfaces, among other components.

Consequently INSPIRE currently contributes directly to GEO by:

- Making accessible interoperable spatial data and services operated by Member States in Europe, and European Community institutions.
- Developing standards and specifications relevant to the GEO effort
- Contributing with the European geo-portal to the GEO Clearinghouse and Geo-portal.

GEO in turn contributes to the development of standards and specifications of relevance to INSPIRE, provides the opportunity for promoting interoperability between GEO and the European Spatial Data Infrastructure and to the wider accessibility of interoperable earth observation data and services.

## Relevance to GEO

INSPIRE, as the European SDI contributes to the cross-cutting initiatives, technologies and systems of GEO through the provision of standards protocols improving data access and sharing, advancing interoperability between systems and related standards, developing mechanisms for the allocation, transfer, and use of data and information products and services, developing detailed specifications and standards, and demonstrating the value of an underlying architecture based on the system of systems approach through the infrastructures operated by the Member States.

The development of INSPIRE provides a major contribution to the efforts of the GEOSS Architecture and Data Committee, and specifically tasks AR.07.01 and AR.07.02 (the INSPIRE geo-portal has been registered a GEOSS Community Portal, the INSPIRE catalogue as GEOSS service and the INSPIRE implementing rules will contribute to the design of the GEOSS architecture and clearinghouse).

## Participants

- European Commission
- all Member States of the European Union
- European Agencies and Organisations.

## Current Status and Next Steps

The Directive was approved in January 2007, and came into force on May 15th 2007. The Members States of the European Union have two years to adopt national legislation to achieve the objectives set out by the Directive, and 10 years after that to implement it in all its aspects. Current activities focus on the development of detailed technical specifications and standards to ensure the coherent implementation of the infrastructure across its key components: metadata, interoperability of spatial data and services, network services, data sharing policies, and implementation monitoring measures.

An open and participative approach including all the key stakeholders has been put in place to develop such technical implementation rules. In addition the European Commission is developing the European geo-portal to act as point of access to the spatial data infrastructures operated by the Member States.

## Introducing GEO relevant environmental research activities in the framework programme of community research of the European Union

### Description

#### Objectives

The nature of environmental research is such that Earth Observation data and activities are needed for most of the topics of the theme environment supported through the Framework Program of Community Research (FP). It was the case already in the previous FPs and became still more visible in FP6 and now in the later FP7 which covers the year 2007-2013.

A specific indent on Earth Observation was introduced under the environment theme of the FP7 Cooperation program. Under this indent the FP7 decision makes an explicit reference to the GEOSS initiative with the aim to support the development of Earth and ocean observation systems and monitoring methods for the environment and sustainable development in the GEO context.

#### Methods

Those research activities relevant to GEO will be implemented during FP7 through an annual call from 2007 until 2013. Depending on the outcome expected the projects will be implemented by mean of coordination and support actions or collaborative projects (small or medium-scale focused research or large-scale integrating projects).

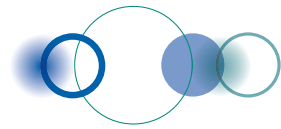
#### Results and impact

Many project supported under the FP6 Environment theme already contribute to GEOSS. This is the case for instance of the TENATSO project (Tropical Eastern North Atlantic Time-Series Observatory), of the DAMOCLES project (Developing Arctic Modelling and Observing Capabilities for Long-term Environmental Studies), and of the GEOMON project (Global Earth Observation and Monitoring of the atmosphere)



*The Ny-Ålesund station on Spitsbergen (79°N, 12E) will play an important role in the implementation of GEOMON to study key compounds like HCL involved in the stratospheric ozone depletion*

The first actions which should be supported under the Cooperation Environment theme of FP7 will deal with priority areas of GEOSS namely, monitoring of the carbon cycle at global level, contributing to a global biodiversity observation system, monitoring the ocean interior, seafloor, and subseafloor, developing of a Global Soil Observing System, building a Georesource information system for Africa, improving observing systems for water resource management, and developing GEONETCast applications for developing countries.



## **Added Value**

As indicated in the call for proposals the above topics will be dealt with through the projects in coordination with the relevant GEO tasks. So there should be a direct contribution of the projects to GEO and the project should benefit of the know-how and participants within the GEO tasks.

## **Relevance to GEO**

### 1. Integration of European activities within GEO

The projects will facilitate the integration of European Earth Observation research initiatives relevant to environment in GEO through collaboration with similar existing initiatives in other continents/countries to contribute to build a Global Earth Observation System of Systems.

### 2. Cross-cutting research activities relevant to GEO

The projects will develop cross-cutting research activities relevant to the societal benefit areas of GEO in the domain of environment.

### 3. Emerging of Earth Observation activities"

The project will support the development of European Earth Observation systems and related activities in areas of environmental research needed for GEOSS where observing/monitoring systems are lacking or need to be significantly completed

### 4. Developing Capacity building activities in the domain of earth observation

The projects will provide support to international research initiatives in which Europe would contribute to develop observing systems and safeguard/protect observation data in countries needing to develop their capacities in the domain of Earth Observation

## **Participants**

The projects are involving all the research organisations in the 27 EU countries, plus the countries associated to the Framework Program of Community Research. Third countries are also invited to participate to those projects, in particular because of the international dimension of the research activities to be carried out in the GEO context.

## **Current status and next steps**

Following the first call for proposal in 2007, a significant effort should be made in 2008 to contribute: to the development of the necessary architecture and data management approach necessary to bridge activities under the INSPIRE directive and tasks overseen by the GEO Architecture and Data Committee, to the monitoring and assessment of the impact of energy exploitation on the environment, to the monitoring and observation of oxygen depletion in all the components of the Earth System, and to building observation capacities in the new countries of the EU and third countries.

Beyond 2008 key activities could be launched to structure the Earth Observation capacities in Europe, to contributing to Earth Observation and monitoring required for meteorological hazards, to supporting Earth Observation activities for the European Technology Platform on Mineral Resources, and for Environment and Health issues. Moreover the coordinated development of data and data processing systems, data archiving, and spatial data infrastructures for effective data updating and exchange should be continued. Finally modeling and prediction capabilities will need to be improved and expanded so that a new generation of models to ensure advancement in predicting high impact events is made available.

## KMA activities for capacity building of GEO

### Description

#### Objectives

- To contribute to the improvement of weather forecasting accuracy of the GEO members by introducing and providing KMA's state-of-the art technology and information to them
- To further enhance the cooperation between GEO members and KMA

#### Methods, data

KMA holds the training workshops and opens the training programs for developing countries.

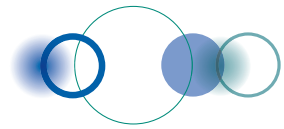
- GEO Training Workshop on Numerical Weather Prediction (2007)
- ICT for Meteorological Services (2005-2007)
- Expert Program for Climate Prediction in Asia-Pacific (since 2006)
- Training Course on Analysis of COMS Data (since 2007)
- ASEAN-ROK Cooperation Training Workshop for the Use of NWP Products (2006)

#### Results, impact

Participations learned the advanced meteorological techniques and had practical training of their applications.







## Added Value

GEO could help KMA's effort for capacity building of GEO members by co-organizing the programs and encouraging GEO members to positively participate in them. GEO members could improve their own capabilities for prevention of meteorological disasters through the training programs. And then, they could further contribute to development of GEO.

## Relevance to GEO

Natural disasters which cause catastrophic casualties and loss of property could drive a nation into its economic crisis and strike a blow to the neighboring or related nations. Improvement of weather forecasting accuracy is the most important for minimization of the damages caused by natural disasters. For this, the international cooperation is an essential factor and holding a training program for developing countries is the most effective method under the framework of GEO. So, KMA held the training programs as a part of GEO Capacity building projects.

## Participants

- Bahrain
- Central Africa Republic
- China
- Ethiopia
- Indonesia
- Latvia
- Mali
- Many other Asian and African countries
- Moldova
- Nepal
- Sudan,
- Thailand
- Uganda
- Uzbekistan

## Current Status and Next Steps

KMA will continue to hold the training programs and try to develop them as a part of GEO Capacity building projects.



## Multi-year GEO Global Workshop Series for GEOSS Users (“The Users and the GEOSS Architecture”)

### Description

How does the user work with GEOSS? The GEOSS implementation plan states that GEO will establish, within 2 years, a process for reaching, maintaining, and upgrading GEOSS interoperability arrangements, informed by ongoing dialogue with major international programs and consortia. An important part of this process is for users to understand and work with the information system described in the Architecture.

Since July 2005, there has been a series of eighteen workshops sponsored by GEO members and participating organizations that have focused on the nine societal benefit areas and provided users with a forum to discuss the benefits they look for in GEOSS and the GEOSS architecture that can support these needs.

Workshops have been held in Africa (South Africa, Burkina Faso), Americas (Canada, Chile, Costa Rica, United States), Asia (China, Korea, Malaysia, India), Europe (France, Spain) and Australia

# GEOSS Global Workshop

**Africa      Americas      Asia      Australia      Europe**







**GEOSS is People**



**GEOSS is Technology**

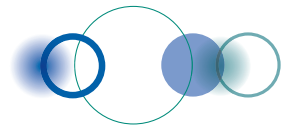


**Renewable Energy – Wind Farm Siting**



**Working Together**

**Sponsored by Host Countries and Participating**



### **Added Value**

The workshops have provided a significant, global forum for user input to GEO, creating the opportunity to make the GEOSS architecture more relevant to users. In addition, the workshops provided a venue for leading managers, scientists and engineers to review and understand GEOSS. Many of the workshops included demonstrations of GEOSS benefits and a library of GEOSS application demonstrations was developed to facilitate future use and understanding of the system of systems capabilities as part of improving outreach to broad groups of users. These workshops have fostered a series of presentations that are available to the public through the internet.

### **Relevance to GEO**

The workshop series has addressed the nine societal benefit areas (SBAs) as specific themes in one or more of the workshops. They have also included cross cutting themes such as science impacts, architecture implementation, advanced communication and networking. As a result, multiple target areas of the implementation plan have been included in this series. The demonstrations have provided vignettes into the use of GEOSS data to provided significant new outcomes for SBAs.

### **Participants**

Workshop host countries (see above) and the following participating organizations:

- IEEE
- ISPRS
- OGC
- UNOOSA
- WMO
- GBIF
- CEOS
- GEO Secretariat and others

### **Current Status and Next Steps**

By November, 2007, 18 Workshops have occurred. The workshops, held in conjunction with major events (such as conferences and meetings), will continue in 2008. The workshops have evolved from a focus on GEOSS and User outreach to also include topical working meetings for the science (global modeling) and engineers (architecture optimization).

## NPOESS/GCOM Cooperation

### Description

As a direct consequence of their respective efforts to address gaps in climate observation and data monitoring in connection with GEOSS, the United States and Japan are actively exploring prospects for cooperation involving the U.S. National Polar Orbiting Environmental Satellite System (NPOESS) and its predecessor missions, and the Japanese Global Change Observation Mission (GCOM) series of satellites. Specifically, both sides will benefit from data exchange and scientific collaboration, and GCOM measurements can be expected to meet key observational requirements for the period prior to the launch of the first NPOESS mission. NPOESS now consists of four U.S. satellite missions, two in the early morning orbit and the other two satellites in the afternoon orbit.

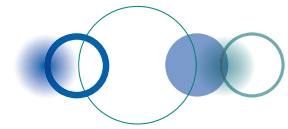
The European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) is contributing its MetOp series of satellites in covering the NPOESS mid-morning orbit. The first NPOESS satellite will be launched in 2013 and provide coverage through 2026. The NPOESS satellites will carry improved imaging and sounding sensors that will greatly increase current capabilities in achieving weather, oceanographic forecasting and climate predictions. Japan's R&D mission, GCOM, consists of two series of satellites; the GCOM-W series for water cycle observation and the GCOM-C series for climate observation. Each GCOM series plans to have 3 satellites (a total of 6 satellites for the two series); each providing 5 years of coverage and all together providing coverage for at least 13 years, with overlaps of one year on orbit between satellites. The first satellite will be launched in 2012.

NPOESS and GCOM can be expected to complement each other in meeting weather, oceanographic and climate observation requirements and in increasing the accuracy and frequency of observations. Particularly, the Advanced Microwave Scanning Radiometer-2 (AMSR2) of the GCOM-W satellite series will complement the NPOESS Advanced Technology Microwave Sounder (ATMS) and Cross-Track Infrared Sounder (CrIS). The Second Generation Global Imager (SGLI) of the GCOM-C satellite series will complement the NPOESS VIIRS (Visible/Infrared/Radiometer Suite). It is planned to exchange and intercompare NPOESS ATMS data with AMSR-2 in order to produce composite products. Both sides are also exploring the possibility of similar exchanges involving NPOESS VIIRS and GCOM-C SGLI. Users worldwide stand to benefit from the exchange and intercomparison of GCOM and NPOESS data and the possibility of creating blended products from AMSR-2 and ATMS. NPOESS/GCOM collaboration further adds an important multilateral dimension to the ongoing NPOESS cooperation with EUMETSAT in support of GEOSS.

### Added Value

GEO has brought together United States and Japanese next generation environmental monitoring satellite systems with the impetus to coordinate these major space-based Earth observation systems in contributing to the GEOSS "system of systems" by providing crucial weather, climate and environmental monitoring data of the Earth. NPOESS and GCOM will support the operational and research needs of the meteorological, oceanographic, environmental, climatic remote sensing programs and will provide global environmental support. In addition, data from these satellites will be made available to the meteorological and environmental organizations in the world in support of their weather forecasting and climate prediction capabilities. Through GEO, U.S. and Japan will cooperate in operating these two major satellite systems, sharing each others' data, and in conducting joint calibration and validation and cooperative science activities.

In this manner, GEO is enabling the development of synergy between NPOESS and GCOM, filling observation gaps, and increasing the frequency and accuracy of observations. NPOESS/GCOM cooperation can benefit not only the U.S. and Japan, but also the whole world by disseminating key Earth observation data which are critical to the safety and security of all people.



## Relevance to GEO

NPOESS/GCOM cooperation directly contributes to the Disaster, Water, Weather and Climate Societal Benefit Areas by providing critical meteorological, climate and environmental observation data. The cooperation also will contribute indirectly to the other SBAs of Health, Energy, Ecosystem, Agriculture and Biodiversity. NPOESS/GCOM cooperation particularly contributes to the Global Climate Observing System Implementation Plan (Climate 2-year, 6-year and 10-year targets) and to GEO 2006 Work Plan Task CL-06-02 (Key Climate Data from Satellite Systems).

The cooperation will contribute to other GEO tasks including DI-06-09 (Use of Satellites for Risk Management), DI-07-01 (Risk Management of Floods), HE-07-02 (Environment and Health Monitoring and Modeling), EN-06-04 (Using New Observation Systems for Energy), CL-06-06 (Global Ocean Observation System), WA-06-07 (Integrated Earth Observation Water Resource Management), WE-06-01 (Space-based Global Observing System for Weather), EC-07-01 (Global Ecosystem Observation and Monitoring Network), AG-07-03 (Operational Agricultural Monitoring System), DA-07-03 (Virtual Constellations) and DA-07-06 (Data Integration and Analysis System).

## Participants

- United States (NOAA and U.S. Government user agencies)
- Japan (MEXT/JAXA and JMA)

## Current Status and Next Steps

NOAA and JAXA have been intensively studying and coordinating this cooperation. They have identified mutual benefits, as well as shared roles and responsibilities to realize the cooperation. They are planning to sign a Letter of Intent on NPOESS/GCOM cooperation in the next few months and to conclude a Memorandum of Understanding following more detailed study and



## Development of a framework for space-based data quality assurance

### Description

The CEOS Working Group on Calibration and Validation (WGCV), in conjunction with members of GEO Task DA-06-02, has developed an initial framework to provide guidelines and standards for data quality assurance for global earth satellite observations. This strategy is outlined in a White Paper, entitled: "Data Quality Guidelines for Satellite Sensor Observations Relevant to GEOSS, *Calibration and Validation Issues*", to be presented at IGARSS-2007. The approach outlined ensures the quality assessment of space-borne optical instrument data from Earth observation remote sensing systems. It exploits ongoing work and available expertise among the CEOS working group members, and provides a mechanism for further development over the 10-year timescale of the GEOSS implementation plan.

By providing a forum for space-based data quality assurance, WGCV has made a significant progress in establishing a consensus among the community of international Cal/Val experts, (representing many space agencies, academia and others) on the contents of a widely accepted data quality assurance strategy. More than 20 presentations and working discussions dealing with GEOSS programs and plans occurred during the last 5 WGCV meetings. Relevant technical issues addressed included standards, benchmark missions, cross-calibration, common solar and lunar irradiance models, recalibration/reprocessing of key data sets, and selection of global validation sites. These deliberations have resulted in formal WGCV recommendations, which were adopted by the CEOS Plenary and distributed to all member agencies. The operational agencies are incorporating the WGCV data quality assurance strategy into the Global Space-based Inter-calibration System (GSICS).

A GEO - CEOS Workshop on Quality Assurance of Calibration and Validation Processes to be hosted by GEO in Geneva from 2<sup>nd</sup> to 4<sup>th</sup> of October, 2007 has been organized by the current WGCV vice-chair under ESA sponsorship. The workshop will focus on: best practises in cal/val processes; harmonisation and standardisation of quality control and cal/val processes; the role of CEOS in identifying standards for those processes; and implementation strategy.

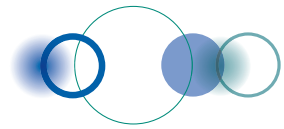
### Added Value

The activities described above are fundamental to meeting GEO goals for productive use of data from disparate sources across the SBAs. However there is a value added component in as much as these activities leverage off of planned cal/val activities needed to meet requirements for operational and research satellite programs of the CEOS member agencies.

### Relevance to GEO

The goal of GEO Task DA-06-02 is to develop GEO data quality assurance strategy, cutting across all nine GEO SBAs, beginning with space-based observations and expanding to *in-situ* observations. The described achievements explicitly address the following key element of the GEOSS 10-year implementation plan, required to meet the needs for inter-usable data collections expressed in sections 4 and 5 of the plan: "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 spacebased 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."

The realization of GEO Task DA-06-02 (led by WGCV) is of crucial importance for the success of all other GEO tasks dependent on satellite measurements and for the success of GEOSS.



## Participants

The participants in these activities are all current members of GEO Task DA-06-02 and the CEOS Working Group on Calibration and Validation (WGCV).

## Current Status and Next Steps

The workplan for WGCV/DA-06-02 is outlined in the chart below.

Phase 1 is nearing completion with refinement of the WGCV White Paper and the GEO/CEOS Cal/Val Workshop to be held in Geneva during the first week of October, 2007. Significant progress has been made toward Phase 2 activities which centres around the development of the ESA sponsored WGCV Cal/Val Portal.

Time frame	2006	2007	2008	2009	2010	2011	2012
<b>Phase 1</b>	<b>Planning</b> ( <i>develop strategy, determine elements/activities/tasks</i> )						
<b>Phase 2</b>		<b>Implementation</b> ( <i>develop and/or establish technical tools and inter-agencies collaborations and agreements</i> )					
<b>Phase 3</b>					<b>Delivery</b> ( <i>present and explain to the community and distribute to CEOS member agencies</i> )		

# SERVIR

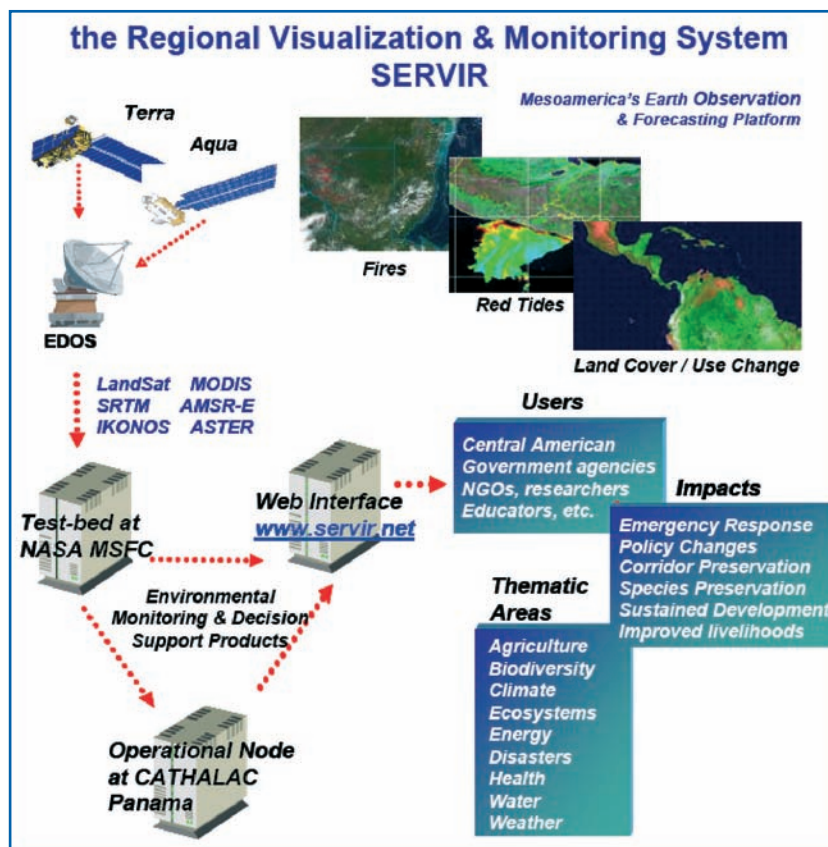
## An Earth Observation, Monitoring, and Visualization System

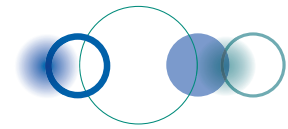
### Description

SERVIR is a system that integrates satellite and other geospatial data for improved scientific knowledge and decision-making by managers, researchers, students, and the general public. It is currently implemented in Central America, but is expanding to other regions of the world. The SERVIR system is web-based and provides a geospatial data portal, online mapping, thematic decision support tools for GEO societal benefit areas, and three-dimensional, interactive visualization of the earth and geospatial data. Operational for over a year, it is being used to monitor the weather, forest fires, and ecological changes, as well as respond to severe events such as red tides, tropical storms, and flooding. Further functionality is being added to address climate prediction, biodiversity conservation, and crop forecasting.

### Added Value

The SERVIR system adds value to GEO by making previously inaccessible satellite imagery, geospatial data, and decision support tools available via the internet. The SERVIR system also is building the capacity of people in developing countries to use Earth observations to make more informed decisions regarding disaster response, weather forecasting, land management, agricultural production, biodiversity conservation, changing climate, fisheries, and other natural resources. The system will accelerate the process of data dissemination, sharing, and integration by forming spatial data networks that link data producers and users, and encourage standardization of disparate data sets. GEO adds value to SERVIR by providing the impetus to expand the system beyond Central America to other regions of the world.





## Relevance to GEO

The SERVIR system is designed to accommodate data and decision support for all GEO societal benefit areas: climate, weather, agriculture, biodiversity, disaster, ecosystems, energy, health, and water. It supports the intent of the Data Management, Architecture, and Capacity Building sections of the GEOSS 10-Year Implementation Plan. Under the 2007-2009 Work Plan, it supports Section 11 for Architecture, Tasks AR-07-01 (Interoperability Arrangements), Section 12 for Data Management, Task DA-06-04 (Data, Metadata, & Products Harmonization), and Section 13 for Capacity Building, Task CB-07-01d (Building National and Regional Capacity).

## Participants

### United States:

- NASA
- USAID

### Countries:

- Mexico,
- Guatemala
- El Salvador
- Belize
- Honduras
- Nicaragua
- Costa Rica
- Panama

### Organizations:

- World Bank
- CATHALAC
- CCAD
- UAH
- UMD
- IAGT
- IABIN
- TNC
- ESRI
- others.

## Current Status and Next Steps

The SERVIR system is expanding functionality to improve decision support for climate change, ecosystems, biodiversity, and agriculture and is expanding to other geographic regions – Africa and South America.

## SIASGE – Sistema Italo-Argentino de Satélites para Gestión de Emergencias (Italian-Argentine System of Satellites for Emergency Management)

### Description

SIASGE is the first satellite system of the world specifically designed for prevention, monitoring, mitigation and evaluation of disasters. It is based on the two Argentine SAOCOM Missions and the four Italian Cosmo-SkyMed. The system uses SAR (Synthetic Aperture Radar) technology, with instruments working in L and X bands, which, takes the use of SAR information one step ahead by allowing the development of applications using a combination of X and L band information. Furthermore, the orbital configuration allows the system to obtain images of disasters from space every 12 hours, and, in addition it can provide information for several other applications.

The SIASGE is a cooperation between Argentina and Italy through their space agencies: CONAE (Comisión Nacional de Actividades Espaciales de Argentina) and ASI (Agenzia Spaziale Italiana). Besides the satellite system, it includes an extensive capacity building activity for user training, as well as the development of software tools and space data transmission networks.

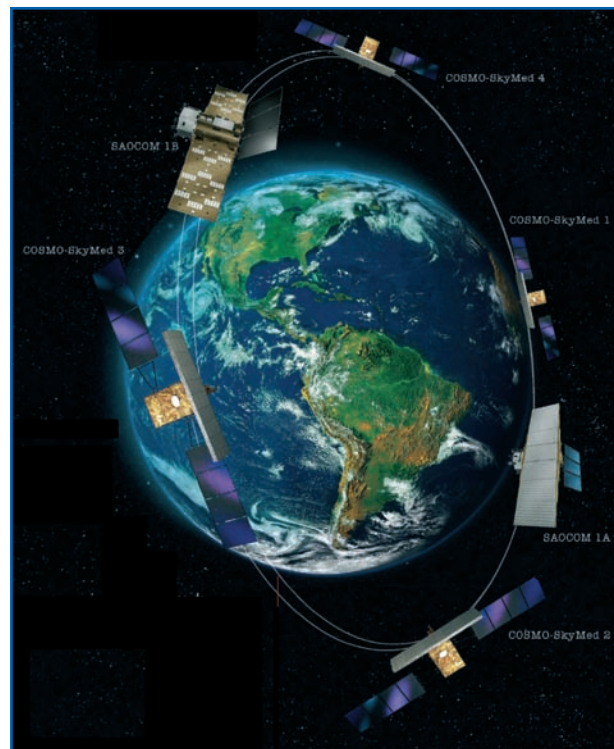
System configuration:

- 4 Italian Cosmo-SkyMed satellites will carry X-band SAR instruments
- 2 Argentine SAOCOM satellites will carry L-band full polarimetric SAR instruments

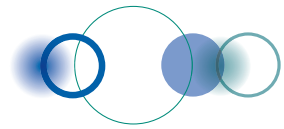
The Ground segment is composed of Italian (Matera and Malindi) and Argentinean (Cordoba) ground stations, which are set up to work as a single system.

The system has a component of capacity building that includes:

1. Development of applications for emergency management and early warning tools.
2. Develop capacity in the use of satellite information for emergency management and health (landscape epidemiology) through the Gulich Institute for Advanced Space Studies (Cordoba, Argentina).
3. Use of SAR information for socio-economic development activities





**Added Value**

SIASGE will be one of the components to the space segment of GEO.

**Relevance to GEO**

SIASGE will provide information relevant to all Societal Benefit Areas.

**Participants**

Both Italy and Argentina engaged the participation of the System at the III Earth Observation Summit in Brussels, Belgium, on February 16, 2005.

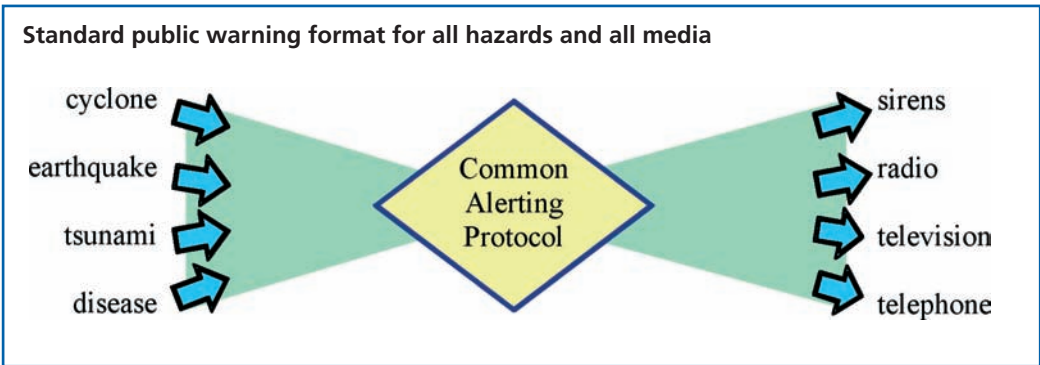
**Current status and next steps**

1<sup>st</sup> Cosmo-Skymed launched in June 2007. Full system to be operative by 2011.

# Standards-based, All-Hazards, All-Media Public Warning

## Description

Major achievements have been made in worldwide implementation of all hazards, all-media public warning as natural hazard alerting authorities and others have implemented the Common Alerting Protocol (CAP) international standard. While early detection of natural hazards is being enhanced through Earth Observations, protection of life and property is only possible when such data is readily available for assessment and the issuing of warnings. Only then can it be fed into dissemination mechanisms for public warning. The CAP standard allows societies to implement the next generation of public warning systems, striving toward the goal to reach everyone at risk, wherever they are and whenever the event occurs. Specifically designed to make public warnings «all media» and «all hazards», the CAP standard responds to the realization of governments, emergency managers, and providers of information and communications technology that technology is available to avoid building separate public warning systems for each type of hazard and communications medium.

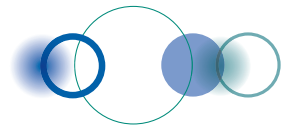


## Added Value

As noted in the GEOSS 10-Year Implementation Plan, many lives were lost due to ineffective public warning after the tsunami of 2004 was detected. Although the issuance of warnings is always handled by local authorities, the GEO community feels uniquely positioned across all types of natural hazards worldwide to assure that derived threat information is available in a common format. Already, earthquakes, tsunamis, and severe weather alerts are available on an experimental basis in the Common Alerting Protocol (CAP) standard format. This allows authorities to disseminate information using all available media ranging from sirens, telephones, television, radio, and satellite broadcast to the Internet.

## Relevance to GEO

All-hazards, all-media public warning is applicable to almost all societal benefit areas, e.g., Disasters (alerts on all kinds of natural and man-made hazards); Agriculture (alerts on disease, pests, drought), Biodiversity (alerts on invasive species); Ecosystems (alerts on oil spills, algal blooms); Energy (alerts on power infrastructure, geomagnetic storms); Health (public health alerts); Water (floods, droughts, water quality); Weather (severe weather alerts). In the «Disasters» societal benefit area, this work partly aligns with Task DI 06-04: «Implementation of a Tsunami Early Warning System at Global Level»



## Participants

- IOC/UNESCO
- U.S.
- European Commission
- Australia
- Canada
- UN/ISDR
- WMO
- ITU.



## Current Status and Next Step

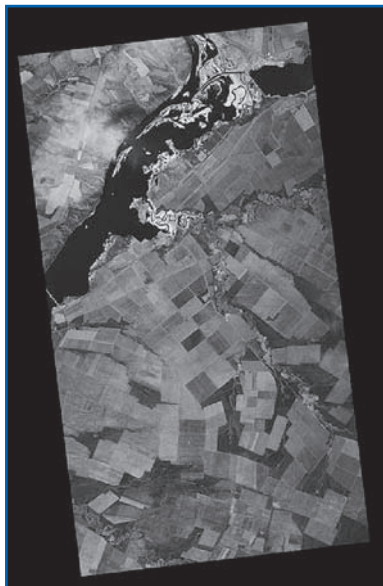
In 2007, the crucial need is for *outreach*-spreading the word among Ministers responsible for those agencies that create such alerts, and among Ministers whose agencies manage or regulate information and communications technology. The Earth Observation Summit could prove to be an excellent platform for such outreach. The CAP standard is being adopted (May 2007) as a Recommendation of the International Telecommunications Union, and ITU has called on all member states to implement the standard. At the time of the EO Summit, ITU will have published its Guidelines for implementing CAP in developing nations. By showcasing this standard, ministers will take home from the Summit an «easy win opportunity» with low cost and high PR value.

## TerraSAR-X – a new system in the System of Systems

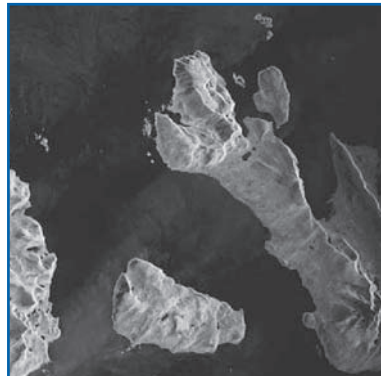
### Description

TerraSAR-X is a new German radar satellite that has been launched on June 15, 2007. The scheduled lifetime is 5 years. It carries a high frequency X-band SAR sensor that can be operated in different modes (resolutions) and polarization:

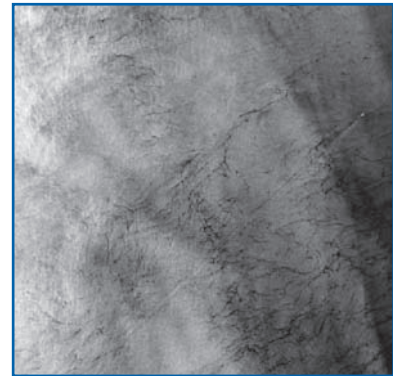
- the «Spotlight» mode with 10 x 10 km scenes at a resolution of 1-2 meters,
- the «Stripmap» mode with 30 km wide strips at a resolution between 3 and 6 meters,
- the «ScanSAR» mode with 100 km wide strips at a resolution of 16 meters.
- additionally TerraSAR-X supports the reception of interferometric radar data for the generation of digital elevation models.



*Reservoir in Soviet Union imaged in TerraSAR-X stripmap mode*



*Norwegian Islands imaged in TerraSAR-X stripmap mode*

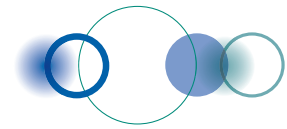


*Ships in the Mediterranean imaged in TerraSAR-X stripmap mode.*

With the TerraSAR-X mission Germany and DLR substantiate their commitment to GEO and its objectives: By the established AO-procedure all TerraSAR-X data are made available to users worldwide, at cost of reproduction or free of charge for scientific use. After the commissioning phase data will be made available generally to scientific investigations. Details can be found on the TerraSAR-X science portal ([http://www.dlr.de/tsx/main/science\\_en.htm](http://www.dlr.de/tsx/main/science_en.htm)).

Germany is actively supporting the implementation of GMES, a key system within the system of systems, by making TerraSAR-X available to the maturing services. In the Public-Private Partnership agreement Infoterra GmbH has agreed to re-invest profits from their exclusive rights for commercial sale of TerraSAR-X data into the next generation satellite, thus ensuring the long-term availability of this information source.

Finally, with TerraSAR-X in orbit, work has begun on the TanDEM-X mission, with the ambitious goal of producing a global high-resolution digital elevation model of unprecedented quality.



## Added Value

When the TerraSAR-X mission was first conceived, it was within an international mission concept involving both an X- and an L-Band sensor. The combination of radar data acquired at different frequencies was well appreciated. Unfortunately, limited funds available for this concept resulted in the realization of only the X-Band sensor by Germany alone. However, some of the added value of integrating data from different radar frequencies can still be realized by coordinating missions currently operated by other agencies.

In fact, dedicated AOs are planned to explore these uses. GEOSS can be instrumental in facilitating this procedure. Furthermore, the flexibility of the TerraSAR-X system with its very short response time and wide potential field of view make it an extremely valuable addition to a constellation concept in support of disaster response activities. Negotiations between DLR and the International Charter Space and Major Disasters regarding the use of TerraSAR-X for Charter activities are well advanced.

Comparison of average and maximum time to next imaging opportunity for Envisat and TerraSAR-x at 29°N58'20"E (location of Bam, Iran). TerraSAR-X only consider right-looking acquisitions.

	Average time	Maximum time
<b>ENVISAT</b>		
Swath 2 only	7 days 10h	16 days 0h
Any swath	1 days 9h	3 days 0h
<b>TerraSAR-X</b>		
Incidence angles	2 days 4h	5 days 0h
20-45° any incidence angle	1 days 14h	4 days 12h

## Relevance to GEO

As a fundamental observation system, TerraSAR-X supports the Data and Information access theme of GEOSS. Due to its value as an element in building virtual constellations (Task DA-07-03), particularly with respect to supporting risk management activities (Task DI-06-09), make the availability of TerraSAR-X a noticeable step forward towards several targets of the 10-year Implementation Plan. An interesting element is also the use of a Public-Private-Partnership to help ensure long-term availability of this data source, noting that ensuring sustainable data availability is also a priority issue for GEO.

## Participants

The mission is realized in a Public Private Partnership (PPP) between the German Ministry of Education and Science (BMBF), the German Aerospace Center (DLR) and the Astrium GmbH. The PPP agreement gives Infoterra GmbH, an Astrium subsidiary, the rights for commercial exploitation of the data. DLR is responsible for coordinating scientific use of the data. An equal share of mission resources, particularly data acquisition capacity, has been agreed on for commercial and scientific use.

## Current status and next steps

The satellite commissioning phase will continue until November 2007, when the five-year nominal lifetime will start. With the planned launch of the TanDEM-X satellite in 2009, TerraSAR-X will contribute to realizing the separate mission goals of the TanDEM-X mission, first and foremost the creation of a global high-resolution (12m) digital elevation model at unprecedented quality. The TanDEM-X satellite will maintain TerraSAR-X data availability after the end of the lifetime of TerraSAR-X. Also, a second TerraSAR-X satellite will be financed from Infoterra profits from the commercial exploitation of TerraSAR-X.



## The ICARE and ETHER Thematic centres

### Description

Several French governmental agencies have developed in common thematic data centres to collect, archive and disseminate data for atmosphere, surface and ocean. The objective is to allow a large use of the data, combine use of satellite and in situ data.

One, the ICARE thematic data centre is dedicated to on Aerosol, Cloud, Radiation, Water and their Interactions and the other one, Ether on atmospheric chemistry studies. The thematic centre builds upon scientific expertise provided by supporting expert laboratories and dedicated data centres. The main goal of these thematic centres is to promote and help research in these research areas.

The objective is to progressively develop operational products and services oriented towards end-users. These centres will allow users benefiting from the largest number of data collected by any source especially setting up a system that will facilitate the development, availability and harmonization of data, and products.

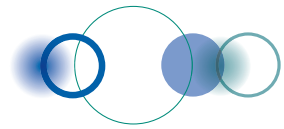
### Added value

Benefit from GEO:

definition of common standard for products and dissemination

Benefits for GEO:

ICARE will offer near real time and 3D aerosols research and operational products as other merged products from A-Train, MSG satellite. ETHER provides users with easy access (with tools and web interfaces) to products from the different instruments from satellite, balloon borne and ground based measurement and develops value added products in the field of atmospheric chemistry. They will become element of GMES atmospheric service.



## Relevance to GEO

These data centres will contribute to the DA 06 04 task.

## Participants

- CNES
- CNRS/INSU
- Meteo France and regional institutions

## Current status and next steps

ICARE involvement in the context of A-train is illustrative of ICARE position as a R&D and service centre: data distribution for the Parasol mission provide users with easy access (with tools and web interfaces) to products from the constellation and develops value added -so called level 4- products combining observations from various instruments of the A –train.

It will provide daily maps of aerosol load from combined satellite observations. ICARE will analyze the quality of the various satellite products as a function of various variables (solar angle, viewing geometry, surface reflectance, and surface type). It will provide a quantitative uncertainty that can be used for the assimilation procedure. This will permit to put more weight to the most reliable data and less to those that are more uncertain. With such combined retrievals, ICARE will derive very high quality aerosol products, to the expense of reduced spatial coverage and developed.

ETHER provides users with easy access (with tools and web interfaces) to products from the different instruments and develops value added products. provide atmospheric products at different levels of processing and contribute to the test of innovative products acquired, archived and distributed on a semi operational basis in particular those of space missions or experiment, network where France is highly involved as NDACC.

ETHER has acquired a significant experience about injection height and emission factors from biomass burning. This software can be used operationally to determine in near real time the fires plumes trajectory. ETHER develops the ECCAD (Emissions of Atmospheric Compounds: Compilation Of Ancillary Data) tool which supplies the existing inventories, either with data necessary for interactive calculation of the emission. The users will found vegetation, land use, fires, and also data linked with human activities.

## The Global Space-based Intercalibration System (GSICS)

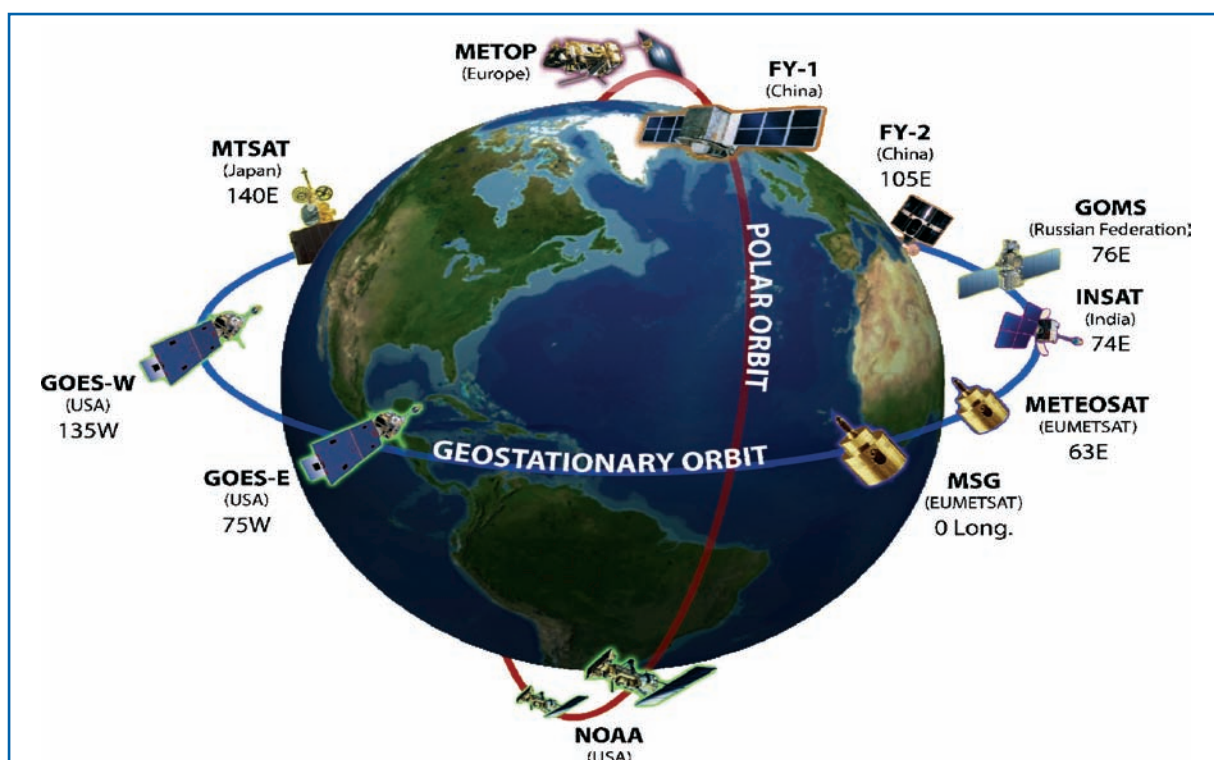
### Description

The Global Space-based Intercalibration System (GSICS) is a new program under the World Meteorological Organization (WMO) coordinated by the United States National Oceanic and Atmospheric Administration (NOAA). The overarching objective of GSICS is to improve the calibration and characterization of space-based measurements through satellite intercalibration of the international satellite observing system.

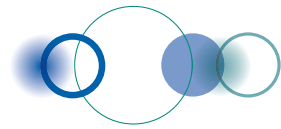
The GSICS program currently includes participation from the United States (NOAA, NASA, and NIST), Europe (CNES/France, EUMETSAT), China (CMA), Japan (JMA), and Korea (KMA). Other participants are welcomed. These agencies have agreed to take steps to ensure better comparability of satellite measurements made by different instruments and to tie these measurements to absolute standards.

The direct benefit of improved satellite observations will be improved weather and climate assessments and predictions. Satellite intercalibration is vital for reducing measurement uncertainty and to optimally integrate data from different observing systems to support the GEO nine societal benefits. The GSICS activities are currently focused on the intercalibration of operational satellites from United States, Europe, China, Japan and Korea. Korea will launch its first operational satellite next year.

GSICS activities are coupled with activities from the Committee on Earth Observation Satellites (CEOS) Working Group on Cal/Val (WGCV). The WGCV provide best practices for calibration and validation which GSICS then implements as part of their operational systems.



An illustration of the current international family of operational meteorological satellites. The GSICS near-term goal is to inter-calibrate all operational satellite instrument measurements to support the nine societal benefits outlined by GEOSS.



The major outcome of GSICS for 2007 is the routine intercalibration of operational instruments in low earth orbit (LEO). In 2008, GSICS will commission routine intercalibration between LEO and geostationary satellites at NOAA, CMA, JMA, KMA and EUMETSAT. Important scientific contributions are being provided by NASA and CNES. A GSICS website has been established at NOAA and includes near-real-time calibration and intercalibration information.

The GSICS objectives are:

- To improve the use of space-based global observations for weather, climate and environmental applications through intercalibration of the space component of GEOSS;
- To provide for the ability to re-calibrate archived satellite data using the GSICS intercalibration system to enable the creation of stable long-term climate data sets; and
- To ensure that instruments meet specification, pre-launch tests are traceable to SI standards, and the on-orbit satellite instrument observations are well calibrated by means of careful analysis of instrument performance, satellite intercalibration, and validation with reference sites.

#### **Added Value**

- GEO will aid the GSICS efforts through contributions from its operational and research space agencies.
- GSICS will impact GEO by facilitating the integration of space-based observations.

#### **Relevance to GEO**

- GSICS will facilitate the integration of space-based observations, which will ultimately improve the information content needed to address the nine societal benefits.
- GSICS contributes to the 10 year plan by providing a coordinated effort to exchange critical datasets between research and operational satellite programs needed to best characterize satellite instrument measurements and to conduct coordinated research.
- GSICS contributes to section 1.7 of the GEO Work Plan and tasks CL-06-02, WE-06-02, and DA-06-02.

#### **Participation**

Research and operational space agencies of:

- China
- France
- Japan
- Korea
- United States, along with EUMETSAT

#### **Current Status and Next Steps**

Commission GEO to LEO intercalibration in 2008

Potential Gaps: Sustained funding and priority commitments from participating agencies

## The Socio-economic and Environmental Benefits of a Revolution in Weather, Climate and the Earth-system Prediction

### Description

There is an urgent necessity for establishing an international *Weather, Climate and Earth-system Prediction Project* to accelerate advances in the prediction of high-impact weather and climate and its complex interaction with the biological-chemical Earth System and global societies. This necessity is driven by the increasing vulnerability of society and the environment to hazardous weather and climate variability and change. The benefits of this *Project* will be:

- Quantum advances in *Early Warning Systems* to identify daily to multi-decadal hazards associated with high-impact weather, and climate variability and change.
- Fourteen-day forecasts of hazardous weather events comparable in skill to that of today's 7-day predictions.
- Seasonal through multi-decadal climate prediction models that resolve the frequency, intensity and preferred tracks of regional hazardous weather events.
- The application of advanced high-resolution climate models to arrive at scientifically based assessments of regional hazardous weather impacts in climate variability and change projections

To initiate this effort, WCRP and WMO(WWRP-THORPEX) developed two position papers to identify:

1. priority areas for scientific collaboration between the weather and climate communities, with a near-term emphasis on advancing the regional prediction of organized tropical convection and its influence on daily to seasonal global prediction (Paper 1);
2. the socio-economic applications and benefits that will result from a "revolution" in weather and climate and Earth-system prediction that includes the provision of multi-petaflop computing facilities incorporating recent scientific advances and applications (Paper 2).

### Added Value

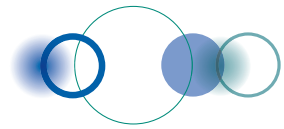
This *Project* will result in a new generation of computer forecast models of the ocean, atmosphere, land/ice and biogeochemical processes that predict the interaction between weather, climate and the Earth system, and the development of application software that will apply this information to benefit global societies and economies. GEO will assist by providing an effective platform for presenting and discussing the proposed *Project* in order to facilitate improved prospects for longer term funding through wider recognition of the important socio-economic benefits. GEO also assists this effort by supporting meetings and conferences.

### Relevance to GEO

The proposed *Project* is described under GEO Task CL-07-01. It will require and fully utilize GEO global observational data sets and deliver comprehensive information that will benefit all GEO Societal Benefit Areas related to weather disasters, regional and global climate variability and change and especially the impacts of extreme weather and climate events on society and the environment.

It will ensure: i) advanced utilization of weather, climate and earth system information by global societies based on a new generation of models predicting the interaction between the atmosphere, ocean, land/ice and biogeochemical processes; ii) the transition of multi-disciplinary research achievements into operational products and services including education and training.



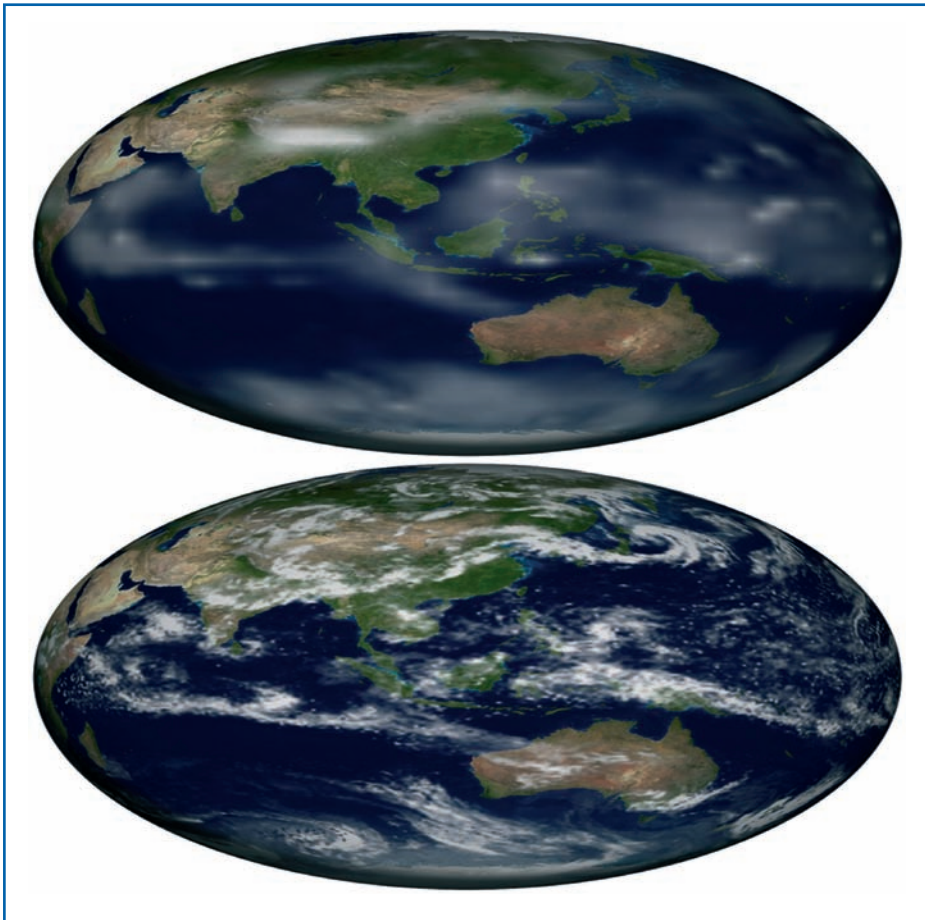


## Participants

- WMO (WWRP-THORPEX)
- WCRP

## Current Status and Next Step

The two position papers (representing a scientific consensus) have been consolidated into a “top level” summary of the expected societal and economic benefits from this Project (as well as the required investment) for presentation and discussion at the GEO Ministerial in autumn 2007.



*An illustration of the current limitation of present-day, multi-decadal climate models to resolve regional high-impact weather events routinely predicted by today's 14-day operational forecast systems. Upper panel; the global cloud distribution in a present-day 320-km resolution climate simulation experiment. Lower panel, same as upper panel, but for a 20-km resolution simulation with the same model. The proposed Project will provide climate models that capture the properties of regional high-impact weather events, such as tropical cyclones; heat waves; sand and dust storms, associated within multi-decadal climate projections of climate variability and change. Figure, courtesy of Takeshi Enomoto (Earth Simulator Center/JAMTEC).*

## Virtual Constellations for GEO

### Description

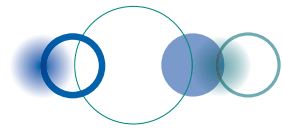
In order to harmonize efforts between space agencies to deploy Earth observation missions and with the aim to close emerging data gaps, the Committee on Earth Observation satellites (CEOS) has established the concept of Virtual Constellations for GEO, whereby a number of satellites or instruments and their observations, when coordinated in their operation and exploitation, have the potential for integration/merging of data and derived information to contribute to a (quantitative) analysis/measurement goal. The essence and greatest benefit of the constellations concept is in providing guidance (standards) for design and development of future systems to meet the broad spectrum of Earth observation requirements.

A Virtual Constellation is either a set of existing ground-based or space-based assets from different partners that are mobilized in a coordinated way for greater efficiency, or a process by which international cooperation is stimulated among space agencies to define a coordinated response to the space-based observation needs focusing on a particular thematic area, ultimately leading to the implementation of a “real” constellation, which may involve formation flying or coordinated operation scheduling.

Observations from a Virtual Constellation provide better coverage and temporal, spatial, and spectral information and yield improved data management and dissemination. A series of prototype Virtual Constellations are currently under definition by GEO members and participating organisations, in consultation with user communities, each being designed to address a significant implementation challenge, and each addressing key GEOSS observations, their sustained continuity and the closing of observational/data gaps. Constellations currently in development are:

- A Precipitation Constellation, which aims to strengthen international cooperation of space-based; observations of precipitation, including realisation of the GPM mission (AR-06-10), and providing guidance to new entrants;
- A Land-Surface Imaging Constellation, designed to ensure the relevant synergy with Mid-Resolution Multispectral Imaging Continuity (AR-06-09);
- An Ocean Surface Topography Constellation, designed to ensure continuity of Sea Level measurement in accordance with GCOS requirements (CL-06-02); and,
- An Atmospheric Composition Constellation, which will address many of the climate community's needs for atmospheric observations (CL-06-02).

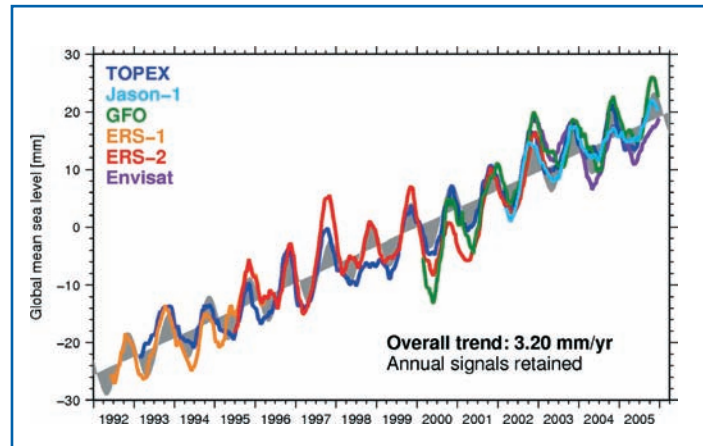




## Added Value

GEO will aid this effort by:

- Enabling coordinated use of existing systems providing global data;
- Coordinating the analysis of gaps in current operations and future mission deployment plans;
- Initiating identification of opportunities for cooperation in current mission operations and future mission planning to increase frequency of coverage, observation performance and improve system compatibility; and,
- Pursuing the provision of routine global coverage for sustained observations.



*Sea levels are rising at over 3 mm/yr. The Ocean Surface Topography Virtual Constellation needs to be sustained to ensure continuous monitoring of this signal.*

GEO will benefit from this initiative by:

- Avoidance of duplication and overlap of efforts in Earth observations within GEO;
- Closure of gaps in information for all GEO SBAs; and,
- Establishment of a globally sustained Earth Observation effort.

## Relevance to GEO

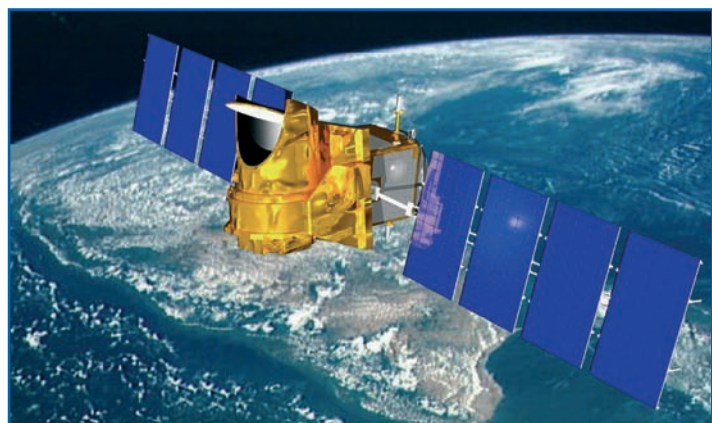
Virtual Constellations are relevant to all 9 SBAs and all Transverse Areas, the socio-economic value is considered very high given the Virtual Constellation's role to sustain observations and fill emerging observation/ data gaps. The main contribution of the Virtual Constellations to the 10-Year Plan will be the harmonisation and consolidation of planned missions between space agencies and system providers.

Work Plan 2007-2009 Data Management Task DA-07-03

## Participants

Australia, Germany, Japan, USA, CEOS, ESA, NASA, GCOS, GTOS, IEEE, WMO.

*The French-Indian MEGHA-Tropiques mission, planned for flight in 2009, is proposed as part of the Global Precipitation Constellation*



## Current Status and Next Steps

The Virtual Constellation Prototypes are under study, both in terms of mission requirements and overall system aspects, including standards and guidelines which satisfy key GEOSS requirements.

Gaps in observations are being identified and more Virtual Constellations are envisaged. Currently an Ocean Colour Constellation, a Disaster Risk Management Constellation and a Terrestrial Topography Constellation are under consideration to continue to lead the Constellations into the future.

## Global Digital Elevation Model (DEM)

### Description

The Ministry of Economy, Trade and Industry (METI) of Japan and the U.S. National Aeronautics and Space Administration (NASA) recently announced plans to produce and validate, in conjunction with the Earth Remote Sensing Data Analysis Center (ERSDAC) and the U.S. Geological Survey (USGS), a 30m digital elevation model (DEM) of the global land surface from Advanced Spaceborne Thermal Emission and Reflectance Radiometer (ASTER) data. The ASTER Global DEM (GDEM) will cover land surfaces between 83°N and 83°S with estimated accuracies of 20 m at 95 % confidence for vertical data (elevation) and 30 m at 95 % confidence for horizontal data (geolocation). The ASTER GDEM should be available in the first half of calendar year 2009, and will be delivered in geotiff format and geographic lat/long coordinates. METI and NASA have accepted an invitation from GEO to contribute the ASTER GDEM to GEOSS, and it will be available at no cost to users from around the world.

### Added Value

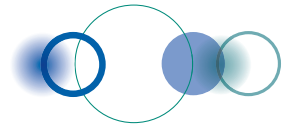
The availability of an up-to-date high resolution (in the order of 30 m) DEM has been a priority of the Earth observation community for a long time. Until now, the path to achieving that goal would require extensive coordination among major stakeholders and owners of high resolution stereoscopic and interferometric datasets, which collectively still lack global coverage and contain numerous internal voids or gaps. GEO's promotion of this new product and facilitation of user access to it will add value by increasing the beneficial application of 30m GDEM data to important research and practical problems by users from many nations.

### Relevance to GEO

The ASTER GDEM will support all SBAs, and it will be particularly relevant for disaster mitigation and relief, water resources management, energy resources management, and many other applications through improved 3-D terrain morphology knowledge.

- For the Disasters SBA the availability of high accuracy topography information is of highest priority to enable prediction, mitigation and response to disasters such as Tsunamis in the coastal Zone. Also the Water Resources, Energy, Ecosystems and Health SBAs will be very positively impacted. For these SBAs, improved knowledge of morphology will yield better forecasting, mitigation, and planning support and thus provide higher socio-economic value for all SBAs.
- Under its 2-year targets, the GEOSS 10-Year Plan emphasizes the high-resolution DEM availability as one of its priority Disaster targets.
- The GEO Work Plan Tasks most relevant to the high resolution DEM availability are:  
DA-07-01 on Global Digital Elevation Models Interoperability, DI-06-07 on Multi-Hazard Zonation and Maps, and DA-06-01 on GEO Data Sharing Principles.





## Participants

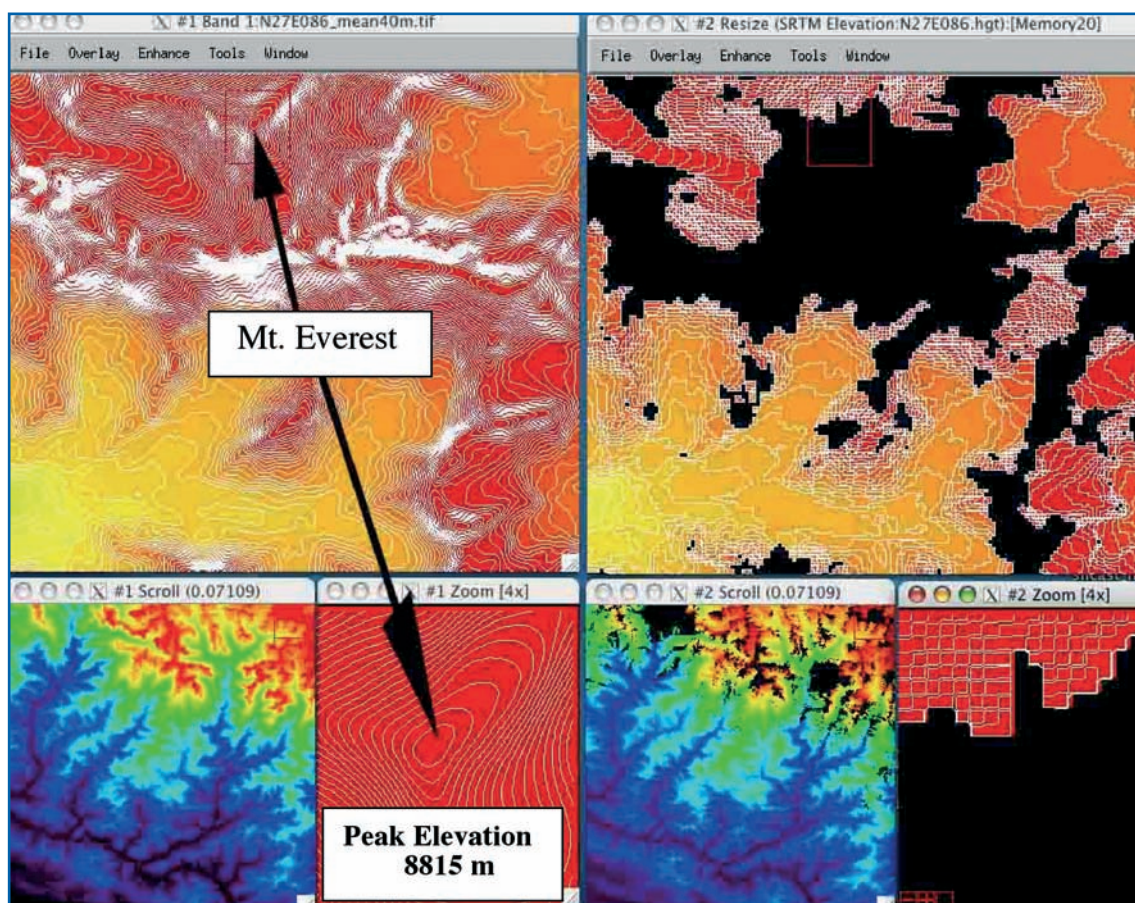
METI and ERSDAC in Japan and NASA and the USGS in the United States.

## Current Status and Next Steps

The ASTER GDEM production system currently is in final stages of system configuration. Generation of more than 1.2 million individual scene-based DEMs will commence in early December and continue through September, 2008. DEM stacking and tile generation will commence in early October, with completion of the final product expected by December, 2008. Validation and verification of the ASTER GDEM will follow immediately, with product release anticipated 3 to 6 months later.

ASTER GDEM

SRTM3 (resampled to 1 arc-sec resolution)



Prototype ASTER GDEM produced for the 1°x 1° area of Mt. Everest from 203 ASTER scene stereo pairs, compared with 90m SRTM DEM resampled to 30m. Measured elevation of Mt. Everest is 8,848 meters. White areas in the larger images are areas where contours are very close together. Black areas in the SRTM images are failed areas (gaps).



## GEO Coastal Zone Community of Practice (CZCP)

### Description

Global, regional and local trends in natural processes and human demands on coastal ecosystems jeopardize the ability of these ecosystems to support commerce, living resources, recreation and habitation. In this context, improved, integrated and sustained coastal observing capabilities are required to better support user information needs. GEOSS provides a valuable framework and mechanism to help implement these capabilities, and under the auspices of GEO, a Coastal Zone Community of Practice (CZCP) was initiated in 2006. The initiative for a CZCP emerged from the activities of the Coastal Theme of the Integrated Global Observing Strategy Partnership (IGOS-P).

The Coastal Theme goal is to develop and implement a strategy for integrated observations across the land-sea interface that will provide data and information needed to make informed decisions on issues related to the propagation of change and variability as required for use, study, or management of coastal ecosystems or components thereof. The Coastal Theme builds on and integrates the extensive activities of the coastal components of GOOS and GTOS (see the Coastal Theme Report (2006) for further details).

Per collaborative, consensus decisions made during and after the recent IGOS-P-14 Meeting (May 2007, Paris), the IGOS Coastal Theme will now transition and undertake its user-driven coastal activities through the rapidly developing CZCP, in coordination with the Panel for Integrated Coastal Observations (PICO), a technical sub-panel of the GOOS Scientific Steering Committee (GSSC). To further facilitate coordination, a representative of PICO has recently been appointed to the GEO Science and Technology Committee. The CZCP leverages and extends all of these complementary activities under the GEO/GEOSS framework, enabling broader participation, improved linkage to users, coordinated implementation, and enhanced societal benefits.

### Added Value

GEO provides a forum for the development of a comprehensive CZCP bringing together relevant user groups and providers of Earth observation data, thus enabling the CZCP to support crucial coastal user needs, in particular through the transition from data to products to information to knowledge. The broad basis of providers represented by the GEO Participating Organizations will help the CZCP to facilitate the necessary integration of satellite with in situ data, aquatic with terrestrial data, environmental with socio-economic data, all coupled within a modelling and data assimilation framework to support improved coastal management and decision-making. The GEO Plenary and Committees are a platform from which the CZCP's common voice can be made heard in support of global implementation of priority coastal observing capabilities.

### Relevance to GEO

The CZCP is one of several Communities of Practice (CP) within the framework of the User Interface Committee (UIC) Task US-06-02 (GEO Work Plan 2007-2009). Like the other Communities of Practice, the CZCP is intended as an user-driven community of stakeholders, with broad representation of providers and users of coastal zone data, products and information, all sharing a common interest in realizing the societal benefits to be gained by GEOSS implementation. The CZCP cross-cuts *all* of the GEO societal benefits areas, underscoring the importance of coastal regions globally, regionally and locally – further manifested by the presence and prominence of coastal issues and topics in a significant number of GEO Work Plan tasks.

## Participants

Representatives from numerous GEO member nations and participating organizations participate in the CZCP. Specifically, it serves as a mechanism to coordinate, advise and integrate coastal activities of IGOS-P, GOOS, GTOS, IGBP LOICZ, and CEOS member agencies amongst other international partners.

## Current Status and next Steps

The CZCP is actively working to significantly expand its user base, building upon considerable interest in GEO Member Countries and Participating Organizations and it looks forward to working with all interested users and partners. In this context it supported the *GEO Inland and Nearshore Coastal Water Quality Remote Sensing Workshop* held March 2007 in Geneva. The CZCP also coordinated submission of three sessions for the upcoming Ocean Sciences Meeting (Orlando, Florida, USA; March 2008), addressing

- coastal inundation,
- coastal and inland water quality assessments via remote sensing,
- coastal phytoplankton dynamics;

all three sessions were accepted and will help identify and address coastal user information needs in support of improved management and decision-making.

Finally, a primary focal point for the coming year is the organization and occurrence of a CZCP-sponsored workshop entitled “Observing System Requirements for Managing and Mitigating the Impacts of Human Activities and Coastal Inundation in the Mediterranean Region”, to be held 9-13 June 2008 at the Hellenic Center for Marine Research in Herakleion, Crete, hosted in conjunction with the Greek GEO Office.

This workshop is part of a broader series of regional workshops being developed by the CZCP; the title of this series is “GEOSS Support for Decision-Making in the Coastal Zone: Managing and Mitigating the Impacts of Human Activities and Natural Hazards in the Coastal Zone”.

A second workshop in this series, this time focusing on the needs of African coastal users, is tentatively planned for late 2008, to be hosted by the African Association of Remote Sensing of the Environment (AARSE), and ideally held in conjunction with AARSE’s 7th International Biennial Conference scheduled for 29 October to 2 November 2008 in Accra, Ghana. Finally, we anticipate subsequent workshops in this series to take place sometime in the 2009 timeframe in support of coastal users in the Americas, as well as in Asia.

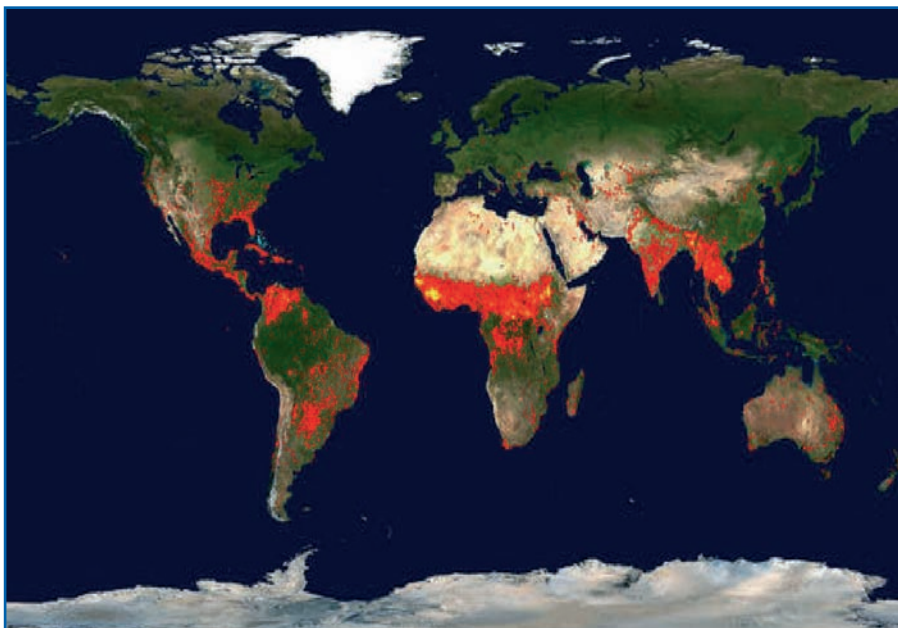
## Global Wildland Fire Early Warning System – African Component

### Description

Wildland Fire is a Global Source of Multiple Hazards. In fact it is at the origin of:

- Significant Ecosystem damage, such as degradation in forest/grassland health due to uncontrolled burning, agriculture and land degradation with losses in production, hydrological changes resulting in desertification and flooding
- Significant loss of life, including negative societal impact and economic losses, such as increased vulnerability at urban-rural interface, global health impact due to smoke and emissions, disruption of transport due to changes in visibility, costly fire suppression programs
- Significant contribution on climate change through global carbon cycle impact

The objective is to develop a global early warning system for wildland fire based on existing and demonstrated science and technologies, with an associated technology transfer program to provide training for global, regional, national, and local communities to enable the use of the System for prevention, preparedness, detection, and fire response decision-making.



*World's Regions affected by Wildland Fires*

### Added Value

- GEO facilitates international cooperation, providing additional political framework for activities execution, in particular when transfer of knowledge and capacity building are involved.
- Direct contribution to is the availability and use of GEONETCast to disseminate daily products.

### Relevance to GEO

- Relevant to the Disaster SBA, with clear inputs from and outputs to other SBA's such as Weather, Climate, Ecosystems and Agriculture. High socio-economic value in reducing vulnerability and associated impacts. Importance of Early Warning Systems in the 10-year plan.
- GEO Work Plan reference Task DI-06-13

## Relevance to GEO

- Relevant to the Disaster SBA, with clear inputs from and outputs to other SBA's such as Weather, Climate, Ecosystems and Agriculture. High socio-economic value in reducing vulnerability and associated impacts. Importance of Early Warning Systems in the 10-year plan.
- GEO Work Plan reference Task DI-06-13

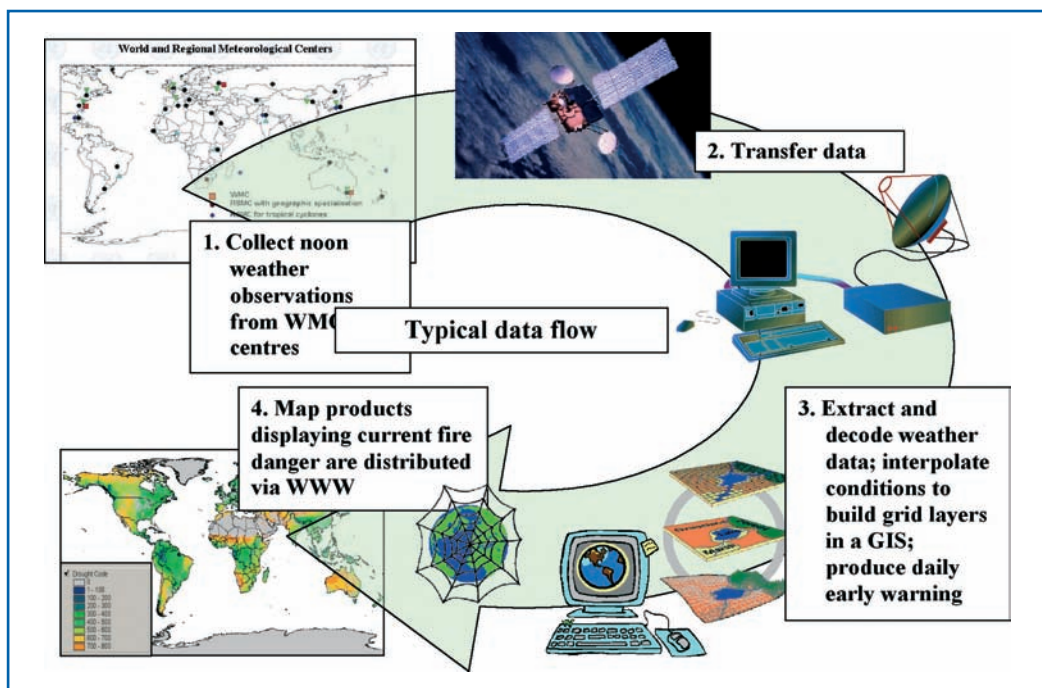
## Participants

The project "Global Early Warning System for Wildland Fire", within the UN-ISDR initiative is considered as the reference, the relevant team includes:

- Global Fire Monitoring Center (GFMC), Max Planck Institute for Chemistry, c/o Freiburg University / United Nations University, Germany on behalf of the UNISDR Wildland Fire Advisory Group / Global Wildland Fire Network
- Canadian Forest Service (CFS), Edmonton, Canada
- Bushfire CRC, Australia
- Global Observation of Forest and Land Cover Dynamics (GOFC-GOLD) Secretariat, Edmonton, Canada
- University of Maryland (UMD), USA
- World Meteorological Organization (WMO)
  - World Weather Research Programme (WWRP)
- Bureau of Meteorology Research Centre (BMRC), Melbourne, Australia
- European Centre for Medium Range Weather Forecasting (ECMWF)
  - Instituto Nacional de Meteorologia, Spain; Finnish Meteorological Institute, Finland, MetOffice, UK

## Current Status and Next Steps

The schedule of activities foresees definition of the Global System and its implementation by progressive inclusion of regional/national systems, that are today at different stages of design and implementation. GEO focus will be to support definition and implementation activities in regions where identified gaps to have the system in place are higher. The GFMC website <http://www.fire.uni-freiburg.de/> is periodically updated with all the progressive contributions.



Daily Fire danger maps production

## The Italian Landslide Inventory (IFFI Project)

### Description

#### Objectives:

The Italian Landslide Inventory is a national project that aims at identifying and mapping landslides over the whole Italian territory, based on standardized criteria. The project has been financed with 4.1 Mil. Euro by the Committee of Ministries for the Land Protection, established by the Italian Government (Law n. 183/89).

#### Methods:

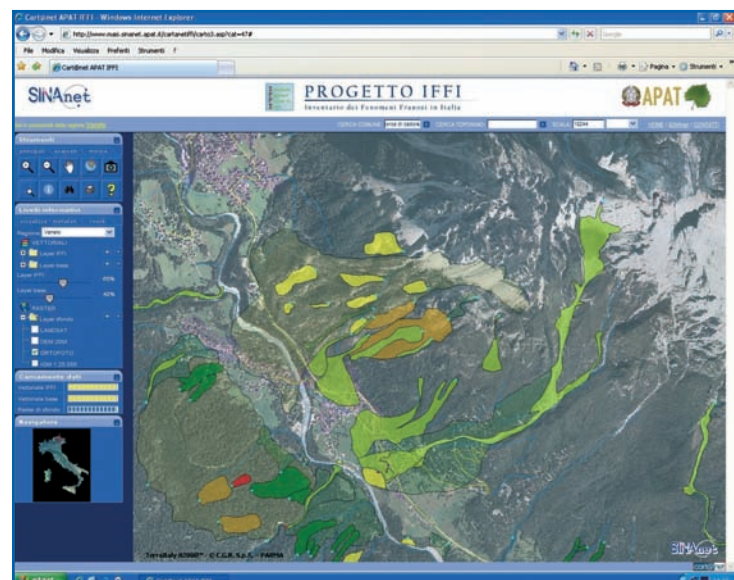
The methodology applied is based on remote sensing and ancillary data sets, such as published sources and historical documents, validated with in-situ data and field surveys. With the aim of homogenize and integrate the landslide data over the whole Italian territory the Landslide Data Sheet has been defined on the basis of International standards of classification: Recommendations of the International Association of Engineering Geology (IAEG), International Geotechnical Societies UNESCO Working Party on World Landslide Inventory (WP/WLI), International Union of Geological Science Working Group on Landslides (IUGS/WGL), Cruden & Varnes (1996).

The IFFI Landslide Data Sheet is organised in three information levels of increasing detail:

- 1st level contains the basic data on landslide location, type of movement and state of activity;
- 2nd level provides data on geometry, geological setting, lithology, land use, causes, date of activation;
- 3rd level gives detailed information on damages, investigation process and remedial measures for risk reduction.

#### Data:

The Italian Landslide Inventory currently holds about 460,000 landslides occurred in the Italian territory. The IFFI geo-database contains vector layers of landslides and an alphanumeric archive of attributes. The relational alphanumeric database scheme is based on the Landslide Data Sheet. The mapping scale varies between 1:10,000 and 1:25,000.



*IFFI Project WebGIS*

#### Results:

The IFFI project represents the first homogeneous and updated inventory collecting landslides at national level. The web publishing of the IFFI Inventory (<http://www.sinanet.apat.it/progettoiffi>) is focused on promoting and spreading out the landslide information to national and local institutions, research institutes, geologists, engineers and citizens. It aims at enabling people to make informed decisions such as to choose where living, where purchase properties and locate economic activities. The IFFI Website runs since 2005 allowing to explore the geographical data and to obtain detailed information on the most important parameters of landslides. Over 200.000 hits have been counted to date.



Through a simple and clear navigation, the user can view the landslides of the IFFI Inventory together with other vector layers (the urban areas - Corine Land Cover 2000, the roads and railways, the drainage network) and raster layers (the digital terrain model, digital orthophoto Terraltaly it2000, Landsat satellite images and IGM topographic map at scale 1:25,000). Among the WebGIS functionality, the Identify tool provides attribute information about landslides and the Photo tool allows to view images of more important landslides. Using the Buffer tool, critical points along the communication network can be selected. According to the European Directive INSPIRE 2007/2/CE (Infrastructure for spatial information in Europe) and the Open GIS Consortium specifications, WMS Services of the IFFI Inventory have also been developed. These interoperable Services allow the users to overlay the IFFI landslides theme with additional layers stored in the pc of the user or even provided by external internet servers.

#### Impact:

The IFFI Inventory has a remarkable impact on land use planning at national level and regional level, as it is used on landslide risk mitigation actions (PAI) over the whole Italian territory.

#### Added value

The IFFI Project is a service in the field of natural hazards that uses an international standard (WMS) for dissemination and sharing of spatial data. If implemented at international level, the IFFI methodology will bring a more timely dissemination of information through better coordinated systems for monitoring, predicting, risk assessment, early warning, mitigating, and responding to landslide hazards. Several GEO Tasks, such as the 'Multi-hazard zonation and maps', would potentially benefit from methodologies that remote sensing with in-situ data, is particularly suited for accomplishing the above requirement in accordance with the mission of GEOSS.

#### Relevance to GEO

In accordance with the 'Disasters' SBA the IFFI Project shows, at country level, how earth observation contributes to "reducing loss of life and property from natural and human-induced disasters". The IFFI Project matches with the Task DI-06-07: Multi-hazard Zonation and Maps, lead IGOS-P and WMO, aimed at conducting an inventory of existing geologic and multi-hazard zonation maps, identifying gaps and needs for digitization and progressively develop related products. In agreement with the Capacity Building Strategy 2007-2009, the IFFI Project will contribute to "Enabling Knowledge Sharing for Improved Disaster Management and Emergency Response".

#### Participants

The institutions involved are:

- APAT - Geological Survey of Italy - Land Protection and Georesources Department, with the task of organising and coordinating the activities, developing the guidelines, verifying the data conformity, building up a national geo-database and a WebGIS;
- Regions and Autonomous Provinces of Italy, charged to collect the historical documents, archive data and to map areas affected by landslides.

#### Current Status and Next steps

The IFFI Inventory is updated at 2006. Further updatings will be provided by Regions and Autonomous Provinces in the next years.

The IFFI Project aims at becoming a European standard for collecting and mapping landslides.

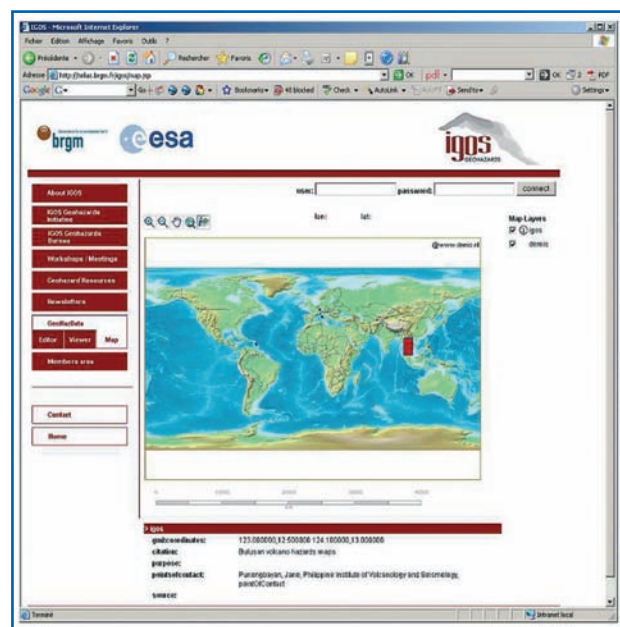
## IGOS-P Geohazards Theme and Community of Practice

### Description

The IGOS-P Geohazards Theme responds to the scientific and operational geospatial information needs for the prediction and monitoring of geological hazards. During the 2003-2007 period, the priority was (1) to bring together a representative Community of Practice of scientists, engineers and users concerned with Geohazards and (2) to write up to date "Geohazards Theme Reports" in 2004 and 2007, and (3) to build the demonstrator of a comprehensive system allowing to include geohazards data in the GEOSS Clearing House.

### Added Value

The IGOS-P Geohazards Theme provided the core for gathering a Geohazards Community of Practice (CoP), within which Earth Observation requirements have been collected over the time frame from 2003 to 2007. It contributes to the GEOSS Clearing House through its GeoHazData system, which is based on an hazard maps inventory. GEO provides a common framework for the Theme and CoP within which means for data exchange between diverse interested groups have been put in place making data available to the wider community. Countries are contributing instruments or systems for integration into a larger earth observation system, thus improving interoperability. Particularly for developing countries, interoperability of systems is very important since they often do not participate in the definition of the systems they receive. GEO facilitates the building of bridges between the communities concerned with an efficient use of Earth Observation data in disaster prevention and mitigation.



*Geohazdata web map server*

### Relevance to GEO

The IGOS-P Geohazards Theme contributes to the Disaster SBA. It acts as an initial kernel of the Geohazards CoP. It leads two tasks, namely DI-06-07 through which it provides a pilot OGC-compliant catalogue and web service for hazard maps inventory (GeoHazData), and DI-06-03, to which it contributes by organizing workshops and raising awareness on InSAR and advanced InSAR techniques in the Geohazards CoP. It has also actively contributed to tasks DI-06-02 through user feedback from regional workshops; DI-06-08 through the promotion of an integrated approach at meetings and conferences; DI-06-09 by helping the task group to identify geological high risk areas; DI-06-12 through organizing user workshops in Latin America and South East Asia; and AR-06-05 with GeoHazData.

## Relevance to GEO

The IGOS-P Geohazards Theme contributes to the Disaster SBA. It acts as an initial kernel of the Geohazards CoP. It leads two tasks, namely DI-06-07 through which it provides a pilot OGC-compliant catalogue and web service for hazard maps inventory (GeoHazData), and DI-06-03, to which it contributes by organizing workshops and raising awareness on InSAR and advanced InSAR techniques in the Geohazards CoP. It has also actively contributed to tasks DI-06-02 through user feedback from regional workshops; DI-06-08 through the promotion of an integrated approach at meetings and conferences; DI-06-09 by helping the task group to identify geological high risk areas; DI-06-12 through organizing user workshops in Latin America and South East Asia; and AR-06-05 with GeoHazData.

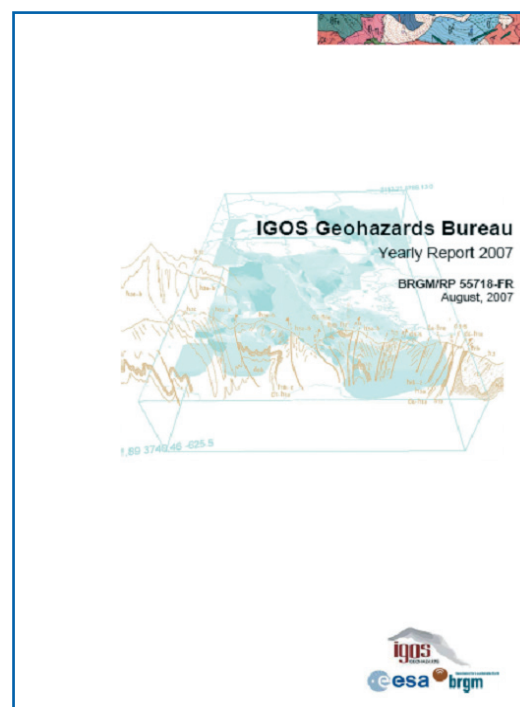
## Participants

- UNESCO (co-chair)
- ESA (co-chair)
- BRGM (co-chair and Executive Bureau)
- BGS (co-chair)
- NASA
- CNES
- CEOS
- USGS
- GGOS
- WOVO FDSN
- ICL.

## Current Status and Next Steps

Long term continuity relies on sustainable community building. The IGOS-P Geohazards Theme represents the diversity of scientists, engineers and users involved in Geohazards, and thus it is pivotal in community building in the Disaster SBA. The Joint Committee of the Theme includes representative of the diverse communities relevant for the SBA. International Geohazards Workshops are regularly organised to gather the main Geohazards communities on a broader basis. The 3rd International Geohazards Workshop has been organised in November 2007 as a GEO event.

In order to support this approach, a better data policy is needed. Geohazdata is a "proof of concept", that should be critically reviewed by GEO participating Countries before moving toward an operational application. The choice of a OGC compliant conceptual model for Geohazards such as GeoScienceML is needed. The actual implementation of an operational clearing house requires the commitment of national organisations in charge of Geohazards assessment in GEO Member countries and the alignment of associated resources at the national level.



*Geohazards theme 2007 Report*

## Improved Use of Satellites for Risk Management

### Description

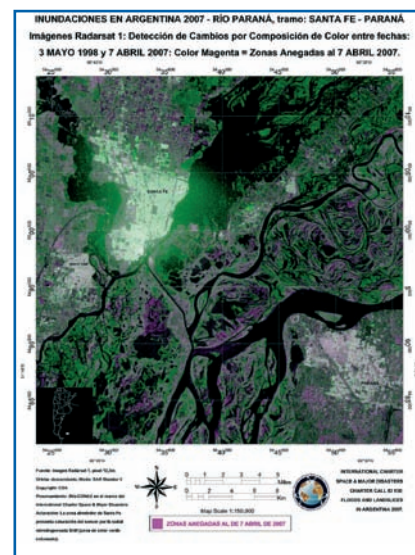
Canada has taken a leadership role in the definition of global requirements for satellite observations in support of risk management. The Canadian Space Agency leads Task DI-06-09, which will compile the first comprehensive set of global user requirements for every phase of disaster management, and identify gaps in sustained observations for mitigation, warning, respond to and recovery from disasters.



*Hurricane Isabelle from space, courtesy of NASA*

Weather satellites have for many years made well-recognized contributions to disaster warning and prevention, particularly hydrological disasters. More recently, other Earth observation satellites are being brought to bear to improve the management of a broader range of natural disasters. This can be achieved through better assessment of risk before events take place, by providing accurate warnings of where disasters will occur, by assessing the situation of critical infrastructure after an event or supporting the recovery process long after the disaster is over. Dozens of Earth observation satellites orbit the world collecting imagery in the visible, near infrared and even microwave spectrum. The images provide information about the effects of hazards derived from low and high resolution data. These data can be integrated into disaster warning systems to improve their accuracy, or may be used to generate maps that assist responders in determining the most affected areas and the status of infrastructure. GEO Members aim to improve access to these unique data sets for disaster managers and ensure that critical observations are sustained over the long-term. In the context of GEO, Member States are also examining how to ensure operational integration of data into disaster management systems, and how to develop capacity for improved use of satellite imagery.

Following the UNISPACE III conference in July 1999, the European and French space agencies (ESA and CNES) initiated the International Charter "Space and Major Disasters" (the Charter), whose membership now includes the Canadian Space Agency and 8 other leading space organizations. The Charter provides a unified system of space data acquisition and delivery to emergency authorities affected by natural or man-made disasters. This system has been activated over 150 times, with more than 30 calls in 2007 alone. In parallel, a number of regional initiatives have been undertaken to better coordinate access to satellite data, including the GMES programme in Europe, Sentinel-Asia's 18 nation operational system and SERVIR, a Mesoamerican visualization and monitoring portal. UNOOSA has worked with UN Members States to define a United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN SPIDER), which was approved by the UN General Assembly in 2006. Building on the lessons learned from these systems and extensive consultations by CEOS and IGOS-P over the past decade, DI-06-09 aims to compile comprehensive user requirements and establish a virtual constellation of satellite assets to address them.



*Flooding near Santa Fe, Argentina. Comparison of archived and near-real time RADARSAT-1 imagery (courtesy INA/CONAE)*

## Added Value

Through GEO, it is hoped that successful systems can be taken one step further. For example, the GEO Secretariat is formulating a request to the Board of the Charter to extend to all Member States the right to directly activate the Charter and access data archives. In parallel, space agencies in the context of CEOS and DI-06-09 are currently discussing how to address needs for data during other phases of the disaster cycle: mitigation, warning and recovery. In order to do this effectively, GEO Members are working on compiling the first comprehensive requirements for satellite data for all disasters on a global basis. This work will build on extensive user requirements analysis in each of the disaster communities involved, as well as technical analyses undertaken by CEOS, the IGOS Partnership, the European Union and others over the course of the last decade. From this analysis, priority observations will be identified and better coordinated, and mechanisms for broader data access will be established. GEO work under DI-06-09 has been closely coordinated with UN SPIDER activities. In June 2007, representatives from GEO members met at UNOOSA headquarters to discuss the data needs of risk managers and to begin planning the regular acquisition of a baseline data set. These acquisitions will support global disaster mitigation activities and facilitate the generation of damage maps after events.

## Relevance to GEO

Satellites offer unique observations of the world's catastrophes useful for every aspect of risk management, from mitigation through response and recovery. Satellites offer the largest potential for improving current practices in support of one of GEO's core societal benefit areas: the reduction of loss of life and property through improved disaster management. Coordinating and facilitating access for GEO Member States and participating organizations to these unique data sets and products will enable national and regional bodies to better prepare and respond to disasters. Work in this area has been coordinated under the User Interface Committee, in close consultation with the Architecture and Data Committee and the Committee on Earth Observation Satellites, within Task DI-06-09.

## Participants

Australia/Geoscience Australia, Austria/Z-GIS, Canada/CSA (lead), Chile/Foreign Ministry, European Space Agency, France/CNES, Germany/DLR, India/NRSA/ISRO, Indonesia/National Institute of Aeronautics and Space, Japan/Ministry for Education, Science and Technology, Korea/Aerospace Research Institute, Italy/ASI and Protezione civile, Nigeria/NCRS/NASRDA, Spain/INTA, Romania/National Meteorological Administration, Russia/EMERCOM, Saudi Arabia/KACST, Syria/GORS, Thailand/GISTDA, US/NOAA and USGS, UK/BNSC, Ukraine/NSAU, CEOS, GEO Secretariat, IGOS-Geohazards, GTOS/FAO, UNITAR/UNOSAT, UNOOSA and UN/SPIDER, World Meteorological Organization.

## Current status and Next Steps

In the context of DI-06-09, user communities are working with satellite data providers to provide the first comprehensive statement of global requirements for Earth observations to support disaster management. These requirements are compiled taking advantage of regional initiatives, such as GMES, Sentinel-Asia, and SERVIR. Given that requirements aim to address a broad range of natural disasters at every phase of the disaster management cycle, the compilation of these requirements has been demanding. This work includes defining global baseline data sets that meet the basic needs of disaster management communities for forecasts, warnings and recovery. Eventually, GEO Members intend to create a virtual constellation of satellites that together can address all phases of disaster management. The initial system architecture is based on existing systems put together to collectively address needs. Future system architecture requirements will address critical gaps identified in the current system of systems. Both users and satellite designers and operators will meet again in fall 2007 to validate initial requirements and to establish a timeline for creating a system that marries existing, planned and future assets together in one operational service.



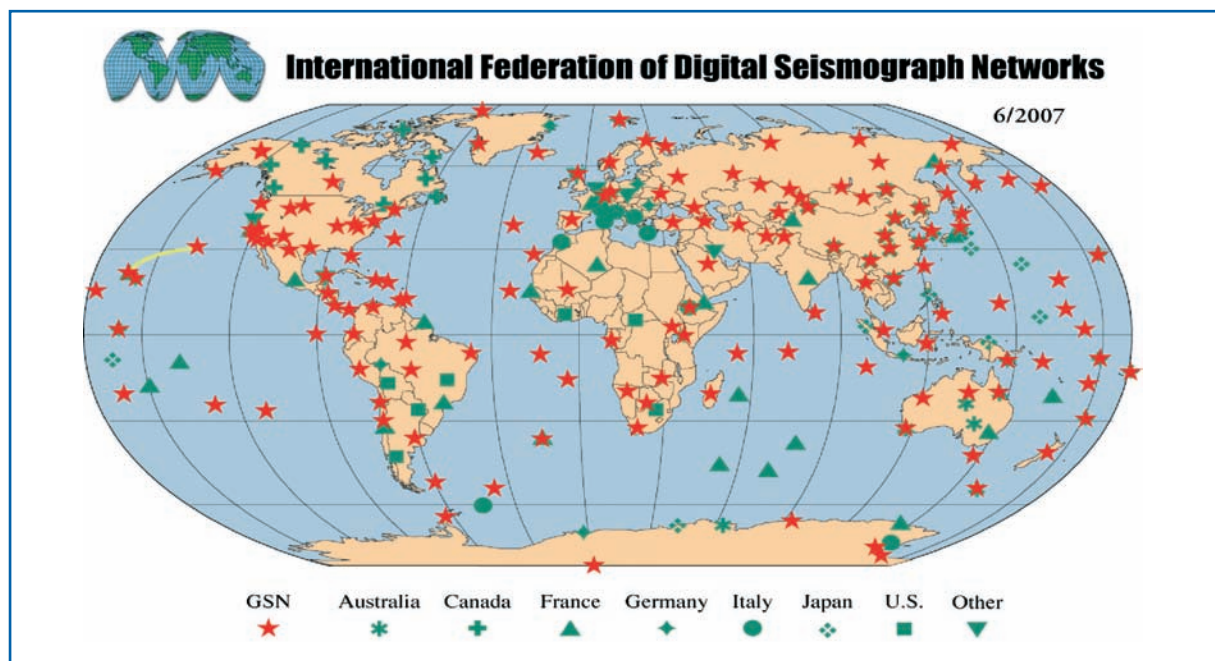
## International Federation of Digital Seismograph Network: increased coverage and data availability for global earthquake monitoring

### Description

The International Federation of Digital Seismographic Networks (FDSN) is the international organization that brings together the primary operators of broadband networks throughout the world. The FDSN is an effective organization to coordinate activities in station site selection, data exchange, and instrumentation standardization. The FDSN has broken the bonds which, in the past, have made it difficult to access data from a variety of networks in a common and comprehensive manner. The FDSN strives to achieve a dense coverage of high-quality broad-band stations in all regions of the world, by pooling together stations contributed by all members. A recent focus is the availability of real-time waveforms from selected stations worldwide. The FDSN primary archive is hosted by the IRIS Data Management Center in Seattle; in addition, most FDSN members allow open access to waveform data at their data centers.

The FDSN is an independent organization and has commission status within the International Association of Seismology and Physics of the Earth Interior (IASPEI/IUGG/ICSU). In February 2005, the FDSN was one of the international organizations signing the GEOSS (Global Earth Observation System of Systems) 10-year Implementation Plan, in recognition of the important role of seismology in the priority area of natural hazards monitoring. Within GEOSS, the FDSN can effectively represent the interests of all countries in a coordinated global policy.

FDSN members include the global networks operated by the US (GSN/IRIS), France (GEOSCOPE) and Germany (GEOFON). These supplement the national networks to serve as the principal global data source for earthquake response and tsunami warning, and contribute to nuclear treaty monitoring.



In 2005-2007, the FDSN has more than doubled its national membership, as digital broadband networks are installed in more countries around the world to replace obsolete technology. Key areas of recent development are Central Asia, South America, Africa and SE Asia. In addition, the availability of real-time data streams from in-situ observing system continues to improve, as well as the worldwide exchange of seismic waveform. For example, over 900 BB stations are now installed in the Euro-Mediterranean network, and the number of open stations is expected to increase from the present 160 to over 500 by 2009; all parameters and open waveforms are exchanged and made available worldwide through a hierarchy of international data centers (EMSC, ORFEUS, and the FDSN archive at DMS/IRIS).

## Added Value

How will GEO aid this effort, how will it impact GEO and be impacted by GEO?

In the *GEO 10-Year Plan Reference Document* the seismograph in-situ observing system and the GSN were recognized as a key observation system in its role for tsunami warning following the Sumatra Earthquake and Indian Ocean tsunami disaster. The data availability has now much improved.

Subsequently, GSN real-time telemetry has been enhanced at over 30 sites globally, and 9 new GSN stations have been installed in the Caribbean, Indian and Pacific Oceans, and central Asia to support tsunami warning and earthquake disaster response. Currently, over 1 Terabyte/yr of real-time GSN data are used by Tsunami Warning Systems internationally.

The joint collaboration of the FDSN members in GEO provides a global infrastructure for in situ observations, integrated data management, and products for the Societal Benefit Area of Disasters associated with the hazards of earthquakes and tsunamis. This GEO framework has strengthened international coordination between GSN/FDSN observing and data managements systems with products organizations (US National Earthquake Information Center, European Mediterranean Seismological Centre, and Intergovernmental Oceanographic Commission Tsunami Warning Systems). These systems currently provide data and products for Societal Benefits in near-real time to GEO Members, Participating Organizations, and the public via a diverse communications network, and are an existing international model of a successful community of practice for GEO.

The GEO work plan focuses on sustaining and improving these systems, enhancing open real-time access to data and products, and advocating synergy with other in situ observing systems on land and in the oceans. The GEO framework of international coordination is essential to the health and function of seismological observing systems, and is needed to help overcome obstacles in data sharing.

GEO Work Plan reference (Societal Benefit Area: Disasters)

- Seismographic Networks Improvement and Coordination, Task DI-06-02
- Implementation of a Tsunami Early Warning System at Global Level, Task DI-06-04

## Participants

Countries: Austria, Bulgaria, Czech Rep., Denmark, France, Germany, Greece, Hungary, Iceland, Italy, Norway, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland, Australia, Azerbaijan, Dubai, China, Georgia, Indonesia, Iran, Israel, Japan, Malaysia, New Zealand, Taiwan, Tajikistan, Thailand, Canada, Chile, Ecuador, Jamaica, Mexico, Puerto Rico, Egypt, South Africa, Kirghyzistan, Kazakhstan, Uzbekistan.

## Current Status and Next Steps

- GSN and FDSN seismic stations provide broad, extensive coverage over all continents and on oceanic islands. Data availability of the GSN is better than 85%, and more than 90% of stations are openly available in real-time. Data availability in many national networks approaches 99%, and data availability through the international data archiving system is rapidly improving.
- Long-term continuity – GSN and FDSN carry the torch for the 100-yr tradition of international cooperation in global seismology. Sustaining the networks is fundamental.
- The FDSN strives to complete the global coverage and country participation in areas such as Africa and South America; to instrument the ocean floors; to integrate seismic sensors with multi-parameter observatories in remote areas for tsunami warning and environmental monitoring.

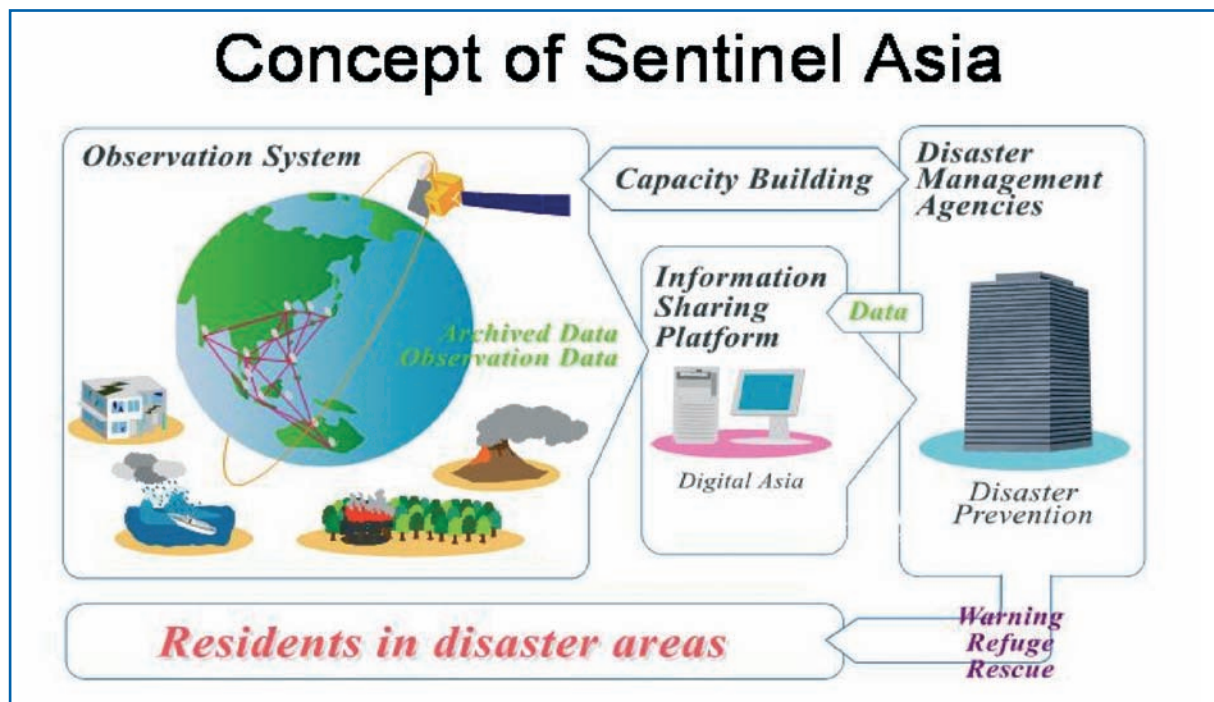
## Sentinel Asia

### Description

- The *Sentinel Asia (SA)* Project has been initiated by the *Asia-Pacific Regional Space Agency Forum (APRSAF)* to share the disaster information across the Asia-Pacific region by integration of Satellite Remote Sensing and Web-GIS technologies, aiming at:
- Construction of a 'life-first society' by information and communication technology and Space technology
- Improvement of speed and accuracy for disaster preparedness and early warning
- Minimizing victims and social economic losses due to disasters.

The SA activities cover many aspects which are characterized as a regional GEOSS as follows:

- Emergency observation by earth observation satellites, and the information sharing through the Internet in case of major disasters in the Asia-Pacific region, which is enabled by the integration of independent systems managed by the members (a system of systems)
- Acceptance of observation requests for Asian countries to support disaster management
- Wildfire monitoring and Flood monitoring as a contribution to the disaster SBA
- Capacity building for utilization of satellite images for disaster management aiming to expand user engagement



### Added value

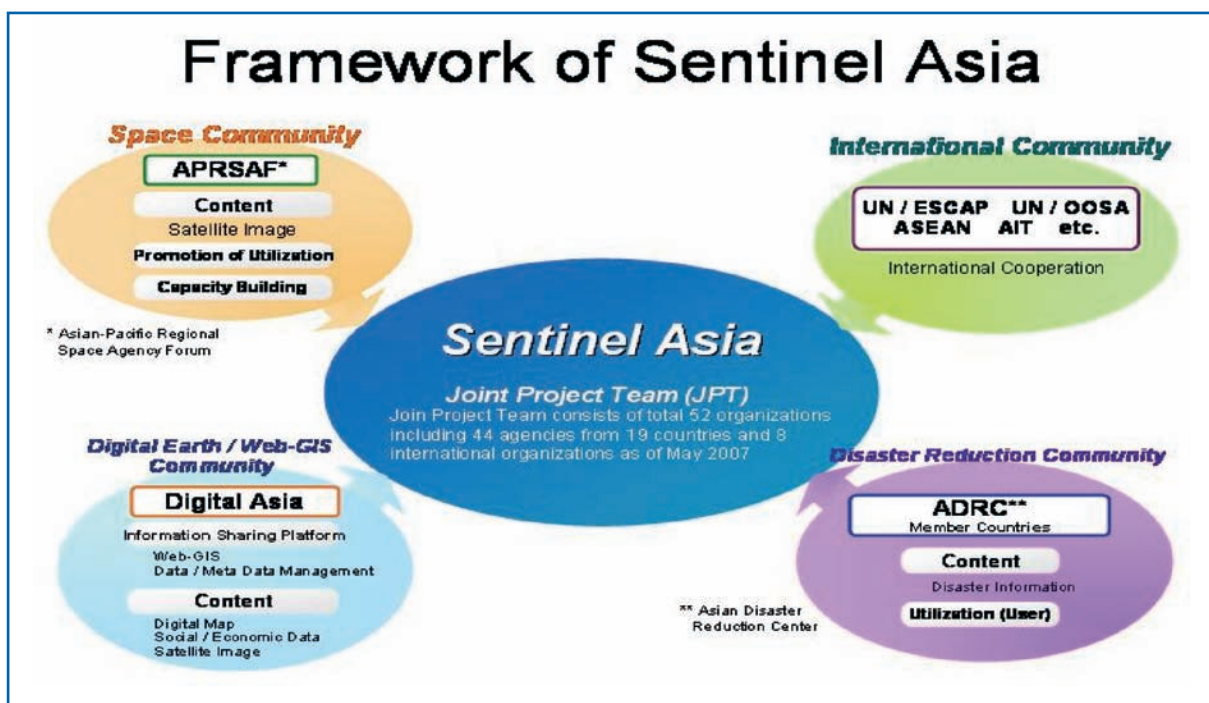
GEO provided major opportunities to SA to have links to the other GEO related projects like GEONET-Cast, GEO-Grid, etc. Taking the advantage of the opportunities, discussion has started to have a concrete cooperation with the projects. In the GEO context, SA was actually closed up in the *GEOSS Symposium on Integrated Observations for Sustainable Development in the Asia-Pacific Region* held in Tokyo, Japan, on 11-12 Jan. 2007. Then through the *GEO Secretariat - SA* meeting on Wildfire monitoring and early warning in Geneva on 13 Feb. 2007, a direct connection between GEO and SA has been clarified, namely, SA is to be "an early success case of the establishment of a regional GEOSS".

## Relevance to GEO

SA will be one of the major components of GEOSS in Asian-Pacific region. Currently, as a regional program of GEOSS, SA is contributing to several GEO tasks (DI-06-08: Multi Hazard Approach Definition and Progressive Implementation, DI-06-09: Use of Satellites for Risk Management, DI-06-13: Global Fire Early Warning System, DI-07-01: Risk Management for Flood and CB-06-04: GEONETCast) in the very first stage, and in the near future SA would contribute more tasks not only for disaster but also Architecture and Data, and Capacity Building gradually.

## Participants

44 organizations from 19 countries and 8 international organizations including GEO members in Asia-Pacific region and participating organizations in GEO; Australia, Bangladesh, India, Indonesia, Japan, Malaysia, Nepal, Philippines, Thailand, UNOOSA, UNESCO/ICHARM, etc.



## Main Participants in GEO task BI-07-02

Annie Simpson (US National Biological Information Infrastructure), Jeff Morissette (NASA), Jim Graham (Natural Resources Ecology Laboratory, Colorado State University), Michael Browne (IUCN Species Survival Commission's Invasive Species Specialist Group), Shawn Dalton and Pam Fuller (US Geological Survey's Florida Integrated Science Center), John Pickering (Discover Life), Brian Steves and Greg Ruiz (Smithsonian Institution).

## Current and Next Steps

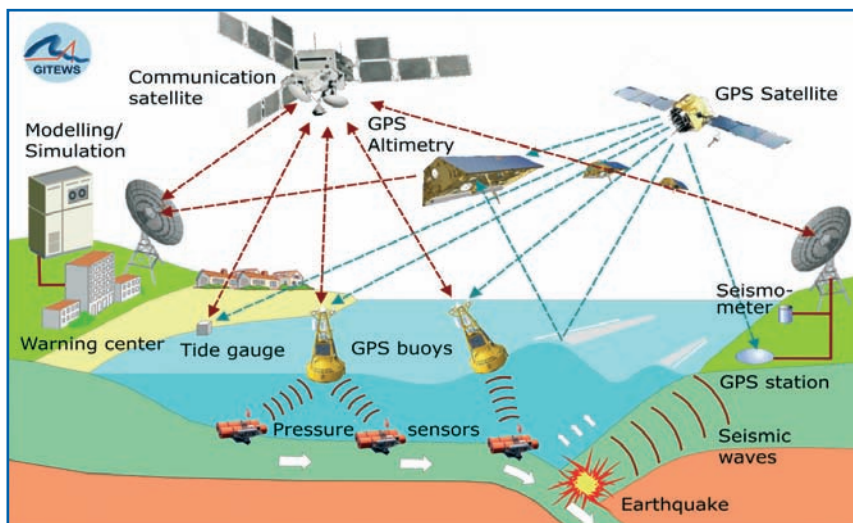
Operations of SA have been commenced since October 2006 by opening its Web site. (<http://dmss.tksk.jaxa.jp/sentinel>) SA activities will be reinforced toward the next step from 2008 through STEP 1 (2006-2007).



## The German Indonesian Tsunami Early-Warning System (GITEWS)

### Description

The goal of this activity is to implement an effective tsunami early-warning system for the Indian Ocean. The tsunami early-warning system is integral part of a multi-hazard Early-Warning-System for the registration of other natural catastrophes including earthquakes and volcanic eruptions. The system integrates terrestrial seismologic and geodetic monitoring arrays with marine and satellite-based observation platforms. It is designed to allow easy integration of new technologic advancements, for which a longer-term research program is implemented in parallel. The initiative is coordinated by the Helmholtz Association of German Research Centres, represented by the GeoForschungsZentrum Potsdam and its project partners: German Aerospace Centre (DLR), Alfred-Wegener-Institute for Polar and Marine Research (AWI), GKSS Research Centre, Leibniz-Institute for Marine Sciences (IFM-GEOMAR), United Nations University (UNU), Federal Institute for Geosciences and Natural Resources (BGR), German Agency for Technical Cooperation (GTZ), as well as from Indonesian and other international partners.



The system concept is focused on the partner countries Indonesia and Sri Lanka. An extension of the system coverage beyond the initial focus areas can readily be achieved. Based on the geologic situation of the region, especially Indonesia faces an acute risk from future catastrophic tsunamis because of its direct neighbourhood to the seismically-active Sunda Arc structure.

The integration of further geophysical and geodetic monitoring systems implemented in the framework of other national activities to develop early-warning capacity in the region will further enhance the system performance. Concrete cooperation has been agreed on with Japan and China.

A fundamental aspect of the GITEWS is capacity building in the area of disaster management for decision makers, experts and the general public at risk.

The GITEWS represents a strong contribution to tasks in the Societal Benefit Area of "Disasters". In particular, the system will be part of a global tsunami early warning system developed under task DI-06-04. The activities also contribute to multi-hazard assessment and rapid mapping (task DI-06-07) and support DI-06-08. The new observation infrastructure built for the GITEWS contribute to the Global Geodetic Observing System (GGOS) and the Global Ocean Observing System (GOOS). The capacity building activities within the GITEWS contribute to the objectives of task CB-07-02.



## Short outline of the system concept

The GITEWS is realized in cooperation with Indonesian ministries and partner organisations. Further cooperations with Sri Lanka, South Africa, Australia, Kenya, Yemen and the Maldives are under discussion).

The focus of the system on Indonesia is due to the fact that the most tsunami-prone continental margin, the Sunda Arc structure, is located almost parallel to the coast line of Indonesia. Tsunamogenic earth- quakes from this continental margin can produce tsunamis, which reach the Indonesian coastline in less than 20 minutes. Other coastlines in the Indian Ocean will be affected after 90 minutes (Thailand, Australia), 120 minutes (Sri Lanka, India) or even later, depending on the source zone. Therefore the GITEWS aims at delivering an early warning message in less than 10 minutes, which will then be substantiated as more geoscientific and oceanographic information becomes available. The early warn- ing messages will be delivered to all Indian Ocean rim countries. This is fully in line with the philoso-phy of UNESCO's Inter-governmental Oceanographic Commission (IOC) which coordinates national activities with respect to the establishment of an Indian Ocean wide integrated Early Warning System.

**The components of GITEWS** The System consists of different components.

1. Core of the system is a seismological network to detect location and magnitude of Earthquakes as fast as possible. About 25 new seismic stations will be installed in Indonesia for rapid (<2min) and reliable detection of earthquakes. An additional 20 seismic stations will be installed in Sri Lanka, Australia, and countries of the East-African coast or on islands in the Indian Ocean for teleseismic observations, which are needed to obtain information on the rupture process – the most important parameter for tsunami modelling. The seismometer network will be completed by a network of GPS stations for the measurement of crustal deformation due to earthquakes. This generates additional information on the earthquake process.
2. Because not every earthquake produces a tsunami the system has to confirm in the open ocean if a tsunami was generated. This is done by ocean-bottom pressure sensors and specially designed tsunami-buoys. In addition, a number of tide gauges on islands in the Indian Ocean will be installed to confirm whether a tsunami has been generated. The oceanographic equipment measures important parameters for the simulation and modelling, including wave height and wave length.
3. Important elements of tsunami early warning are pre-calculated simulation results. Based on the measured earthquake and oceanographic parameters tsunami models are calculated in advance. These models include inundation at the coastline of Indonesia and propagation models for the entire Indian Ocean. These simulations are updated during the propagation of an actual tsunami with new information becoming available from the sensor networks. Thus at all times an updated model result of tsunami travel times and wave heights is available. This is important information for all Indian Ocean countries and the basis for detailed warning bulletins.
4. An important aspect of the warning system is to combine all available sensor information including the simulation results in a comprehensive manner, derive and display the situation analysis, and generate decision proposals. These are the tasks of a newly developed Decision Support System (DSS) which is an essential part of the Early Warning and Mitigation Centre to be deployed at BMG Jakarta. Depending on the decisions made, the DSS provides further support by ad-hoc provi-sion of warning and information products to be sent to the individual recipients by the Indonesian dissemination system.
5. An important element of the GITEWS is Capacity Building. This includes training of scientists and engineers for the technical and scientific part of the project, but also training of authorities, organizations and people in Indonesia with respect to awareness and preparedness for such catastrophic events.

## Timelines

The operational system, i.e. sensor networks including seismic, GPS and oceanographic instruments, the early warning and mitigation system including DSS, the modelling data base, shall be completed end of 2008. Test and Operation of the above mentioned System in Indonesia will be performed in 2009 and 2010 jointly by Indonesian and German partners. The complete system shall be handed over to Indonesia in 2010. Activities in the field of Capacity Building have already started and will run until 2010.

## The Network of Centers of the Italian Civil Protection System

### Description

The Network of Centers is constituted by the operative units, able to collect, elaborate and exchange every kind of data (meteorological, hydrological and precipitation data for hydro-geological and hydraulics risk, volcanic, seismic is coming...), thus providing a multiple support system for decisions taking by the Civil Protection Authorities.

The Network is coordinated by the Department of Civil Protection – DPC – that is under the direct Authority of the Prime Minister of the Italian Government.

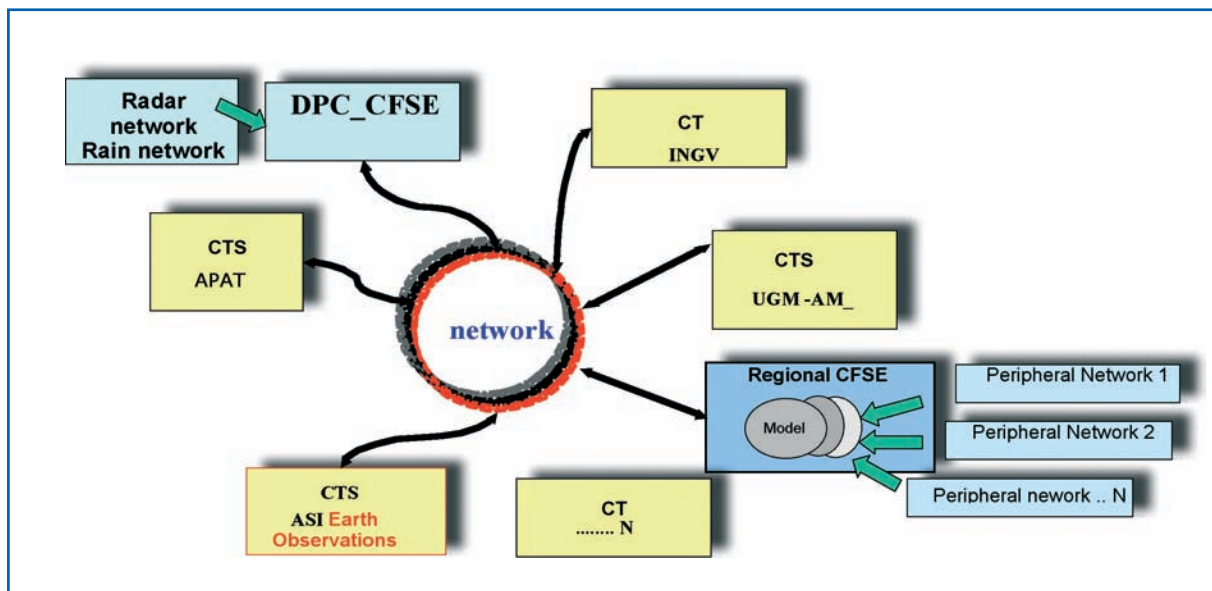
DPC is responsible to issue the guidelines, procedural and operative standards, as well as to coordinate the Network during national level emergencies.

The Network includes two type of Centers :

“Centro Funzionale” = Center for Forecasting and Surveillance of Effects(CFSE).

When completed the Network will include 21 Regional Centers, collecting observations, running forecast models and one at National level, under the control of DPC, collecting Regional data, integrating the national picture and acting as back up in case of need.

“Centro di Competenza”= Center for Technological and Scientific services (CTS) are National level Institutions which provide services, information, data, elaboration, technical and scientific contributions for specific topics.



A number of CTS has already been defined, and are operational. Major Institutions include:

- The General Office for Meteorology - UGM - of the Military Air Force
- The National Environmental Agency - APAT
- The Italian Space Agency - ASI
- The Italian Institute for Geophysics and Volcanology - INGV

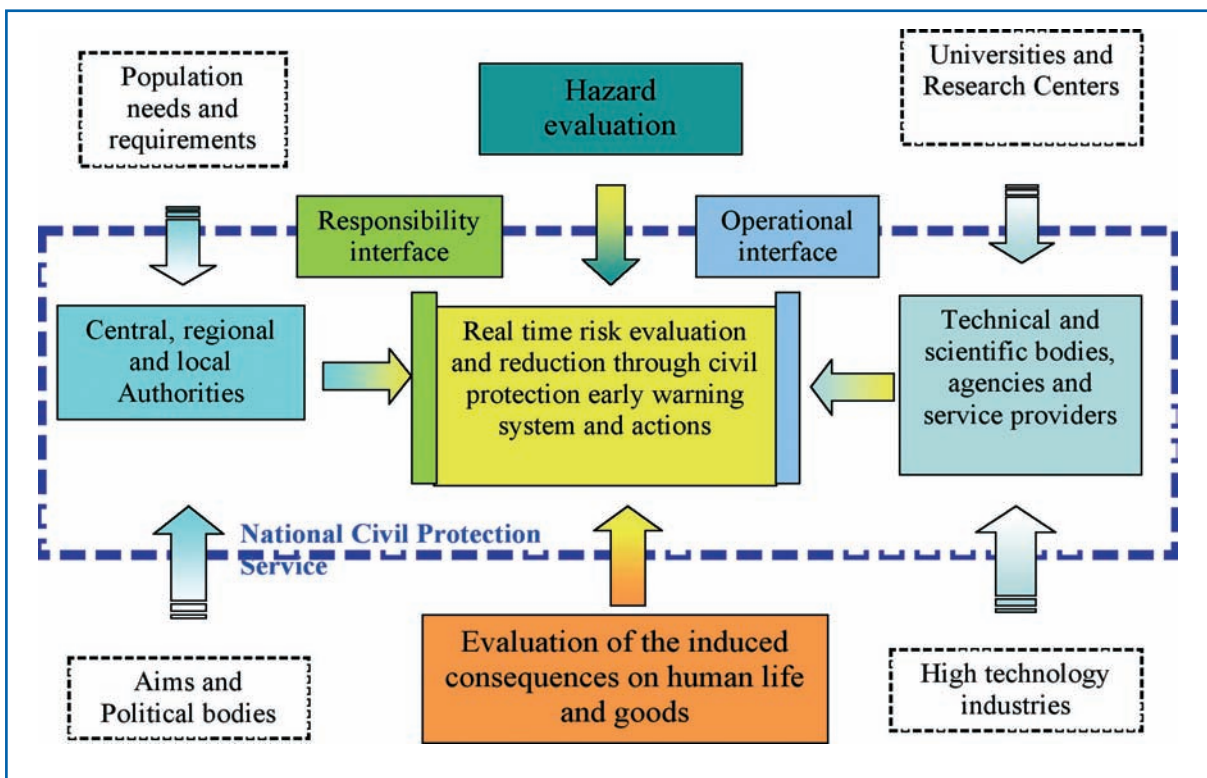
### Added value

The system directly addresses two major calls of the GEO 10-year implementation plan: On information needs, by involving Agencies and Institutions in charge of services in other SBA's, it puts in practice the development and use of common products across different SBA's. On Disasters SBA, it realizes the coordination of systems for monitoring, predicting, risk assessment, early warning, mitigating, and responding to hazards at local and national levels, bringing more timely dissemination of information for decision making.

### Relevance to GEO

It represents, at Country level, an operational set-up that involves all actors involved in Risk Management, realizing synergies and avoiding duplications in the use of Observation Systems and associated modeling, ensuring the discharging of the relevant responsibilities from Central to local governments and putting together in the same network the Government, the major Public Institutions and the Scientific and Technological Communities. The approach represents a "good practice" to be replicated in other Countries, and, according to its main features, has the potential to be scaled up from Country to Region.

### Participants



### Current Status and next steps

The Network is being built up. Today 10 Functional Centers and 41 Competence Centers are operational.

## Air Quality and Human Health

### Description

This SBA provides atmospheric forecasts of dust, aerosol, and ozone conditions by assimilating Earth observations data into weather models and provides reliable 2-3 day forecasts of air quality so authorities can intervene to reduce human health responses diseases. Another critical objective is to relate statistically the frequency and severity of air quality episodes with health outcomes from hospital records and patient complaints to better understand the transmission pathways of human respiratory diseases. Methods include:

1. retrieving satellite measurements of ground level conditions that control the concentrations of air pollutants;
2. assimilating these measurements into forecast models embedded in operational weather models to replace outdated measurements; and,
3. broadcasting air quality information via GEONETCast and other communication networks on actionable time scales.

Several types of surface and near-surface air quality measurements are made routinely from satellites and ground networks. Among the more useful are the total area and distribution of dust sources; soil moisture at the surface; the timing, amounts, and patterns of rainfall; topography; the speeds and directions of wind; and anthropogenic sources. Early achievements indicate that replacing outdated land cover maps with satellite observations improves the performance of regional dust models for forecasting the time and severity of air quality episodes. Such improvements have augmented the interest of national health authorities and air quality compliance agencies to include environmental conditions at the Earth's surface in daily weather forecasts. Augmenting these capabilities with vertical profile measurements of smoke from fires and anthropogenic emissions from agricultural and industrial sources will further improve forecasts and improve understanding of epidemiology and intervention mechanisms.

Figure 1 shows elements of the air quality and human health system-of-systems. Some elements are operational (GEONETCast and SERVIR); others are quasi-operational (red dots); and still others (yellow dots) are conceptual, but expected to be implemented by 2009.

## Added Value

GEO has assisted these early achievements by stimulating collaborations between organizations that provide Earth observations, those who process data and information into useful products, the modeling communities who assemble products into forecasts, and those who disseminated results as early warning broadcasts of air quality conditions. Routine forecasts of dust and aerosol events will add to the global Earth observing system-of-systems for both the air quality and human health Societal Benefit Areas. Finally, continued development of GEOSS abilities to identify and monitor major air quality events will help long-term efforts to understand international transport of both dust and aerosols on a global scale.

## Relevance to GEO

The Northern Hemisphere mid latitudes are known as being dusty and polluted by a ring of unhealthy aerosols. The Northern Hemisphere is also labeled as a breeding ground for emerging infectious diseases, some of which begin as respiratory syndromes capable of progressing into human health epidemics. The threat of these possibilities translates into adverse consequences on national gross domestic products (GDP) and cost of rising health care needs.

GEO Work Plan reference:

- SBA: Air quality; Human health and well-being
- Task: HE-07-02 – Environment and Health Monitoring and Modeling

## Participants

Members: • USGEO;  
Participating Organizations: • WMO; ICSU; ISPRS;

## Current Status and Next Steps

Gaps include data missing in current satellite measurements, gaps in geographic coverage, sensor technology gaps, standards, and interoperability, among others.

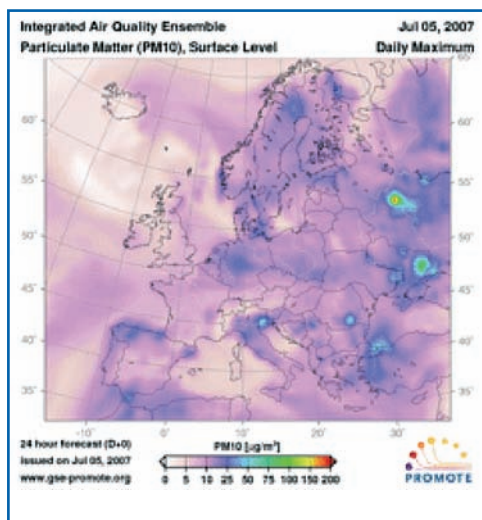


## European Space Agency GMES Service Element Project “PROtocol MONiTORing for the GMES Service Element: Atmosphere (PROMOTE)” <http://www.gse-promote.org/>

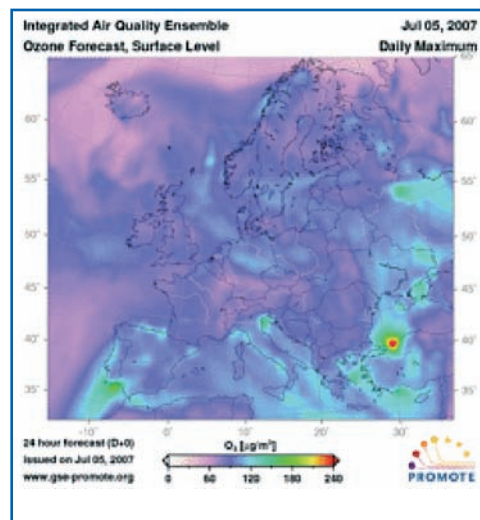
### Description

The GMES Service Element for Atmosphere PROMOTE, sponsored by the European Space Agency (ESA), delivers policy-relevant services on multiple atmospheric issues to end-users. With a consortium of over 20 European and Canadian institutes, including service providers and researchers, PROMOTE focuses on stratospheric ozone, surface ultraviolet radiation, air quality, greenhouse gases, and special services. PROMOTE services assist user organizations in the public sector in things such as their monitoring obligations and in their tasks to warn the public for air pollution episodes or enhanced levels of ultraviolet radiation. Currently about 50 such user organisations in 16 European countries have signed a Service Level Agreement with PROMOTE service providers. With these services PROMOTE reaches out to 30 % (air quality) or even 60% (UV) of the population in EU25. International organizations like EEA and WMO are provided with information such as long-term satellite data on stratospheric ozone and up-to-date information, including forecasts, on the Antarctic ozone hole.

One of the biggest challenges being addressed by PROMOTE is the integration of existing ground-based air quality networks with models and the newly available satellite measurements on air pollution in order to generate accurate daily information on air pollution levels over Europe. The maps below represents an integrated forecast of air quality (surface-level PM10 and ozone) over Europe produced jointly by several of the leading models in Europe.



*Particulate matter, surface level*



*Ozone forecast, surface level*

PROMOTE covers spatial scales from the ozone hole over Antarctica to polluted streets in London, and temporal scales from climate and ozone trends across decades to hourly information on ultraviolet radiation levels on Mediterranean beaches. Of special note regarding PROMOTE, the close interaction of providers and users in the project helps to ensure high-quality services that directly address users' needs.

## Added Value

Through the gathering together of and cooperation among European and Canadian experts into a consortium focused on delivering operational products, PROMOTE has made an excellent step towards beginning a global network of experts concerned with the use of Earth Observation for further understanding the Earth's atmosphere and its effects. Through the GEO initiative, the User Interface Committee on 'Air Quality and Health' has brought together the European side, including PROMOTE, and the United States initiatives of NASA on similar topics and a dialog has begun on how best to collaborate. It is expected that the GEO initiative will continue to foster these connections and dialogs between Europe and North America and it is hoped that similar connections can be made with other regions such as Asia and Africa.

## Relevance to GEO

PROMOTE is directly relevant to the Climate, Health, Weather, and User SBAs.

In the Climate SBA, the PROMOTE services being provided on Greenhouse Gases, Aerosols and Stratospheric Ozone are all directly related to Task CL-06-02 (Key Climate Data from Satellite Systems). In the Health SBA, the PROMOTE services being provided on ground-level Air Quality and Personalized UV Information are directly applicable to the aims of Task HE-07-03 (Integrated Atmospheric Pollution Monitoring, Modelling and Forecasting) and the epidemiological aspects of HE-07-02 (Environment and Health Monitoring and Modelling) as relates to UV/skin cancer relationships. In the Weather SBA, the stratospheric ozone services are of direct application to Task WE-07-01 (Development of Data Assimilation for Operational Use). In the User SBA, PROMOTE is providing support to Task US-06-02 (Pilot Communities of Practice) in the 'Air and Health' Community of Practice.

## Participants

- Austria
- Belgium
- Canada
- Denmark
- Finland
- France
- Germany
- Greece
- Ireland
- Italy
- Netherlands
- Norway
- Portugal
- Spain
- Switzerland
- United Kingdom
- ESA
- ECMWF
- WMO
- CEOS

## Current Status and Next Steps

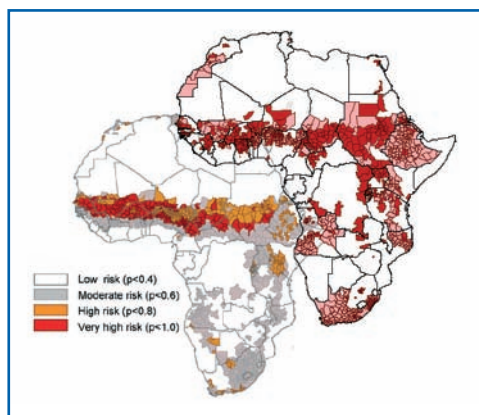
The PROMOTE project has funding through late 2009 and many services are expected to be funded in further GMES funding mechanisms of the European Commission, notably the 7th Framework Programme (FP7). Additionally, participation in the CEOS Atmospheric Composition Constellation (ACC) project will contribute toward continuation of international cooperation and addressing potential gaps in the availability of Earth Observation data necessary to continue provision of operational services.

## Improving intervention strategies for meningitis epidemics in Africa through enhanced application of environmental information

### Description

GEO is actively involved in facilitating efforts to combine Earth observations with public health data and information systems to improve strategies for the prevention and control of meningitis epidemics in Africa.

Meningococcal meningitis is one of the most feared diseases in Africa because of its rapid onset, high fatality rates and long-term disabilities such as brain-damage and deafness. Epidemic outbreaks pose a serious threat to susceptible populations, with each outbreak placing severe burden on the public health system and socio-economic development of affected areas. In 1996-97 alone, epidemics infected 250,000 people and led to 25,000 fatalities in Africa.



*Epidemic outbreaks tend to occur roughly on a four- to seven- year cycle throughout a region of Africa known as the 'Meningitis Belt', stretching from Senegal in the west to Ethiopia in the east. While meningococcal meningitis is an endemic disease across this region, with carriage of the bacteria common and often benign, epidemic outbreaks are typically triggered during hot, dry and dusty conditions and in regions of high population density.*

While there are still many uncertainties about the transmission of the disease and the development of an epidemic event, an increasing amount of scientific research conducted by numerous research institutes throughout the world is shedding light on the environmental factors which may influence the start, duration and nature of a meningitis epidemic. The environmental risk indicators, including changes in temperature, humidity levels and concentrations of sand and dust aerosols, appear to influence the spatial and seasonal distribution of epidemic outbreaks. Climate variability on a year-to-year basis as well as longer term climate change may also impact the timing, occurrence and extent of epidemic events.



Significant improvements are also being made in the quality, effectiveness and availability of meningitis vaccines used in response and control programs. Unlike past and current control strategies which have been based on reactive, short-term mass vaccination campaigns, the public health community is optimistic about the opportunities provided by the recent development of an affordable and effective conjugate vaccine, through efforts of the Meningitis Vaccine Project. This new vaccine offers the potential to provide life-long protection against the dominant strain of the bacteria (Serogroup A) to 300 million-plus people in Africa's Meningitis Belt over the next 10 years.

While advances are being made within both the scientific research community and the public health community, of critical importance to the success of future prevention strategies is the identification and bridging of the gap between the providers and users of relevant and up to date information. While it is clear that a number of often complex environmental, social, demographic and economic factors need to be taken into consideration in the design of strategies to reduce the burden of meningitis in Africa, a more comprehensive and in-depth understanding of these specific risk indicators will assist decision-makers in determining populations at highest risk of an outbreak and help inform strategies for the distribution of preventative vaccines.

## Relevance to GEO

Recognizing the emerging opportunities for collaborative efforts between the environmental, epidemiological and public health communities to improve these strategies, GEO has been actively involved in the development of the Meningitis Environmental Risk Information Technologies (MERIT) Project. In collaboration with the World Health Organization (WHO) and other partners, GEO hosted a consultative meeting from 26-27 September 2007 which brought together experts to investigate opportunities to improve the understanding of the relationship between meningitis epidemics and environmental parameters, to increase the understanding of the information requirements of the public health community, and to identify critical research gaps.

As part of ongoing collaborative efforts, participants at the meeting agreed to work together on the development of the MERIT Project initiative under the initial coordination of GEO, with identified aims to: improve the application of climate and environmental information to meet the needs of public health policy-makers in Africa; enhance regional and national surveillance capabilities; and strengthen decision-making and public health policy development through institutional capacity building efforts.

## Added Value

GEO adds value to this activity by providing an opportunity for effective engagement between the environmental and public health communities and by promoting areas for effective integration of environmental information with public health information systems to support the development of meningitis early warning and alert systems.

## Relevance to GEO

The MERIT Project is contributing to the objectives of the GEO Health Task HE-06-03, 'Forecasting and Monitoring Environmental Health Hazards'. This project which is driven by the public health community, contributes to the Health Societal Benefit Area of GEO by emphasizing a systematic approach to increasing the application of environmental information based on the proven benefit to public health strategies. The MERIT Project brings together non-GEO organizations with GEO Members and Participating Organizations to address climate- and weather-sensitive diseases and provides a forum for non-GEO participants, especially public health workers, to benefit from interactions with the GEO community.

## Participants

The participants involved in the initial development of the MERIT Project include:

- World Health Organization
- World Meteorological Organization
- International Federation of the Red Cross and Red Crescent Societies
- Health and Climate Foundation
- International Research Institute for Climate and Society
- Meningitis Vaccine Project PATH

## Current Status and Next Steps

1. Development of a MERIT framework to enable effective integration of environmental information into public health strategies for meningitis epidemics;
2. Improvements in the uptake and use of health decision support tools to provide timelier warnings of potential epidemics;
3. Identify funding opportunities to meet resource requirements and sustain future operations of the MERIT Project.

## Ozone-Web – Near Real-Time Information on Ground Level Ozone Concentrations for Europe

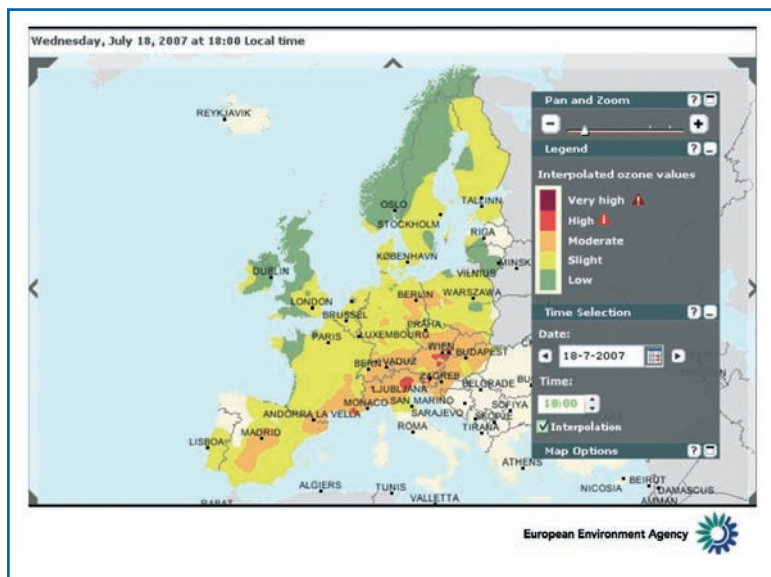
### Description

Ozone Web <http://www.eea.europa.eu/maps/ozone/> is a public website based around ozone data and air quality information integrated in European Environment Agencies (EEA's) spatial data infrastructure. It is published within the EEA main site and links back to data providers as well as to national and regional air quality websites, giving easy access to more local information.

The purpose of the web site is to inform about ground level ozone in Europe for current and recent situations on an hourly basis based on near real-time data. Either by entering a place name or by clicking on a map of Europe, users are able to follow air quality across Europe. The web site also includes information on the health implications of ozone values.

Ground level ozone is a health hazard that presents one of the most prominent air pollution problems in Europe. It can irritate airways, causing breathing difficulties and damaging lungs after only a few hours of exposure. Up to 30% of Europe's urban population is exposed to ozone concentrations above the threshold levels set by the EU. Ozone pollution is responsible for as many as 20 000 deaths in Europe every year.

As a joint European project, Ozone Web reflects the international character of air pollution. It is produced in one place but may have an impact in another many hundreds of kilometres away. Data from more than 700 air quality monitoring stations is sent to the EEA every hour and displayed in near real-time on the web site. The web site is an excellent example of how an international institution can create partnerships with member countries to serve and empower citizens.



Ground level ozone concentration over Europe on July 18th 2007 6:00 p.m. local time

### Added value

The web site demonstrates how multi-national near real-time environmental data can be stream-lined, harmonized and used to create a visual and easily understandable presentation of air quality measurement data for the public using state of the art information technology. The web site provides the following main features:

- European status (what is the situation in Europe) including current and recent historic status data;
- Advanced mapping tool;
- Interpolated maps;
- Comparison views;
- Supporting texts;
- Links to national, regional or local data providers.



## Relevance to GEO

Ozone Web is linked to a number of GEO societal benefit areas (SBAs) mainly to 'Human Health Improvement' and 'Management and Protection of Ecosystems' since ozone is also affecting plant growth. There are also links to 'Understanding and Adapting to Climate Variability and Change'. Ground level ozone concentrations are linked to heat waves with high impacts on human health.

Ground level ozone concentrations are especially relevant for the GEO tasks 'Strengthen Observation and Information Systems for Health (HE-07-01)', 'Environment and Health Monitoring and Modelling (HE-07-02)', and can deliver validation data for 'Integrated Atmospheric Pollution Monitoring, Modelling and Forecasting (HE-07-03)'. Ozone Web may also be used as good practice example for near real time assimilation of multi-source data and support the Geo tasks 'Enabling Deployment of a GEOSS Architecture (AR-07-01)' and 'GEOSS Architecture Implementation Plan (AR-07-02)'.

The most important issues for GEO are in line with the basic principles of Ozone Web as there are:

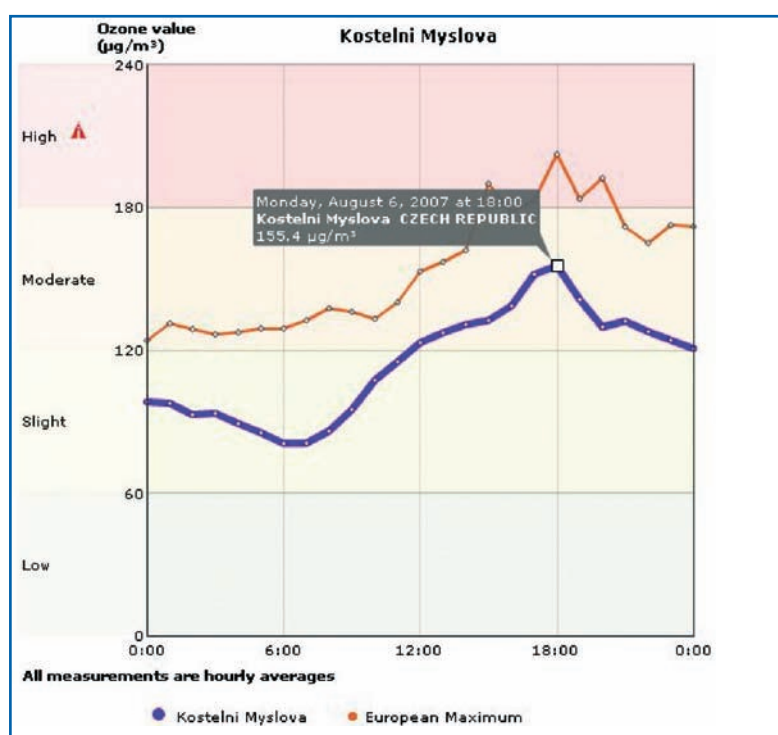
- Control: Data providers remain in control of the data provision and use.
- Visibility: Visibility should be given to the data providers (branding and their services).
- Quality control: Data received in real-time by EEA will be filtered to check for data outside pre-set limits and null or error values.
- Added value services: EEA aims to provide added value services back to the data provider organisations based on the data.

## Participants

Ozone Web is a joint activity from European Environment Agency (EEA), its 32 Member States organized in the European Environment Information and Observation Network (EIONET). 24 of the countries are also GEOSS members. EEA and the European Commission (DG-Environment) are a participating organization of GEO. Links to other organizations and networks around the globe are envisaged.

## Current Status and Next Steps

Ozone Web is an operational web based. Over the next year the project plans to expand data coverage to other pollutants such as particulate matter and link the different thematic layers to other environmental information as well as to other regional and global data sets.



Ozone concentration over the whole day as measured at an individual station

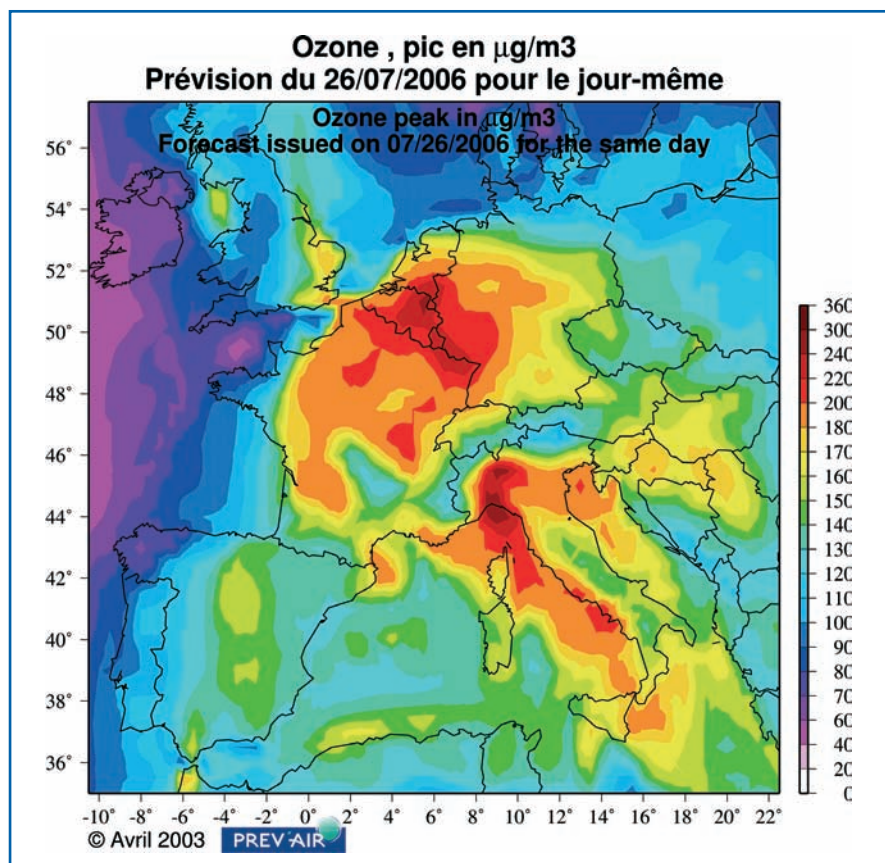
## PREV'AIR: European air quality forecasting and mapping system ([www.prevail.org](http://www.prevail.org))

### Description

The PREV'AIR system was implemented in 2003 upon an initiative by the French Ministry in charge of Ecology and Sustainable Development with the aim of generating and publishing daily air quality forecasts and maps resulting from numerical simulations performed for different spatial scales (global, European, and national). Information related to ozone and nitrogen dioxide forecasted concentrations can be accessed for the northern hemisphere, Europe and France; particles (PM10 and PM2.5) are available on both European and French scales. The PREV'AIR system should address the concerns of people and organisations that would like to personally or professionally understand the continent-wide evolution and trends of the atmospheric pollution behaviour in the short and medium terms.

The PREV'AIR products :

- Maps that represent daily average and peak concentrations of ozone, nitrogen dioxide and PM are drawn up every morning for the same day, the following day and the day after. Beyond the graphical displays, numerical data are also available on the PREV'AIR website.
- Re-analyses for ozone and PM concentrations, issued from numerical simulations that are corrected, in an a posteriori process, in accordance with observation data provided by bodies responsible for air quality monitoring in Europe. It should be noted that these analysed maps are built following a near real time process, unvalidated near real time observation data being regularly assimilated in the models. Re-analyses should provide the most objective representation of air pollution patterns.



*PM10 and PM2.5 : Particles with a diameter lower than 10 and 2.5 microns respectively*

### **Added value**

This kind of operational product is quite new in the field of the regional air quality (in Europe). GEO will help in promoting such an approach and in providing new observation data (earth observations especially) that could be assimilated in the numerical models for a better assessment of air pollution levels. These new data could be crucial for improving air quality monitoring where in-situ data are not implemented (in maritime areas, or in some eastern side countries for instance).

Conversely, integrated air quality modelling systems such as PREV'AIR will support the development of earth observations dedicated to this field. Specification of expected complementary measurements can be established by the regional air pollution community.

Moreover, the PREV'AIR system should be included in the GEO tools for a better evaluation of the atmospheric pollution that is well-known for having significant adverse impact on human health and ecosystems.

### **Relevance to GEO**

The PREV'AIR system will contribute to the tasks on health issues and it has been identified as a main contribution of the task HE-06-03.

### **Participants**

- INERIS (France)
- CNRS (national research centre –France)
- Météo France
- ADEME (french environment agency)

### **Current status and gaps**

PREV'Air is running in an operational way for almost 5 years now. It is funded by the Ministry in charge of Ecology, being one of the component of the French air quality monitoring system. It is considered as a sustainable system. PREV'AIR consortium is now involved in several European consortia created within the GMES initiative which aim at developing the European expertise in the field of air quality forecasting and mapping. PREV'AIR contributes to the PROMOTE (ESA) and GEMS(FP6) projects that are examples of such ambitious projects that will allow gather skill and experience on this topic and that will benefit to GEO.

## USGEO Program to Improve Air Quality Forecasts and Decision Support for Respiratory Health

### Description

Research and operational agencies in the United States, collaborating as members of the United States Group on Earth Observations (USGEO), are coordinating their actions and programs to related Earth observations technology to improve air quality forecasts that have respiratory health consequences. This contribution describes the early successes from this collaboration between NASA, EPA, NOAA, USGS, and CDC, among others.

The objective is to provide timely forecasts of severe environmental dust and aerosol episodes by assimilating Earth observations data into global weather models that currently do not include dust observations as part of the daily forecasts; and, to provide reliable two to three day forecasts of these episodes so public health authorities can intervene to reduce health affects that exacerbate respiratory and cardiovascular diseases. Another critical objective is to relate statistically the frequency and severity of air quality episodes with health outcomes from hospital records and patient complaints to better understand the epidemiology of human respiratory diseases. Methods include

1. retrieval of most recent satellite measurements of near-surface environmental conditions that control dust entrainment;
2. assimilating these measurements into dust forecast models embedded in operational weather models to replace earlier, outdated measurements of these properties; and
3. running the models with the refreshed data to obtain short-term forecasts of atmospheric dust loads and movements on time scales that are useful for public health actions.

Several types of surface and near-surface measurements are made routinely from satellites. Among the more useful for predicting dust entrainment in arid and semi-arid regions are the total area and distribution of dust sources as determined by the amount and distribution of vegetation cover; soil moisture at the surface; the timing, amounts, and patterns of rainfall; topography; and the speeds and directions of near surface wind. Results achieved from model runs indicate that replacing outdated land cover measurements with actual satellite observations of land cover improves the ability of the models to forecast when dust episodes will occur, and in some cases, the magnitude of the dust concentration. The impact of these early results has augmented the interest of local, regional, and national health authorities and air quality compliance agencies in the United States to include environmental conditions at the Earth's surface in daily weather forecasts. Moreover, it is expected that extending these forecast capabilities to include vertical profile measurements of smoke from fires and anthropogenic emissions from agricultural and industrial sources in the lower atmosphere will further improve air quality forecasts having health applications.

The program is executed through federally-funded research and applications projects. These include: Health & Environment Linked for Information Exchange (HELIX); Public Health Applications in Remote Sensing (PHAIRS); Geo-Medical Statistics (GeoMedStat); Public Health Air Surveillance Evaluation (PHASE); and the Environmental Public Health Tracking Network (EPHTN).

Specific health applications are aimed at understanding the epidemiology of asthma and myocardial infarction through tracking outcomes of populations at risk; improving decision support for health communities-of-practice; and linking exposures to health outcomes. To do this requires timely forecasts of aerosol and particulate concentrations as measured by satellite sensors and verified by in-situ monitoring networks.



## Added Value

GEO can aid these early achievements through its support of the Sand and Dust Storm Warning System being established by the UN World Meteorological Organization and by supporting the International Council for Science (ICSU) initiative on Science for Health and Well-being. To achieve this will require encouragement from GEO to stimulate interoperability among weather satellite data processing systems to achieve consistency and validity of forecasts. Improved forecasts of extreme dust and aerosol events will add to GEO's system-of-systems for both the air quality and human health Societal Benefit Areas. Finally, GEO can have a significant impact on the future of GEOSS abilities to identify and monitor major air quality events and the international transport of both dust and aerosols on a global scale.

National assets for in situ, airborne, and satellite sensor systems are synergized through multi-agency formalized in some cases with administrative memoranda of understandings. These are implemented in various ways by the funded projects to gain access to required data sets (e.g., EPA's AIRNow and Aeronet networks), processing algorithms (e.g., NASA sensor Science Team products), models (e.g., NOAA's NCEP and EPA's CMAQ), visualization technologies, and delivery mechanisms. Workshops are organized to bring air quality/public health project teams together to review cross-cutting developments, reinforce program goals and objectives, and reinforce communication between communities-of-practice. Sustainability is achieved by each agency's long term strategic plan, supported by the changing mix of projects awarded through competitive processes.

## Relevance to GEO

Early achievements demonstrate that timely forecasts of extreme dust events can be made for the American Southwest. The Northern Hemisphere is known, even if anecdotally, to be very dusty and polluted by a global, mid-latitude ring of unhealthy aerosols. In the 21st Century, the Northern Hemisphere is also being labeled as a breeding ground for emerging diseases. Some of these could begin as respiratory syndromes that if not monitored closely, could progress to pandemic status across the economically developed world. The threat of pandemics aside, the growing incidence of chronic respiratory diseases in any nation's general population takes its toll on the gross domestic product (GDP) and cost of rising health care needs. The evolving air quality/respiratory health system should be evaluated as a component of GEONETCast.

Contribution to 10-year plan:

- To be added

GEO Work Plan reference (SBA, Task, Target):

- SBA: Human health and well-being
- Task: HE-07-02 – Environment and Health Monitoring and Modeling

## Participants

Participating Organizations: USGEO (including NASA, EPA, NOAA, USGS, DOE); ISPRS (through working group participation on projects)

## Current Status and Next Steps

Long-term continuity depends on continued program funding as expressed in individual agencies' strategic plans; progress in developing products based on Earth observation inputs and modeling outputs; success in growing the communities of practice who will use the products; and demonstrated success linking air quality forecasts with related health outcomes, and socioeconomic benefits.

Gaps include missing data in satellite measurements, gaps in geographic coverage, sensor technology gaps, standards, and interoperability.

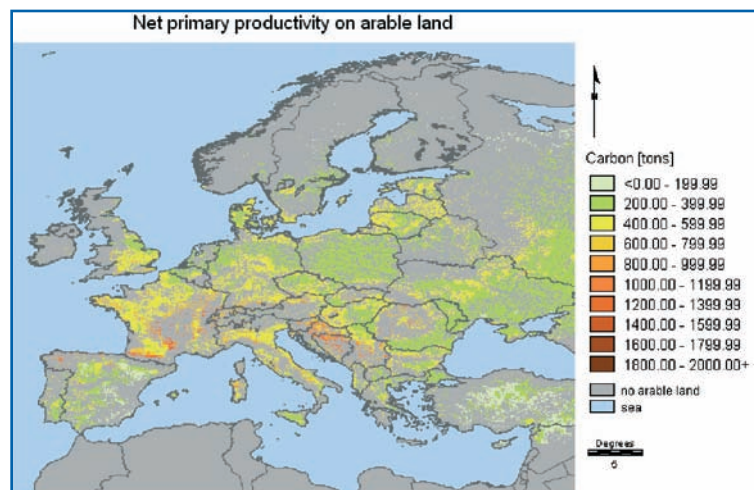


## Bioenergy resource assessment

### Description

At the German Aerospace Center (DLR) a methodology is developed analyzing the spatial distribution of biomass potentials with Geographical Information Systems (GIS, Gehrung & Scholz, 2007). Various remote sensing data is incorporated into this GIS tool. On the one hand data on land cover is used to assign various biomass fractions to their origin. Data sets such as PELCOM (Pan-European Land Use and Land Cover Monitoring) deliver information on land use in Europe at a high resolution. Specific biomass fractions are assigned to various land cover classes as more detailed information on the energy crop level is missing. Land cover classes used are e.g. arable land, grassland and forests and thus define the quality of biomass assessment in a given area.

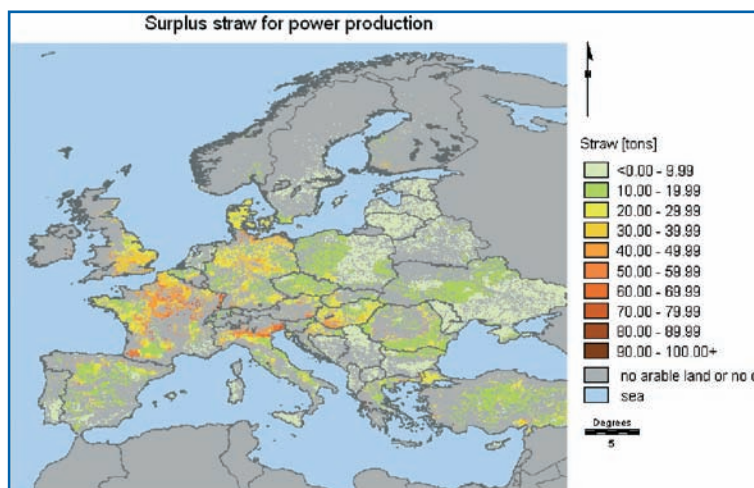
Based on a dynamic carbon cycle model BETHY/DLR (Wißkirchen und Günther, 2005) net primary productivity (NPP) and finally above ground biomass was estimated. Such a model is a special type of soil-vegetation-atmosphere-transfer (SVAT) model that makes estimates of the transfer of carbon from the atmosphere in the form of CO<sub>2</sub>, to the earth in the form of C, commonly referred to as carbon fixation. The NPP model takes into account the photosynthetic processes, as well as the environmental conditions that affect photosynthesis.



Example of net primary productivity on arable land for 2005 derived from the BETHY/DLR model and EO data

Static inputs to the model, such as soil type or growth parameters associated with particular plants, come from existing databases. For variable inputs, such as vegetation state, NDVI and LAI from current satellite sensors are used. Daily atmospheric parameters as solar radiation, temperature and precipitation are obtained from the European Center of Medium Range Weather Forecasts (ECMWF). In some cases, the inputs required for the NPP models cannot be obtained directly from the sensor data, and must instead, be derived through some other models. Thus the NPP model, the static input databases, the satellite data, additional models, and suitable retrieval algorithms have to be merged together seamlessly into a single modelling chain.

The resulting distribution of NPP can be used in combination with forestry and agricultural statistics e.g. from EUROSTAT for deriving biomass energy potentials. Results have been obtained e.g. for surplus straw potentials from maize, rape, and cereals.



Example of surplus straw available for power production for 2005 derived from the BETHY/DLR model, EO and statistical data

#### References:

Gehring, J., Y. Scholz, Evaluating the benefit of simulated NPP data for modelling the spatial distribution of bioenergy potentials in Europe, submitted to Biomass & Bioenergy, 2007

Wißkirchen, K., K.P. Günther, Modeling the Net Primary Productivity of European land cover classes using remote sensing data. Geophysical Research Abstracts, Vol 7, 05450, 2005

#### Added value

GEO allows the provision of EO based vegetation monitoring to be used in services specifically adapted to user's needs in the bioenergy sector.

#### Relevance to GEO

This activity contributes to EN-07-01 (Management of Energy Sources) as it supports the development of EO services for resource assessment and monitoring of the bioenergy resource. The collaboration between energy system research and remote sensing specialists at DLR made this interdisciplinary work possible. Results are included in system analysis and policy planning tools in the energy system analysis research work at DLR (reference to EN-07-03, Energy Policy Planning).

#### Participants

DLR (D) – German Remote Sensing Data Center and Institute of Technical Thermodynamics, System Analysis Group

Experience from this work is reported to GEOSS also via the Energy Community of Practise.

#### Current Status and Next Steps

The methodology will be extended to more energy crops and applied to further years and regions.

A gap in remote sensing data is existing as there are no land cover classifications distinguishing between different energy crops. Therefore, statistical data from EUROSTAT with only rough spatial resolution is used. This could be replaced by improved land cover classifications in future.

## Energy Community of Practice

### Description

We have developed an international network of GEOSS Energy participants through an Energy Community of Practice (<http://www.geoss-ecp.org/>). This group has developed a Charter and an administrative structure that represent the wind, solar, biomass, geothermal, ocean, hydro, coal, gas/oil and nuclear energy communities. An energy expert group met in Geneva in August of 2006, and representatives of that group have developed a 'Management of Energy Strategic Plan' to be tabled at the 2007 GEO Plenary in Cape Town. The Energy Community of Practice has also developed the user survey for solar and wind energy (cf. Early Achievement, Solar User Questionnaire), and has assisted in the ENVISOLAR development (cf. Early Achievement, ENVISOLAR). This group has sponsored a „GEOSS and Wind Energy“ workshop in Milan in May of 2008 ([cp.org/sections/wind/geoss-wind-energy](http://cp.org/sections/wind/geoss-wind-energy)), an invited session on Renewable Wind Energy at IGARSS'07 in Barcelona and called for papers for a thematic issue of the IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing (J-STARS) on Renewable Wind Energy in 2008. The Energy CoP has sponsored a two day workshop in Yellowknife, Canada in August 2007 on "The User and GEOSS Architecture - The Impact of Climate Change and Variability on Biodiversity and Energy in the Arctic" as part of its outreach and collaboration with the GEO Architecture and Data Committee.

### Added Value

The Energy Community of Practice has provided the structure for an international network of Energy specialists in developed and developing countries. This group has contributed to the GEOSS Energy Societal Benefit Area (SBA) Strategic Plan. The Energy CoP represents an end-to-end linkage from data provider to decision maker to user in all areas of renewable and non-renewable energy. This provides a clear illustration of the value of the GEO concept to the person 'on-the-street' and a direction for future energy management in a sustainable environment. Plans for 'Demonstration' projects in a range of energy applications are in progress.

### Relevance to GEO

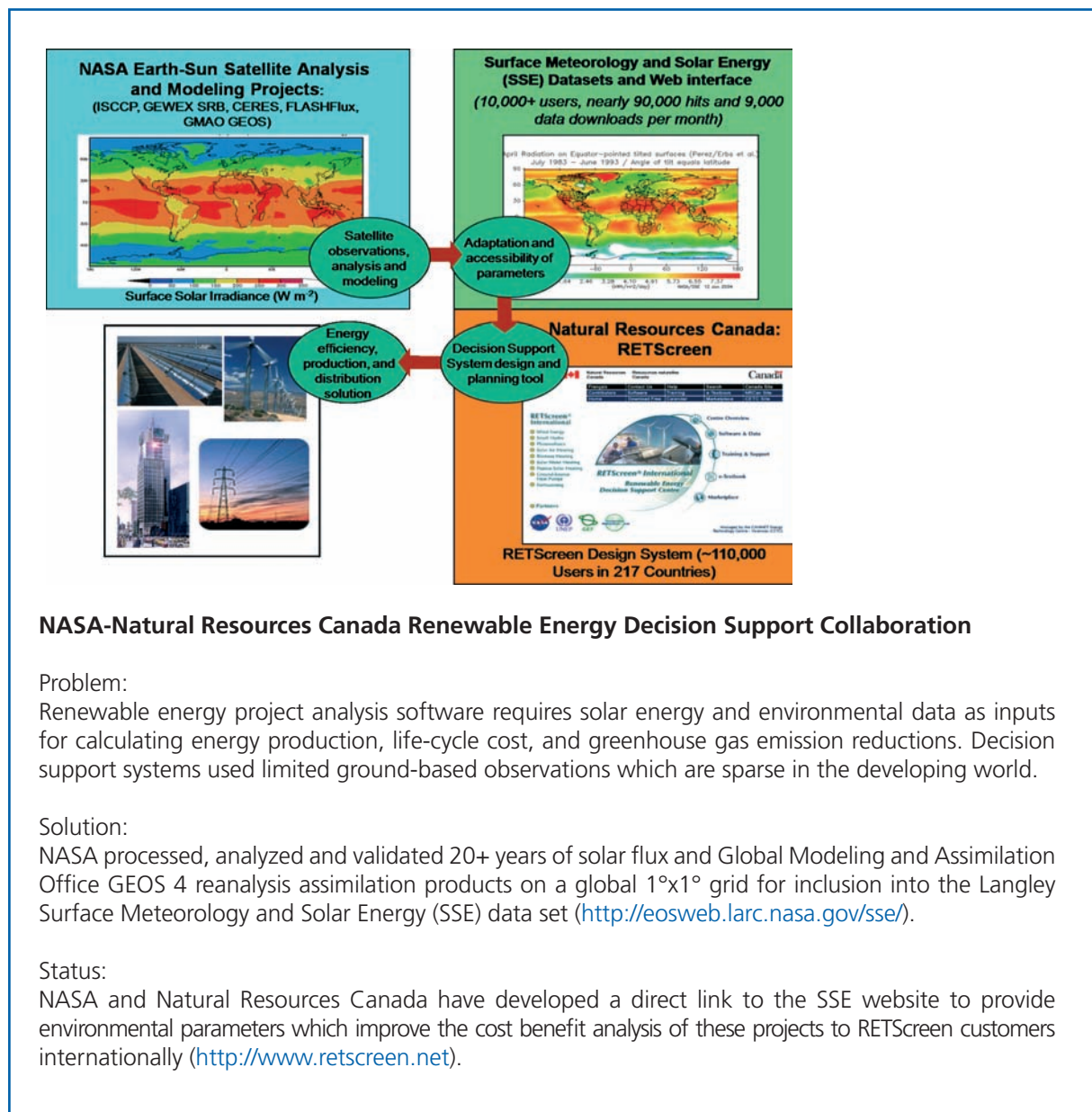
This activity contributes to the Energy Work Plans (Alexia, should we list the tasks numbers, and if so, which) and provides a strategic direction for GEO activities over the next decade that has been endorsed by the international GEO Energy Community.

### Participants

- China Energy Institute of State Committee
- Department of Science and Technology, South Africa
- Ecole des Mines de Paris, France
- Electricité de France (EDF)
- ENEA - Italian National Agency for New Technology
- ESA
- European Centre for Medium-range Weather Forecasts
- European Commission, Directorate General Research
- German Aerospace Center (DLR)
- IEEE
- IGOOS
- NASA
- OGP - International Association of Oil & Gas Producers
- STATKRAFT, Norway
- The Boeing Company
- University of Stellenbosch, South Africa
- Windlogics Inc., USA

## Current Status and Next Steps

The Strategic Plan outlines steps for 'Requirement Assessments', 'Demonstration Projects' and 'Outreach' for the various sectors of the Energy Community of Practice. It also provides an assessment of accomplishments to date in terms of the 2- 6- and 10-year targets in the GEO Implementation Plan Reference Document (2005) for the energy SBA.



### NASA-Natural Resources Canada Renewable Energy Decision Support Collaboration

**Problem:**

Renewable energy project analysis software requires solar energy and environmental data as inputs for calculating energy production, life-cycle cost, and greenhouse gas emission reductions. Decision support systems used limited ground-based observations which are sparse in the developing world.

**Solution:**

NASA processed, analyzed and validated 20+ years of solar flux and Global Modeling and Assimilation Office GEOS 4 reanalysis assimilation products on a global 1°x1° grid for inclusion into the Langley Surface Meteorology and Solar Energy (SSE) data set (<http://eosweb.larc.nasa.gov/sse/>).

**Status:**

NASA and Natural Resources Canada have developed a direct link to the SSE website to provide environmental parameters which improve the cost benefit analysis of these projects to RETScreen customers internationally (<http://www.etscreen.net>).

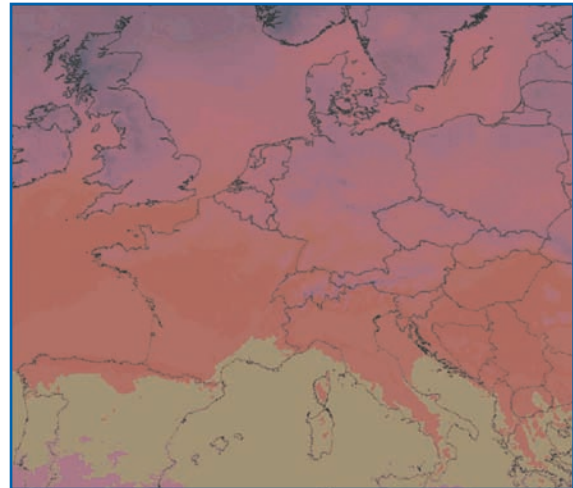
## ENVISOLAR – Space based environmental information for solar energy industries

### Description

ENVISOLAR is an international project funded by the European Space Agency, Earth Observation Market Development Program (EOMD) 2003 – 2007

The main focus of ENVISOLAR is to support the industrial use of Earth Observation based information in the solar energy sector. Earth observation data providers have teamed with market players using Earth Observation data and providing end user services. Key customers using such services as basis for their downstream businesses are also involved in the consortium.

Earth observation data is taken mainly from meteorological satellites of the METEOSAT series. Geophysical parameters exploited are cloud cover and cloud height, aerosols, water vapor and snow cover. All these parameters are used to assess the surface solar irradiance as the solar resource.



Annual sum of global irradiance in 2004 derived from the SOLEMI data base, source DLR

### Services for Investment Decision

Site assessment allows the investor to find the best site for a planned power plant and to optimise the financial yield. The financing of solar power plants is based largely on loans and financial institutes and insurers expect precise audits in the planning stage.

### Services for Plant Management

Plant monitoring of individual solar power plants assures good benefit from the investment. To meet the different demands, the scale of service is different. Smaller solar energy systems need low cost monitoring with a performance check while large solar energy systems need detailed monitoring with automatic fault detection routines.



Photovoltaic system Petersen Alpa (Germany) planned on the basis of premium site audits during ENVISOLAR, source Enecolo

### Services for Utilities

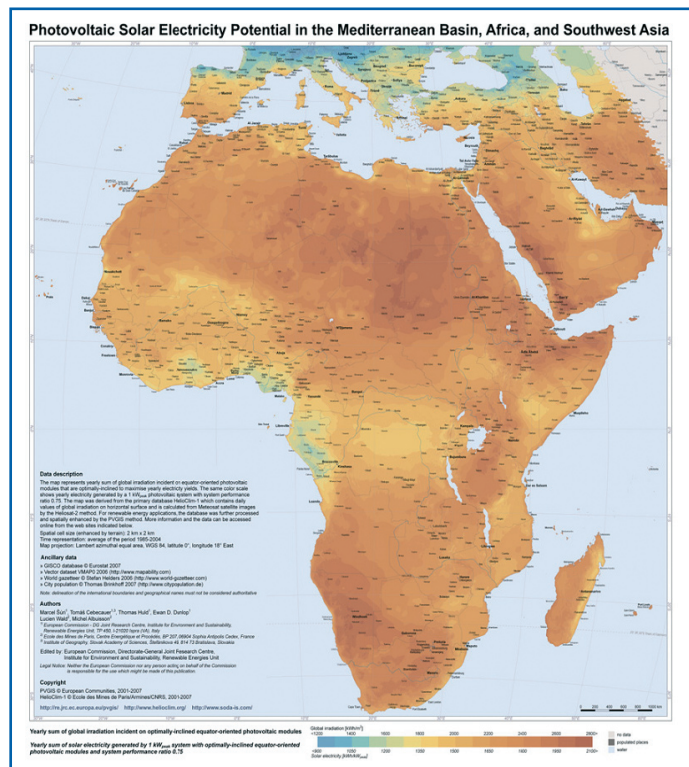
Scheduling of large power plants needs a precise knowledge of the expected load. Besides temperature, irradiance is the major environmental influence on electricity demand. Electric power transmission systems collect power from the conventional plants as well as from different renewable sources like solar PV plants and deliver it to the final users. A fundamental aspect for the management of such a complex grid system is an accurate forecast of the solar power generated.



Services for Science and Consulting Time series, maps and statistics of irradiance, direct and diffuse components and spectral components such as illumination are provided to the planners, architects and scientists.

ENVISOLAR consortium members set up a variety of user-specific services and assessed the value of these products when used by end-users for their activities.

Over 50 users were involved in market trials. Their feedback was collected and serves as basis for further improvements of the services.



Solar electricity potential, source JRC/Armines

## Added value

GEO allows the provision of EO based surface solar irradiance services specifically adapted to user's needs in the solar energy sector. Especially, the temporal and spatial resolution of geostationary satellites as the METEOSAT series is essential for this application.

## Relevance to GEO

This activity contributes to EN-07-01 (Management of Energy Sources) as it supports the development of EO services for resource assessment, monitoring and forecast of the solar energy resource. The collaboration between users and providers was enhanced significantly. New geophysical parameters derived from satellites were included in commercial activities of the consortium members.

## Participants

DLR (D), Ecole des Mines de Paris (F), Edisun Power AG (CH), Enecolo AG (CH), ENEL Produzione (I), Enercity Stadtwerke Hannover (D), Flyby s.r.l. (I), Meteocontrol (D), Meteoswiss (CH), Oldenburg University (D), SAG Solarstrom GmbH (D), Stromaufwärts GmbH (A), TECSOL S.A. (F).

Most consortium members are contributing to GEOSS also via the Energy Community of Practise.

## Current Status and Next Steps

The project ended in July 2007. Processing chains and EO data us is already a part of the consortium member's commercial activities and will sustain.

# Solar Data for Developing Countries

## Description

Objectives: providing an early demonstration of the value of globally coordinated Earth observations, supporting GEOSS outcomes in the energy area, supporting the development of Earth observation products and services, encouraging the use of Earth observations for informed energy-policy planning in developing and developed countries

Methods, data, results: Building upon the HelioClim (Ecole des Mines de Paris) and SSE (NASA) databases to offer a compound global service providing access to solar radiation information worldwide. This will be included in a future Open Source Software for creation of Energy Services.

**Solar Energy for the Developing Countries**

**GEO** Group on Earth Observations

NASA MINES PARIS ParisTech

```
Gc = I0 c [ sin γs exp(-0.864 ka ma(m)) + Tcl(Tcl) Fcl(γs, Tcl) ]  
procedure clearsky(Gc,I0,gamma,TL,day);  
{  
  double *Gc, *I0, *gamma, *TL;  
  double B, D, epsilon;  
  int *day_error;  
  call diffuse(gamma, TL, &D);  
  call direct(gamma, TL, &B);  
  call exponential(day, &epsilon);  
  Gc=I0*epsilon*(B+D);  
  return(error);  
}
```

The central screenshot shows a web application interface for solar radiation data. It includes a search bar, a world map, and various data visualization options. A line graph on the right displays solar radiation curves over a period of time, with values ranging from 0 to 1500. An inset photograph shows a solar panel array installed on a structure in a rural, arid environment.

### **Added Value**

GEO facilitates international collaboration, GEO proposes interoperability and architecture standards, GEO allows worldwide coverage, GEO is a simulator to enhance our services. This achievement is a GEOSS proof of concept using high scientific research, based on GEOSS concepts, allowing the Energy Community to build capacities and services on it.

### **Relevance to GEO**

- First relevance for the Energy SBA. Transverse areas: Climate, Oceans, Agriculture. Provide tools for development of Solar energy
- Contribution to the 10-Year Plan: facilitate the exchange and use of existing data/products (2 year targets) for efficient energy management (6 Year Targets), facilitate capacity building in order to bring energy management at the local level to equivalent high (national and regional) levels of efficiency and facilitate the development of renewable energy systems taking advantage of products available through GEOSS (10 Year Targets)
- Energy SBA, Task EN-07-03, support to Task EN-07-01,

### **Participants**

- Ecole des Mines de Paris, NASA, Energy CoP

### **Current Status and Next Steps**

- The long-term continuity of this compound service will be ensured by the strategic activities of Ecole des Mines through the SoDa-Information System.
- Next steps are the extension of this global service to other databases

## International Energy Agency (IEA), Solar Heating and Cooling Program (SHC), Task 36 on Solar Resource Knowledge Management, User survey is completed

### Description

A survey on users' requirements for solar energy resource data was hosted by EU JRC and advertised on the PVGIS (<http://re.jrc.cec.eu.int/pvgis>), SoDa (<http://www.soda-is.com>), Satel-Light (<http://www.satel-light.com>), Meteotest (<http://www.meteotest.ch>) and GEOSS Energy Community of Practise (<http://www.geoss-ecp.org/>) web sites during June 2006 to February 2007.

Questions were organised in 14 different groups related to affiliation, type of profession, technology, purpose of data use, type of data used, time resolution, timeliness of delivery, synthetic data, site or gridded data, spatial resolution, post processing, quality of existing data, forecast needs and climate change issues.

Approx. 120 answers were collected and 96 valid answers were analysed. They originate from Albania, Belgium, Canada, Croatia, Czech Republik, Djibouti, France, Gambia, Germany, Greece, Iran, Italy, Japan, Luxembourg, Mexico, Morocco, Netherlands, Pakistan, Panama, Portugal, Spain, Switzerland, Thailand, Tunisia, United Kingdom, and the United States with approx. 80% originating from European countries. Answers came from manufacturers, engineering companies, utilities, public research, public and governmental agencies and their technology background is photovoltaics, concentrating photovoltaics, concentrating solar power, solar heating and cooling, chemical systems, water desalination and architecture. Answers could be given from 0 (low) to 5 (high importance).

#### *Purpose of solar radiation data use*

Purpose	Average points	Answer >3
site selection:	2.31	45
feasibility study:	2.97	60
cost assessment:	2.42	46
investment decision:	2.47	52
guarantee/certification/insurance:	0.96	17
system design:	<b>3.1</b>	<b>65</b>
deployment:	0.94	19
plant operation:	1.27	24
grid operation:	0.78	13
plant maintenance:	0.71	11
plant decommissioning:	0.26	1
monitoring:	1.4	24
fault detection:	0.73	12
research/education/promotion:	2.06	39
policy-making:	0.56	8
energy trading:	0.79	13

#### *Geophysical paramters needed*

Type of data	Average points	Answer >3
global horizontal radiation:	3.32	69
direct radiation:	<b>3.66</b>	<b>75</b>
diffuse radiation:	2.83	52
radiation on tilted and tracking surfaces:	2.83	59
daylight (illuminance, luminance):	1.91	35
spectral distribution of irradiance:	1.6	27
ambient temperature:	3.03	59
snow cover:	1.02	16
wind speed / wind direction:	2.33	46
relative humidity / dew point:	1.49	27
atmospheric pressure:	1.17	20

Temporal resolution	Average points	Answer >3
annual averages:	2.69	53
monthly averages:	<b>3.19</b>	<b>67</b>
weekly averages:	1.61	31
daily averages:	2.06	38
hourly averages:	2.39	48
15 minute averages:	1.22	21
5 minute averages:	0.84	14
instantaneous values:	0.77	12

*Temporal resolution needed for solar radiation information*

Timeliness	Average points	Answer >3
very recent (e.g. last hours/days):	1.79	29
recent (e.g. last month / last year):	<b>3.06</b>	<b>64</b>
from older archives:	2.83	60

*Timeliness of data delivery requested*

Type of spatial data	Average points	Answer >3
A single site:	1.65	33
Several sites, but less than 10:	1.95	39
More than 10 sites:	1.6	28
A grid (map) of point values covering a region:	2.16	43
A grid (map) of average values covering a region:	<b>2.62</b>	<b>54</b>

*Spatial resolution and type of data requested for solar radiation information*

Spatial resolution	Average points	Answer >3
Values or time-series averaged over regions:	1.21	19
(approx. 300 km x 300 km, global coverage):	1.03	12
(approx. 100 km x 100 km, global/regional cov.):	1.95	35
(approx. 10 km x 10 km):	<b>2.41</b>	<b>48</b>
5 km x 5 km:	1.97	44
1 km x 1 km:	2.12	42

Are radiation forecasts important to you?	Average points	Answer >3
Nowcasting (up to 6 hours):	0.79	14
Forecast up to 24 hours:	1.1	23
Forecast up to 3 days:	0.8	12
Forecast up to 1 week:	0.87	8
Forecast up to 1 month:	1.12	21
Seasonal forecast (2-6 months):	<b>1.51</b>	<b>25</b>

*Need for forecasting of solar irradiance*

## Relevance to GEO

This activity contributes to EN-07-01 (Management of Energy Sources) as it supports the development of EO services for resource assessment, monitoring and forecast of the solar energy resource.

## Participants

SUNY, USA; Ecole des Mines de Paris, F; EC, JRC Ispra; Suntechnics, D; NREL, USA; ENTPE, F; DLR, D; CIEMAT, E; Meteotest, CH; Univ. Oldenburg, D; Univ. Geneva, CH; Univ. Appl. Sciences Magdeburg, D. Most consortium members are contributing to GEOSS also via the Energy Community of Practise.

## Current Status and Next Steps

The questionnaire is closed, a more detailed analysis is ongoing. Activities will be continued based on stakeholder interviews planned in the EU coordination action MESOR (Management and Exploitation of Solar Resource Knowledge). An extension to more non-European stakeholders is needed.



## Satellite land cover mapping of Canada's forests

### Description

A survey on users' requirements for wind energy resource data was hosted by GEOSS Energy Community of Practise (<http://www.geoss-ecp.org/>) web site during January 2007 to June 2007 and advertised by the members of the Wind Energy working group.

Questions were organised in 14 different groups related to affiliation, type of profession, use of data, Type of onshore and offshore data, temporal resolution of data, age of data, synthetic data, site or gridded data, spatial resolution, how the data are used, the satisfaction of the users about present situation, wind forecast needs and long term data sets issues.

60 answers were collected and analysed. They originate from USA, Germany, France, Denmark, Switzerland, Spain, United Kingdom, Belgium, Greece, The Netherlands, Nigeria, Australia, New Zealand, Lesotho, Portugal, Cyprus, Montserrat, Estonia, Serbia and Montenegro, Poland, Bulgaria, Finland. Answers came from Consultants, Developers, Manufacturers, Engineering companies, Utility companies, Public research laboratories, Governmental / public agency / services, Private research laboratories, Universities, Non-governmental organizations or other promoters of wind energy:

Answers could be given from 0 (low) to 5 (high importance). Table 1 is an example of the answers collected through the survey. A report has been produced on the analysis of the survey by the wind energy working group of the Energy Community of Practices.

Use of data	Average	Number of answer > 3
Site selection	3.96	40
Feasibility study	4.25	45
Cost assessment	3.33	27
Investment decision	3.51	30
Wind integration study	3.38	28
Guarantee/certification/insurance	2.57	16
System design	3.08	21
Deployment	2.81	16
Plant operation	3.06	22
Grid operation	2.71	14
Plant maintenance	2.88	19
Plant decommissioning	1.85	4
Monitoring	3.41	26
Fault detection	2.63	14
Research/education/promotion	3.23	28
Policy making	2.48	12

*Purpose of wind data use*

### Added Value

This user questionnaire helped to identify user requirements in more detail and will help in defining the needs of Earth Observation for the Energy Societal Benefit Area.

### Relevance to GEO

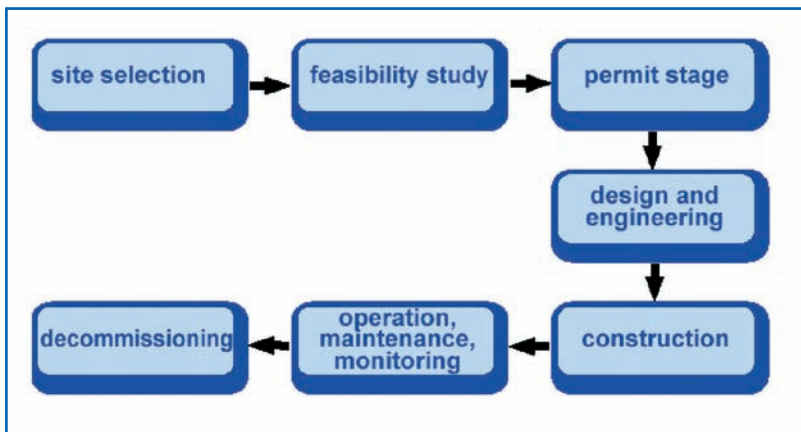
This activity contributes to EN-07-01 (Management of Energy Sources) as it supports the development of EO services for resource assessment, monitoring and forecast of the solar energy resource.

### Participants

Most consortium members are contributing to GEOSS also via the Energy Community of Practise.  
Leader: Ecole des Mines de Paris, F

### Current Status and Next Steps

The questionnaire is closed, a more detailed analysis is ongoing. Additional contact with the wind energy community will be achieved through individual interviews based on the needs of data for the complete life cycle of a wind farm as proposed in the following scheme.



*Life cycle of an energy system*

## The World Climate Research Programme (WCRP) and Anthropogenic Climate Change Research

### Description

Growing observational and modelling evidence is clearly indicating that climate change due to increasing concentrations of anthropogenic greenhouse gases has the potential of having major consequences on human societies and natural ecosystems. In 2007, the IPCC Fourth Assessment Report (AR4) was published, marking a crucial year for major developments in anthropogenic climate change.



The current phase of the WCRP Anthropogenic Climate Change (ACC) initiative is centred on modelling activities (mainly WCRP Working Group on Coupled Modelling), with the defined goal being to deliver products for the successive state-of-the-science assessments on climate change (e.g., a potential IPCC AR5). WCRP/ACC is a pan-WCRP initiative drawing on the expertise of all WCRP core projects, task forces, working groups and panels, and seeking interactions with the International Geosphere-Biosphere Programme, the International Human Dimensions Programme, the Earth System Science Partnership (ESSP) and other agencies and institutions on the national and international levels. While the current focus is on process-level and modelling investigations, and projections of human-induced climate change, the long-term vision is that, over time, WCRP/ACC will expand in scope. The WCRP Anthropogenic Climate Change initiative builds on the clear evidence that climate change is caused by anthropogenic greenhouse gas emissions. Photographer: Gerla Brakkee.

### Added Value

WCRP is a significant contributor to IPCC AR4: Modelling activities organised and coordinated by the WCRP have been the basis for the 2007 published IPCC AR4. In addition, over 90% of the Working Group 1 coordinating authors are WCRP-associated scientists, and some 70% of the reviewers. WCRP scientists and projects contributed significantly to the collection and assembly of climate observations, model development and understanding of the climate system necessary for the detection and attribution of past climate change, and the provision of climate information, including projections of future change based on various emission scenarios. As a direct result of these activities: 15 modelling groups from 11 countries which participated in these experiments with 23 models have contributed their simulations to the WCRP-CMIP3 (Coupled Model Intercomparison Project: <http://www-pcmdi.llnl.gov/projects/cmip/index.php>) archive at the Program for Climate Model Diagnosis and Intercomparison (PCMDI); more than 200 papers from scientists around the world have been submitted to peer-review journals with results from multi-model analyses (100 of these have been published); and 900 analysis projects have been registered at the PCMDI (<http://www-pcmdi.llnl.gov/>).

WCRP delivers direct input to the Subsidiary Body for Scientific and Technological Advice (SBSTA) on research gaps and needs for the United Nations Framework Convention on Climate Change (UNFCCC):

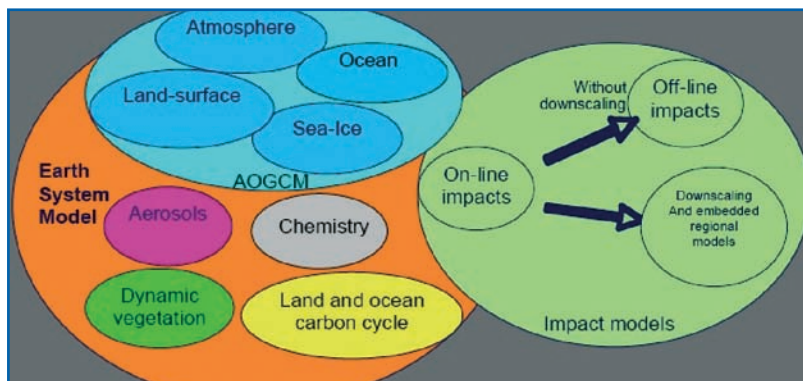
The UNFCCC and the SBSTA have become increasingly aware of and engaged with research requirements for climate change. As a result and at the request of SBSTA, WCRP

- prepared a statement on research gaps for SBSTA 24 (May 2006);
- participated in the “official” side event on research gaps at SBSTA 24 held in Bonn, Germany, May 2006;
- held an additional side event at SBSTA 24 on WCRP research to identify research needs and climate change research challenges; a DVD summarizes the highlights of this event (view DVD at: [http://wcrp.wmo.int/PG\\_CDsDVDs.html](http://wcrp.wmo.int/PG_CDsDVDs.html));
- submitted a document on research needs for SBSTA 25 with its partners in the ESSP (September 2006);

- participated in an informal discussion at SBSTA 26 (Bonn, May 2007) to enable a more effective dialogue between Parties and regional and international climate change research programmes and organizations;
- organized together with its ESSP partners a side event at SBSTA 26 on Connecting Earth System Science Research to Climate Change Policy.

WCRP reached significant consensus at workshop on next generation Earth System Models (ESM) and emissions scenario requirements:

The WCRP Working Group on Coupled Modelling (WGCM) and the IGBP Analysis, Integration and Modelling of the Earth System (AIMES) project convened a joint workshop in Aspen, Colorado, USA (July 2006) to construct a unified position of the modelling community with respect to the possible scenarios to be used in the future IPCC Fifth Assessment Report (AR5). This meeting represented a very significant breakthrough in the understanding of model forcings. The resulting joint report, approved by WCRP and IGBP in September 2006, has been communicated to the Chairman of the IPCC in response to his invitation for input in preparation for a future IPCC assessment. A White Paper is available for download at [http://wcrp.wmo.int/documents/Aspen\\_WhitePaper\\_1final.pdf](http://wcrp.wmo.int/documents/Aspen_WhitePaper_1final.pdf) (WCRP Informal Report No. 3/2007).



Schematic diagram of an Atmosphere-Ocean General Circulation Model (AOGCM) as an integrated part of the Earth System Model (orange oval), and various types of impact models (right).

WCRP with some of its key partners will hold the following major events during 2007 as part of its capacity building remit to help improve the science, better connect research to policy:

- Future Climate Change Research and Observation: *GCOS, WCRP and IGBP Learning from the IPCC Fourth Assessment Report, Workshop*, 4-6 October 2007, Sydney, Australia. The main goal of the workshop will be to consider the implications from the IPCC AR4 on future climate research challenges and climate observing strategies with a primary focus on the lessons learned from Working Groups I and II. It is intended that the workshop provide a major input into the evolution of the Global Climate Observing System (GCOS) and the research agenda for WCRP.
- Interpreting Climate Change Simulations: *Capacity Building for Developing Nations*, ICTP and WCRP Training Seminar, 26-30 November 2007, Trieste, Italy. Recognizing that response to climate change requires the capability to appreciate and properly interpret research findings and to apply them to national planning initiatives, the WCRP and the International Centre for Theoretical Physics (ICTP) wish to support capacity building in developing and least developed countries. WCRP together with the ICTP can help 'transfer knowledge' with respect to the science used to make input to and described in the IPCC assessment reports. By improving knowledge pertaining to climate change research can have a significant regional and global impact.

#### Relevance to GEO

Task CL-07-01. Coordinator: WCRP.

## APEC Climate Center for Information Services (APCC)

### Description

APCC is a regional climate center aimed at realizing the APEC vision of regional prosperity through the reduction of economic losses due to abnormal climate and the application of climate information for socio-economic benefits. APCC produces real-time operational climate prediction information based on a well-validated multi-model ensemble (MME) system. APCC contributes to enhancing capacity-building in the monitoring and prediction of unusual climate in the Asia-Pacific region by sharing high-cost climate data and information.

### Added Value

APCC is one of the modeling and data processing centers of GEOSS. It can be an important contributing component and addition to the inter-governmental action plan of Earth Observations in many ways. The well-validated multi-model ensemble system will utilize the comprehensive observations and produce reliable climate prediction information for disaster reduction, integrated water resource management, air quality monitoring and forecasting, sustainable land use, management, etc. The advanced capability in climate monitoring and forecast tools developed by APCC will contribute to the success of the 10-Year Implementation Plan of Earth Observations.

### Relevance to GEO

APCC activities will contribute to the following 6 year and 10 year targets identified in the GEOSS Implementation plan:

- Enhance the collaboration mechanism between observation organisations and research communities with users of climate information to make maximum use of the observations, analyses and products.
- Develop data integration facilities for exchanging data, products and information between climate sectors and socio-economic benefit areas.
- Provide support to the development of a long-term strategy that encompasses progress in observation, data assimilation and modelling
- Contribute to major advances in the monitoring and predictability of climate on seasonal, interannual and decadal time scales, including the occurrence of extreme events.

### Participants

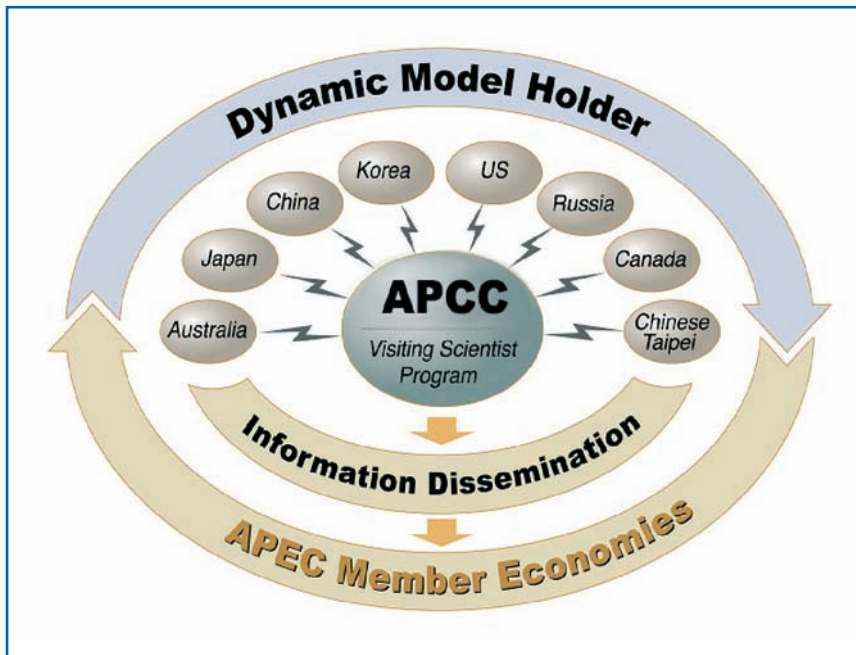
- 21 economies in Asia Pacific Economic Cooperation (APEC)
- World Climate Research Programme (WCRP)

### Current Status and Next Steps

APCC has been providing operational 3-month lead dynamical seasonal predictions to user communities, based on a well-validated multi-model ensemble system (MMES). Currently, APCC-MMES uses outputs from operational-mode global climate models at various institutes from eight APEC member economies (Fig. 1). Organizations and institutes participating in the joint real-time MME operational forecasts are the National Aeronautics and Space Administration (NASA), National Center for Environmental Prediction (NCEP), International Research Institute for Climate and Society (IRI) and Center for Ocean Land Atmosphere Studies (COLA) of USA, Hydrometeorological Center (HMC) and Main Geophysical Observatory (MGO) of Russia, Korean Meteorological Agency (KMA), Meteorological Research Institute (MRI) and Seoul National University (SNU) of Korea, Japan Meteorological Agency (JMA), Central Weather Bureau (CWB) of Chinese Taipei, Institute of Atmospheric Physics (IAP) and Beijing Climate Center (BCC) of China, Canadian Meteorological Center (CMC) and the Australian Bureau of Meteorology (BOM). MME seasonal predictions are distributed through the APCC website (<http://www.apcc21.net>) four times a year. Currently APCC operates the world's largest and most extensive operational MME dynamical seasonal prediction system.



APCC multi-model ensemble system



APCC seeks to provide useful climate information for disaster preparedness and mitigation efforts for the APEC region. This will be done by innovative use of climate monitoring, prediction techniques, as well as analyses and interpretation of climate data.

For the needs of regional applications, current forecast products from global models are often inadequate; they have too coarse spatial and temporal resolutions. To bridge the gap between model outputs and end-user requirement, a suite of statistical downscaling tools will be implemented which will leverage the end values of MME outputs. The potential of using high-resolution dynamical models to predict extreme climate events from the intraseasonal to interannual timescales, such as the MJO and its associated clusters of high-impact weather, will be vigorously researched and exploited.

Within the next five years, APCC will provide reliable 12-month predictions using a Tier-1 MME system, focusing on information of major climate modes such as ENSO, IOD and the Monsoons. This warrants much research on the coupled climate prediction problem, for instance the impact of initial data, error characteristics and their controlling mechanisms, and predictability limits. In the end, our capacity of predicting local climate variations, including the likelihood of inclement weather and extreme climate, with relatively long lead time, will be vastly expanded.

Combining these prediction technologies with comprehensive monitoring efforts of the climate state using near real-time satellite data, an Early Warning System will be setup. Timely information of climate events and potential climate hazards will be available for sound decision making on the local, national and international level, and for the specific needs of various sectors such as agriculture, energy, water management, health and transport.

APCC will serve as the WCRP Data Center for Seasonal to Interannual Prediction, constructing an easily accessible database for subsets of model data, generated through co-ordinated experiments in participating institutes, to further serve the climate research community.

# Climate for Development in Africa Programme (ClimDev Africa)

## Description

Climate for Development in Africa (ClimDev Africa) is a new integrated programme that addresses the need to improve climate observations and services in Africa in support of development planning and achievement of the Millennium Development goals. The Programme will be implemented as a partnership between the providers of climate information (principally the national meteorological and hydrological services) and users of climate information. The programme outputs will include:

- 1. strengthened climate observation networks and improved data management,
- 2. new and improved climate services for a variety of user needs,
- 3. incorporation of climate risk management practices in development planning, and
- 4. raised awareness and enhanced political engagement among African national decisionmakers concerning the importance of addressing climate change-related issues.

The expected outcomes associated with Programme implementation will include improved food security and opportunities for agricultural growth, better protection from malaria and other climate sensitive diseases, better management of water resources, better management of disaster risks, improved environmental sustainability, and more judicious use of energy resources.

The 10-year Programme is expected to be formally launched in 2008 after a design phase is completed.



## Added Value

GEO could help by assisting ClimDev Africa partners in resource mobilization efforts. The successful launch of ClimDev Africa would constitute a significant early success for GEO. Through improved climate risk management in a number of SBAs, implementation of ClimDev Africa will address many GEO goals and support sustainable development in Africa.

## Relevance to GEO

The ClimDev Africa Programme responds most directly to the Climate SBA of GEO. However, it is specifically designed to improve climate risk management in Africa in a variety of SBAs. It is therefore highly relevant to achieving development goals in the weather, agriculture, water, health, disaster management, and energy SBAs. Data sharing, capacity building, and outreach (in particular disseminating knowledge of climate risk management throughout Africa) are additional elements of the Programme that contribute to GEO's goals.

The Programme directly addresses GEO tasks

- CB 07-01 (building regional and national capacity),
- US 07-02 (Millennium Development Goals),
- US 07-03 (environmental risk management).

## Participating Organizations

- The Global Climate Observing System
- World Meteorological Organization
- African Union Commission
- UN Economic Commission for Africa
- African Development Bank
- UK Department for International Development
- International Research Institute for Climate and Society
- World Food Programme, and others.
- Potential donors also include several G-8 countries.

## Current Status and Next Steps

ClimDev Africa has substantial high-level political support within Africa. Significantly, key African partners include the African Union Commission (AUC), the UN Economic Commission for Africa (UNECA), and the Africa Development Bank (ADB). In January 2007, the Assembly of the African Union, comprised of AU Heads of State, endorsed the Programme and requested the AUC, UNECA, and ADB to further develop and implement the Programme and to report on its progress every other year.

At the recent (29 March–1 April 2007) Conference of African Ministers of Finance, Planning and Economic Development ministers requested ECA to develop and implement the Programme in collaboration with relevant partners.

In April 2007 the Programme was cited in the UN Security Council debate on the impact of climate change on peace and security as an example of collaboration within Africa, and the supportive efforts of development partners were acknowledged. Important next steps include finalizing and approving the detailed Programme proposal and resource mobilization.

Commitments for over ten million USD have been made to date, with a major contribution announced by the UK's Department for International Development. However, the total cost of the 10-year programme is estimated to be approximately \$250 million, so fundraising remains a key concern. GEO could play an important role in helping to facilitate the mobilization of resources for ClimDev Africa.

## EuroCryoCli- A European contribution to a global cryospheric climate monitoring system

### Description

This project is bringing current Earth observation methodology and technology for remote sensing of the cryosphere from algorithms and prototype systems into operational services in mandated organisations for a very valuable contribution to long-term systematic climate monitoring of the cryosphere. The system and services proposed will be designed to be integrated into the planned international system of systems for global monitoring – the part of the system aimed for climate monitoring.

Based on scientific and technological results from several past and current projects, it is proposed to develop a network-based system building on standards and communication languages identified by GMES and GEO for the global system of systems. The network of processing chains and databases (the nodes) will be hosted by mandated organisations in order to ensure long-term and stable operation. The development of this system will draw on the pool of institutions that has developed the current knowledge and technology base for remote sensing of the cryosphere and data processing and management.

This work leading to the Norwegian part of the proposed European network includes nodes for:

1. Global sea ice monitoring, hosted by The Norwegian Meteorological Institute and EUMETSAT Ocean and Sea Ice SAF, providing products on sea ice concentration and sea ice edge.
2. Global snow monitoring, hosted by The Norwegian Meteorological Institute, providing snow cover area, snow depth and snow water equivalent.
3. Regional glacier monitoring for mainland Norway, hosted by The Norwegian Water Resources and Energy Directorate (NVE), for glacier zones and glacier time-lapse photography.
4. Regional glacier monitoring for Svalbard, hosted by The Norwegian Polar Institute (NPI), for glacier surface type and glacier balance area (leading to an estimate of the mass balance).

### **Added value**

This contribution to global climate monitoring needs to follow GCOS' principles as well as the standards and system architecture currently being developed and specified by GEO.

The project will make thematic cryosphere information available in a GEO context, thus making it much simpler for users to access this type of information.

### **Relevance to GEO**

Climate monitoring is currently being developed and coordinated within initiatives like GCOS, GMES, GEO and CEOS. This project was initiated as part of the CEOS response to the GCOS report on *Systematic observation requirements for satellite-based products for climate*.

In order to make the project results becoming a contribution to the system of systems for global climate monitoring being developed, it is crucial to coordinate this project with these initiatives. Special links will therefore be established to GCOS, GMES, GEO, CEOS and other relevant initiatives and organisations. This task will also cover coordination and possible contributions from other projects where the project partners are not already involved.

The project will definitely contribute to the SBA on Climate but will also have an impact on Water and Energy as well.

### **Participants**

The project is a cooperation between Norway and European Space Agency. It will be implemented by the Norwegian Meteorological Institute, the Norwegian Water Resources and Energy Directorate, the Norwegian Polar Institute and the Norwegian Computing Center.

### **Current Status and Next Steps**

The project is approved and will start in September 2007. It is planned for a four years duration with the sea ice products being stipulated to be operational after two years.



## Global Monitoring of Greenhouse Gases

### Description

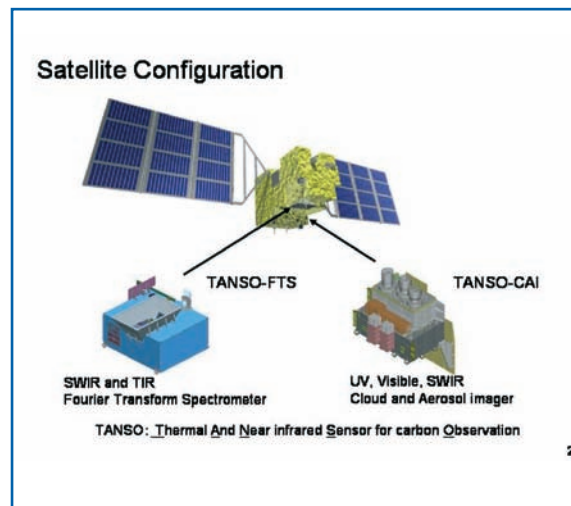
Climate change is threatening the safety and security of human society – as indicated by the recent IPCC Fourth Assessment Report and the Stern report – and is becoming a top-priority political issue. The upcoming G8 Summit meetings in Japan will focus on this issue. The global monitoring of greenhouse gases is important for clarification of climate change mechanism. The *Greenhouse Gases Observing Satellite (GOSAT)* is being jointly developed by the *Japan Aerospace Exploration Agency (JAXA)*, *Japan's Ministry of the Environment (MOE)*, and the *National Institute for Environmental Studies (NIES)* to be launched in 2008 (tentative date) to conduct frequent (once every three days) and precise monitoring of carbon dioxide (CO<sub>2</sub>) and methane distributions in the Earth's atmosphere. Through the Global Earth Observation System of Systems (GEOSS), GOSAT data will be made available to research communities around the world to contribute to the prediction of the Earth's climate and the setting of evidence-based policy decisions.



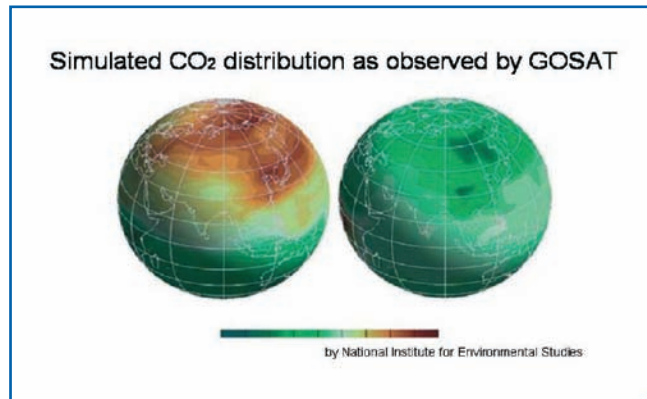
Cooperation is planned with the *Orbiting Carbon Observatory (OCO)* being developed by NASA, and with scientific communities in the US and Europe. Accurate information on greenhouse gases can be obtained not only through satellite monitoring, but also by direct atmospheric observation at fixed sites at the ground level, at oceanic surfaces by ships, and in the upper atmosphere by aircraft. These comprehensive observation networks bring us closer to an understanding of the global cycles of these gases. In support of the objectives of GEOSS, the *Japanese Alliance for Climate Change Observation (JACCO)* was launched by MOE and the *Japan Meteorological Agency (JMA)* in April 2006 to plan and coordinate comprehensive climate change observation systems.

### Added Value

GEOSS has brought together GOSAT, OCO, JMA, NIES, and JACCO to coordinate global greenhouse gas observation systems and provide better access to observed data and derived information. Global observation data of CO<sub>2</sub> and methane by these satellites will offer a unique contribution to the Climate Societal Benefit Area of GEOSS. GOSAT and OCO are also cooperating to establish interoperability in data quality through cross-calibration and validation. JACCO is promoting the planning and coordination of climate change observation systems, and seeks to improve access to data and information for policy decision support. GEOSS has facilitated dialogue between the World Data Centre for Greenhouse Gases (WDCGG) at JMA and the Carbon Dioxide Information Analysis Center (CDIAC) which provides data and information services on concentrations of greenhouse and related gases (CO<sub>2</sub>, CH<sub>4</sub>, etc.) around the world.



The Integrated Global Carbon Observation system (IGCO) being promoted by GEOSS will contribute to the harmonization of space-based observations and in-situ observations, in addition to the harmonization of observation planning, modeling, and predictions.



### Relevance to GEO

These efforts contribute to the following tasks in the GEO 2007-2009 Work Plan:

- CL-06-02: Key Climate Data from Satellite Systems,
- EC-06-01: IGCO, DA-07-03: Virtual Constellations, and
- DA-07-06: Data Integration and Analysis System

### Participants

Collaborating countries:

- Japan (JAXA, NIES, Ministry of Education, Culture, Sports, Science and Technology (MEXT), MOE, JMA, Japan Agency for Marine-Earth Science and Technology (JAMSTEC), JACCO),
- USA (NASA, CDIAC),
- World Meteorological Organization (WDCGG), IGCO

### Current Status and Next Steps

GOSAT is in full-scale development for its scheduled launch in 2008. Cooperation with OCO for calibration, validation, and data exchange is being coordinated with NASA. Collaboration on data analysis with the US and European science communities is being planned. The global monitoring of greenhouse gases data that will be provided through WDCGG, CDIAC and other organizations include the observation data:

1. at fixed stations by JMA and NIES for land,
2. and research vessels by JMA, voluntary observational ships by NIES and buoys managed by JAMSTEC for ocean, and
3. aircraft observation by NIES, Tohoku University, JMA and JAXA for upper air. Data integration among satellite, *in-situ* and mobile observation is necessary for validation of satellite products and clarification of climate change mechanism.

## Global Precipitation Climatology Centre (GPCC)

Since 1988 GPCC operates under the auspices of the WMO as a German contribution to the World Climate Research Programme (WCRP) and to the Global Climate Observing System (GCOS). It is funded by the Federal Government of Germany and is located within Deutscher Wetterdienst (DWD).

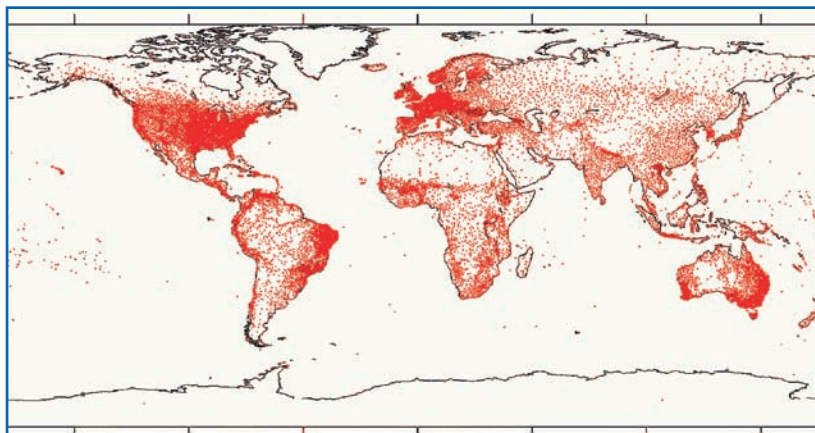
### Description

The main objective of GPCC is the analysis of the spatial and temporal distribution of global land-surface precipitation on a monthly time-scale based on in situ observation data.

The rain gauge station observation data base used for the GPCC analyses comprises:

- near-realtime weather and climate observation data (SYNOP and CLIMAT) continuously exchanged via the WMO Global Telecommunication System (GTS);
- non realtime precipitation observation data provided by WMO Member State's National Hydrological and Meteorological Services. More than 170 WMO member countries have contributed data to GPCC. All major monthly precipitation station databases have been integrated into GPCC's database.

Thus GPCC holds the largest monthly in situ precipitation observation database of the world comprising more than 1.5 million station years (since 1951) of rain gauge based precipitation data for more than 60 000 stations. More than 10 000 station records are available for year 1920, more than 15 000 stations for 1940, more than 25 000 stations for 1960, and more than 40 000 stations for 1990.



*Spatial distribution of monthly in situ precipitation stations with at least 10 years of data in GPCC Data base (Total number of stations in July 2006: 43028)*

The GPCC data processing steps include quality-control and quality assurance of the station meta data and of the precipitation observation data, interpolation of the station-related data to regular grids, and calculation of the spatial means on the 2.5° respectively 1.0° latitude/longitude gridbox areas.

In order to fulfil the different user requirements the GPCC has implemented a set of various gridded monthly precipitation products, which have been optimized for the purpose of their application:

First Guess Analysis (Oct. 2003-present)

- Designed for global precipitation anomaly analysis useful e.g. for early drought monitoring;
- Based on weather observation data received near real-time via the GTS from ca. 6,500 stations;

Monitoring Product (Jan. 1986-present)

- Designed for global near realtime precipitation monitoring in context of GCOS and used by GEWEX/ GPCP for global satellite-gauge combined products;
- Based on weather and climate observation data from approximately 7,500 stations;

Full Data Reanalysis (1951-2004, Version 3)

- Optimised for spatial density and accuracy needed for model verification and water cycle studies;
- Best spatial coverage for the individual months by use of all available data in the GPCC data base;
- Data coverage per month varies from 10,000 to more than 43,000 stations;

50-Year Analysis of monthly precipitation (1951-2000, Version 1.1)

- Optimised for time-series homogeneity and quality needed for climate variability/trend analyses;
- Based on more than 9.300 stations in the GPCC data base providing nearly complete time-series;

Corresponding to international agreement, station data provided by Third Parties to GPCC are protected. However, all gridded GPCC analysis products are disseminated free of charge via Internet (<http://gpcc.dwd.de>). More than 2000 users per month visualise and download GPCC products.

### Added Value

The provision of historical as well as timely precipitation data by GEO Member States to the GPCC can be widened substantially and maintained on a sustainable level with the agreement and adherence of GEO Members to the GEOSS Ten Year Implementation Plan. The quality of the gridded GPCC precipitation products highly depends on the availability of sufficient rain gauge station observation data. High quality precipitation products of the GPCC enable its clients in the research and modelling community to substantially improve their findings which in turn has a direct impact on the GEO identified societal benefit areas related to weather, water, climate, disasters, agriculture.

### Relevance to GEO

Water serves as the basis for life on earth and impacts on all GEOSS societal benefit areas. Precipitation is not only a key component of the hydrological cycle, but also of paramount importance to sustain life. Accurate knowledge of precipitation amounts reaching the land surface is of special importance for fresh water assessment and management related to land use, agriculture and hydrology, incl. risk reduction of flood and drought. High interest in long-term precipitation analyses arises from the needs to assess climate change and its impacts on all spatial scales. Therefore timely and reliable information on precipitation on a global scale is critical to the purpose and scope of GEOSS.

GPCC is listed in the GEOSS 10 year Implementation Plan Reference document among the initially identified GEO modelling and data processing centres. It presents a direct contribution towards the objectives of tasks DA-07-03, DI-07-01, US-07-03, WA-06-02, WA-06-05, WA-07-01, WA-07-02.

### Participants

All GEO Members are involved through their National Hydrological and Meteorological Services. They are the points of contact for the provision of precipitation observation data and associated meta-data. The GPCC maintains links to a number of GEO Participating Organisations, inter alia WMO, WCRP, GCOS, UNEP, UNESCO, FAO. Water and climate related programmes and projects of the United Nations, their specialised agencies and the scientific research community are users of GPCC analysis products and influence further product improvements adjusted to their application purposes.

A special thank is addressed to the many data contributors, which have supported GPCC so far. Their kind support enables the GPCC global precipitation analyses described in this document.

*Contact:* Global Precipitation Climatology Centre (GPCC) c/o Deutscher Wetterdienst (DWD)  
Postbox 100465 - D-63004 Offenbach  
Phone +49 69 8062 2872 - Email: [gpcc@dwd.de](mailto:gpcc@dwd.de) - Web: <http://gpcc.dwd.de>

### Current Status and next Steps

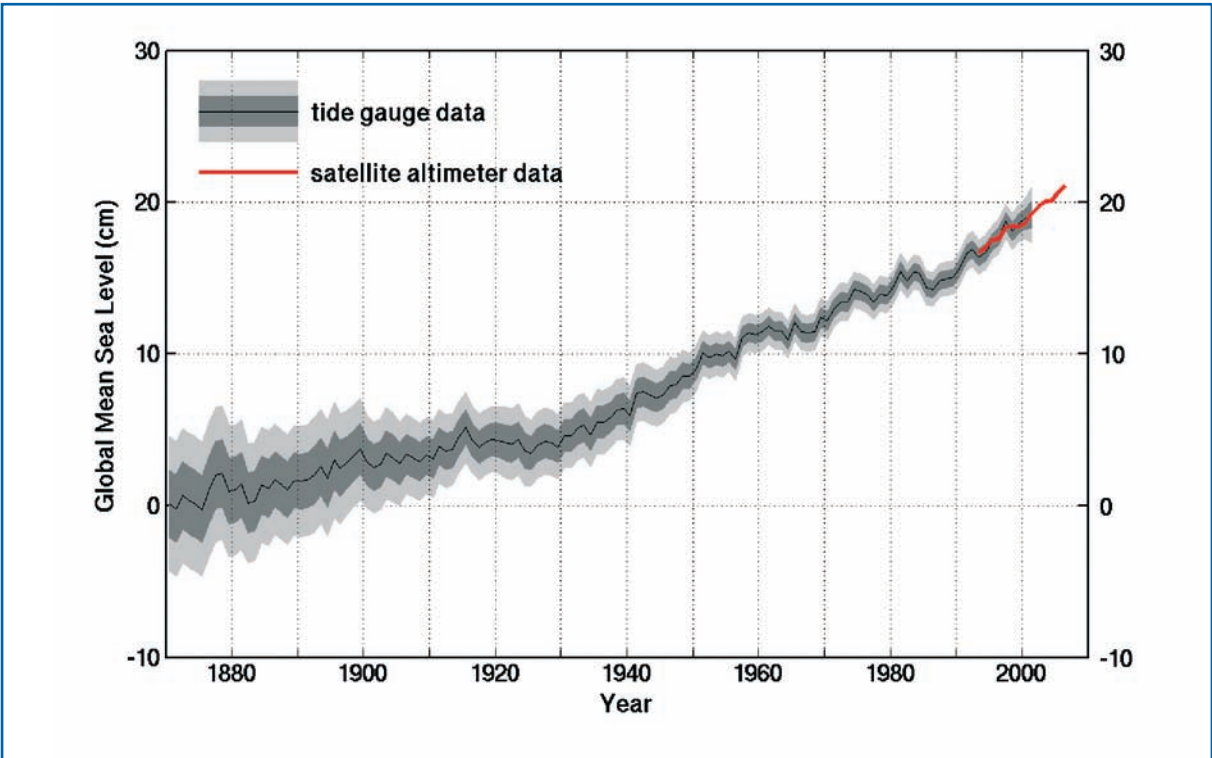
Long-term operation of GPCC is ensured due to its operational implementation within the Deutscher Wetterdienst (DWD). Continuous update of the monthly GPCC in situ observation precipitation database by contributions of GEO members is needed to meet the quality demands for the different GPCC products, e.g. concerning climate variability/trend studies and verification of global climate models.

The significantly enlarged GPCC data base enables to prepare new and extended versions of the Full Data Reanalysis (Version 4) and of the VASCLimO Climatology (Version 2) as well as the release of a new global monthly precipitation climatology, planned to be available until end of year 2007.

# Improving projections of sea-level rise and variability – A World Climate Research Programme Workshop in support of the Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan

## Description

The coastal zone has changed profoundly during the 20<sup>th</sup> century. In 1990, 23 percent of the world's population (or 1.2 billion people) lived both within a 100 km distance and 100 m elevation of the coast at densities about three times higher than the global average. By 2010, 20 out of 30 mega-cities will be on the coast, with many low-lying locations threatened by sea-level rise. With coastal development continuing at a rapid pace, society is becoming increasingly vulnerable to sea-level rise and variability -as Hurricane Katrina recently demonstrated in New Orleans. Rising sea levels will contribute to increased storm surges and flooding, even if hurricane intensities do not increase in response to ocean warming. Rising sea levels will also contribute to the erosion of the world's sandy beaches, 70 percent of which have been retreating over the past century. Low-lying islands are also vulnerable to sea-level rise.



Global averaged sea levels from 1870 to 2006 as inferred from tide-gauge data (black line, with 66% and 95% confidence limits given in dark and light shading) and satellite altimeter data (red line).

An improved understanding of sea-level rise and variability will help reduce the uncertainties associated with sea-level rise projections, thus contributing to more effective coastal planning and management. Adaptation measures, including enhanced building codes, restrictions on where to build, and developing infrastructures better able to cope with flooding, should help to minimize the potential losses.

Since the beginning of high-accuracy satellite altimetry in the early 1990s, global mean sea-level has been observed by both tide gauges and altimeters to be rising at a rate of just above 3 mm/year, compared to a rate of less than 2 mm/year from tide gauges over the previous century. About half of the sea-level rise during the first decade of the altimeter record can be attributed to thermal expansion due to a warming of the oceans; the other major contributions include the combined effects of melting glaciers and ice sheets. Changes in the storage of water on land (such as the depletion of aquifers and increases in dams and reservoirs) remain very uncertain.



## Added Value

In support of the Global Earth Observation System of Systems (GEOSS) 10-Year Implementation Plan, the World Climate Research Programme (WCRP) organized the Workshop on Understanding Sea-level Rise and Variability to bring together all relevant scientific expertise with a view towards identifying the uncertainties associated with past and future sea-level rise and variability, as well as the research and observational activities needed for narrowing these uncertainties. The Workshop develop international and interdisciplinary scientific consensus for those observational requirements needed to address sea-level rise and its variability.

## Relevance to GEO

Sea-level rise is a high impact aspect of climate change and it is directly relevant to the Disasters, Health, Climate, Water, Weather, Ecosystems and Biodiversity Societal Benefit Areas.

Understanding of many factors is required to narrow uncertainties of projections and the impacts of sea-level rise. International collaboration on global observations across a range of disciplines is an essential element of improving projections of sea-level rise.

## Participants

163 scientists from 29 countries and representatives of GCOS (and GOOS, GLOSS and OOPC), GGOS and space agencies attended the Workshop on Understanding Sea-level Rise and Variability, hosted by the Intergovernmental Oceanographic Commission of UNESCO in Paris June 6-9, 2006.

John Church, CSIRO Marine and Atmospheric Research and Antarctic Climate and Ecosystems Cooperative Research Centre, Hobart, Australia

E-mail: [john.church@csiro.au](mailto:john.church@csiro.au)

Stan Wilson, NOAA, USA

E-mail: [stan.wilson@noaa.gov](mailto:stan.wilson@noaa.gov)

Philip Woodworth, Permanent Service for Mean Sea Level, Proudman Oceanographic Laboratory, UK,

E-mail: [plw@pol.ac.uk](mailto:plw@pol.ac.uk)

Thorkild Aarup, Intergovernmental Oceanographic Commission

E-mail: [t.aarup@unesco.org](mailto:t.aarup@unesco.org).

## Current Status and Next Steps

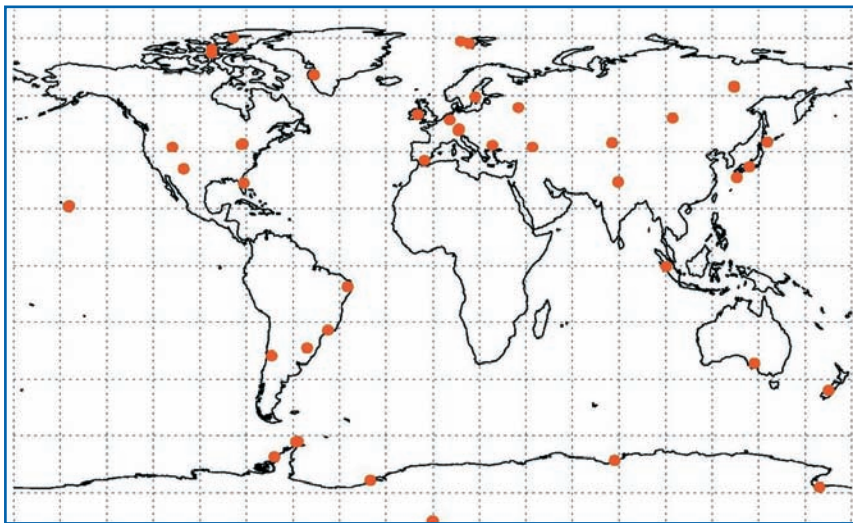
The Workshop clearly spelt out the satellite and in situ observational priorities. Urgent action is required to ensure that there are no gaps in satellite observational programs. Action is also required on implementation of the in situ observational priorities. The conference statement is available at

[http://wcrp.wmo.int/AP\\_SeaLevel.html](http://wcrp.wmo.int/AP_SeaLevel.html).

## Network for the Detection of Mesopause Change (NDMC) <http://wdc.dlr.de/ndmc/pags/ndmc-1-home.html>

### Description

NDMC is a global program started in 2007 with the mission to promote international cooperation among research groups active in studying the mesopause region (80-100km) of the atmosphere with the goal of early identification of changing climate signals. At this time, the 46 stations, whose geographical distribution is represented in the map below, have registered participation in NDMC.



This program involves the coordinated study of atmospheric variability at all time scales (seasonal as well as known solar cycles), the exchange of existing know-how, and the coordinated development of improved observation and analysis techniques and modeling, with initial emphasis is on airglow techniques utilizing existing ground-based and satellite measurement capabilities.

The formation of NDMC in itself is a significant result as it helps to close the gap between existing ground-based networks, namely those of the Global Atmosphere Watch (GAW) program of the World Meteorological Organization (WMO) and the Network for the Detection of Atmospheric Composition Change (NDACC), by addressing different altitude regimes of the atmosphere.

### Added Value

The GEO initiative is expected to aid in the success of NDMC through the focusing of attention on the international cooperation required to answer the large questions facing the global community. NDMC, with its strong start, will impact GEO by ensuring that all important regimes of the atmosphere, including the mesopause, are addressed.

### Relevance to GEO

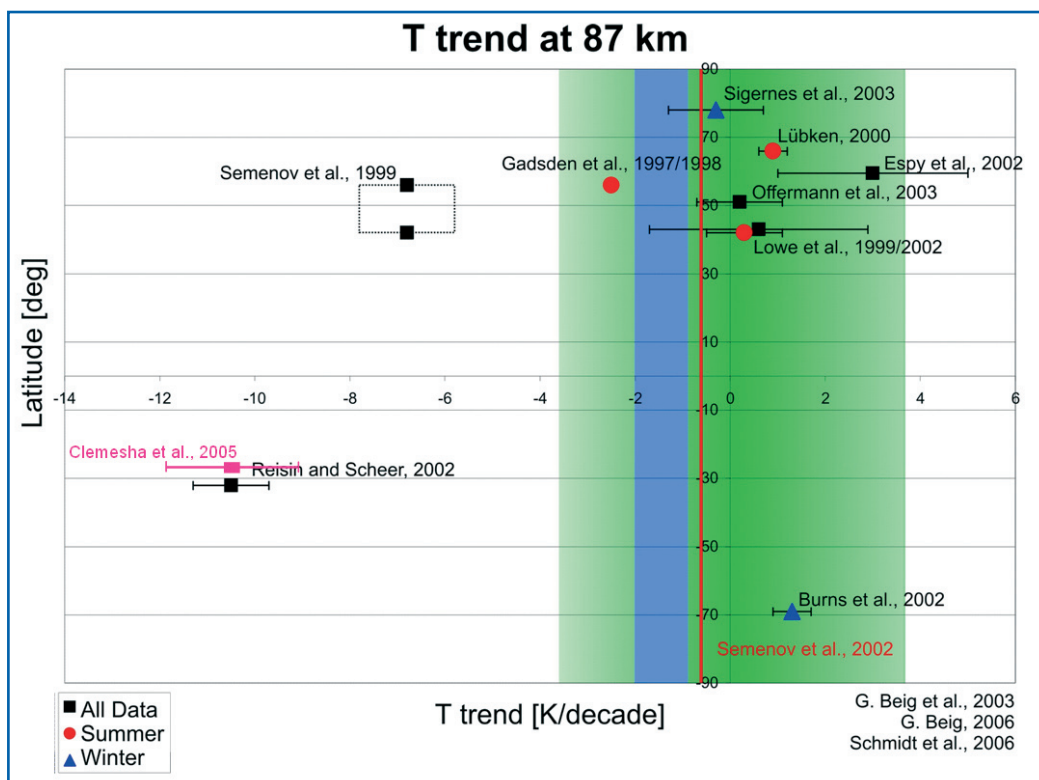
NDMC has clear relevance to the Climate SBA and will contribute to social-economic benefits gained from early detection of climate change. NDMC can play a significant role in Task CL-06-03 as it will coordinate a large number of researchers working on terrestrial observations contributing to the study of climate change.

## Participants

- Argentina
- Australia
- Brazil
- Bulgaria
- Canada
- Georgia
- Germany
- India
- Indonesia
- Ireland
- Japan
- Kazakhstan
- New Zealand
- Norway
- Russian Federation
- Spain
- Sweden
- United Kingdom
- United States
- WMO

## Current Status and Next Steps

The funding for the management of NDMC, which comes from the Bavarian State Ministry of the Environment, Public Health and Consumer Protection, Germany, is assured through 2010, while the funding of measurements is the responsibility of each of the NDMC participants. Now that NDMC has been established, work will be initiated to study differences in trends related to the regional differences detected in the temperature of the mesopause, illustrated in the figure below.



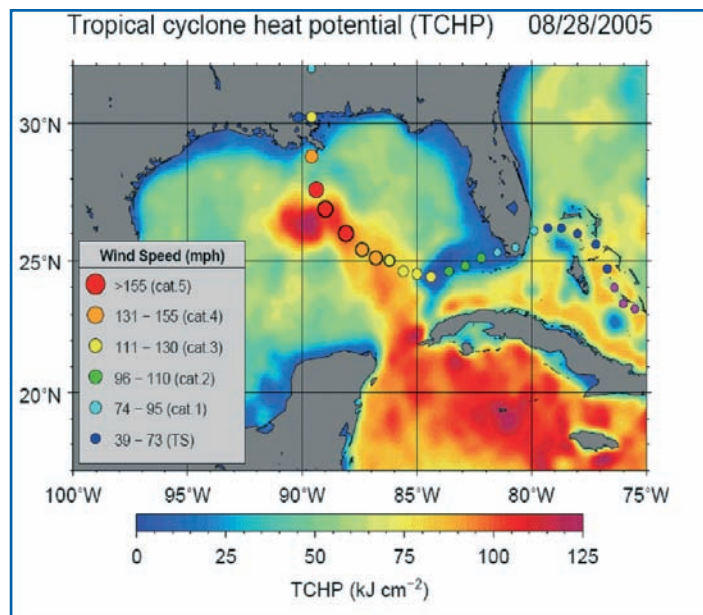
The major gap seen is a complementary satellite-based measurement capability which would allow for establishment of an ideal transfer standard for the cross-validation of different ground-based sensors.

## Establishment of a U.S. National Land Imaging Program

### Description

Satellite measurements of the global surface topography of the ocean in recent years have revealed the critical role of the ocean in disasters, weather, climate, water resources, marine ecosystems, and human health. These measurements, coming from a simultaneous series or constellation of satellites carrying altimeters, are a fundamental part of any global Earth observing system and should be continued as part of GEOSS. Shaped by currents, winds and Earth's gravity, the surface of the ocean tells a larger story about its most basic functions; how it stores vast amounts of energy from the Sun, how it moves that energy around the globe and how it works together with the atmosphere to create climate and weather. Just as forecasting atmospheric changes requires both surface pressure and atmospheric density, so does forecasting ocean circulation require the surface pressure field from ocean surface topography as well as density profiles in the ocean. Sampling is key; scientists have learned that one altimeter is not enough. At least one precision altimeter in an inclined reference orbit must be joined with at least two complementary altimeters in polar orbits to observe the full range of scales from global to mesoscale. In addition, for scientific understanding and operational forecasts, the altimetry data must be combined with in situ information that comes from various sources including the global Argo float array, moored buoys, and coastal sea level gauges. When fully operational, the constellation and in situ instruments will provide valuable societal information.

The data collected to date by the existing constellation are striking. Today, we have the first accurate global observations of sea-level change. The new data has allowed modeling of the ocean response to warming and ice melting, and has shown the impact of the ocean on atmospheric temperature and precipitation, as well as on hurricanes and typhoons. For weather, altimeter data has improved knowledge of upper-ocean heat content and hurricane intensity forecasting, helped high-seas forecasting, and has improved operational oceanography (forecasting eddies, etc) in general. For climate, the altimetry data has yielded for the first time the basin-scale variability in the oceans including ENSO forecasting and its impact on seasonal floods and droughts, and longer-term decadal changes such as the North Atlantic Oscillation.



The era of modern satellite altimetry began with the European ERS-1 in 1991 and the US/French TOPEX/POSEIDON in 1992. These have been followed by ESA's ERS-1, ERS-2, and Envisat; the US Navy's GFO, and the French/US Jason-1 and (when launched next year) Jason-2. These altimeter satellites are now advancing our knowledge of ocean circulation and seasonal changes, improving forecasting of climate events, measuring global sea-level change, improving open ocean tide models, and providing estimates of significant wave height and wind speeds over the ocean. For the future, the Committee on Earth Observation Satellites (CEOS) has recommended that the Jason-derived climate data record be continued beyond Jason-2, together with continuity of coverage by at least two complementary altimeters in polar orbit, thus enabling both the global aspect of ocean processes as well as oceanic mesoscale variability to be monitored. This future constellation is currently being planned and implemented, with some budget commitments not yet been made. To avoid gaps and provide long-term continuity, nations need to commit now to all aspects of the ocean surface topography constellation for GEOSS.

## Added Value

In addition to the points mentioned above, an ocean topography constellation adds value by providing data for operational forecasts ranging from tides and marine ecosystems to human health and water resources on land. For example, when used together with coastal tide gauges, the altimeter information provides tide-resolving forecasts of sea level in coastal areas around the world. Information on long term ocean change such as the North Atlantic Oscillation can be linked to fisheries regime changes, zooplankton variability, and marine mammal migration. Changes in coastal currents that affect water-borne diseases are also monitored by the altimeter constellation. Moreover, the altimeter provides crucial information on the amount and extent of polar ice, and will be an important contribution to the International Polar Year(IPY). Finally, building on constellation results, new wide-swath precision altimeters promise data on water levels over land that will be critical for management of water resources.

## Relevance to GEO

Information from the ocean surface topography constellation together with in situ data system contributes to several of the GEO Societal Benefit Areas (SBAs 1,2,4,5,6,7,8: Work Plan Task Numbers indicated):

- Disasters:  
Data to improve the forecast track for hurricanes and typhoons and associated flooding (DI-07-01)
- Health:  
Data for predicting coastal ocean currents and temperatures for harmful algal blooms and water-borne diseases such as cholera outbreaks (HE-06-03)
- Climate:  
Data provides basic ocean and ice information for assimilation and forecasting seasonal, interannual, and long term climate change (CL-06-02, CL-06-05, CL-06-06, and CL-07-01)
- Water:  
Data provides basic information on terrestrial water levels and state of water resources for forecasting and for water resource management (WA-06-02, WA-06-05, WA-06-07, and WA-07-02)
- Weather:  
Data provides basic ocean information on circulation and heat content for global forecasts (WE-06-02, WE-07-01)
- Ecosystems:  
Data provides the basic ocean information necessary for management of marine resources (EC-07-01)
- Agriculture:  
Data improves seasonal forecasts of drought and precipitation (AG-07-02)

## Participants

The existing and proposed series of missions are supported by partnerships between GEO participants US (NASA, Navy, and NOAA), ESA, EUMETSAT, France (CNES), China (SOA), and India (ISRO). All data are to be made freely available for use by others, and are regularly assimilated into operational forecasting models in the US (NCEP), Europe (ECMWF), and in forecasting centers around the world.

## Current Status and Next Steps

Currently, intensive discussions are on-going between EUMETSAT and NOAA to define a concept for a Jason-3 precision altimeter mission in the reference orbit, and funding is in the process of being committed. Continuity of coverage for global and mesoscale will require at least two complementary altimeter missions. Several countries, including the US, France, ESA, EUMETSAT, China, and India are involved in the planning for the complementary altimeters. The first satellite in the Chinese HY-2 series is now committed, as is the Indian/French SARAL mission. ESA's Sentinel-3 series, part of GMES, is under active development. NASA is considering a wide-swath altimetry mission. It is hoped that substantial progress towards commitments to the ocean surface topography constellation can be made by the time of the GEO Ministerial Summit. But final budget commitments, particularly for Jason-3, are not yet in place, and gaps are possible. Without commitments soon, society may lose essential long-term continuity of the data. Commitment to an ocean surface topography mission will be an important part of the success of GEO and GEOSS.



## World Climate Research Programme and Ozone Depletion and Recovery and Climate Change

### Description

Although depletion of stratospheric ozone was, at first, considered as being somewhat distinct from climate change issues, it had become increasingly clear that the future evolution of the ozone layer and its eventual recovery are part of the broader story of climate change associated with increasing concentrations of radiatively, and chemically active substances in the atmosphere as a result of human activities. The critical role of such substances in the chemistry of ozone in the Antarctic stratospheric winter polar vortex, remote from their source regions, is in itself indicative of the importance of transport and exchange between the troposphere and stratosphere on time scales ranging from weeks to years. It was becoming understood, however, that this dynamical coupling could influence the troposphere as well. In addition, the recognition that the signal of climate change is sensitive to the composition and structure of the upper troposphere/lower stratosphere region underlined the need for a programme of research directed toward understanding the role of the stratosphere in the climate system. It was also clear that to be successful this programme would have to combine a wide range of disciplines and expertise and fully recognize the key role of atmospheric chemistry in climate change.

Since its inception in 1992, the WCRP core project Stratospheric Processes and their Role in Climate (SPARC) has addressed key issues related to the stratosphere and its role in climate, both from scientific and policy information perspectives. Further, as the science and science-policy needs have evolved, SPARC has refocused its activities to provide the most useful research and information.

The current SPARC programme focuses on three key themes of modern climate science:

1. Chemistry-Climate Interactions,
2. Detection, attribution, and prediction of stratospheric change, and
3. Stratosphere-troposphere dynamical coupling. These main themes are complemented by a number of cross-cutting activities with specific foci. Current prominent SPARC activities include the Chemistry-Climate Model Validation project (CCMVal), work by the Data Assimilation Working Group (SPARC-DAWG), the activity on Solar Influence (SOLARIS), and the recently initiated Dynamical Variability activity.

The first of the SPARC themes listed above deals specifically with ozone depletion and recovery and its relationship to climate change. It addresses such questions as:

- How do stratospheric ozone and other constituents evolve as climate changes?
- How do changes in stratospheric composition affect climate?
- What are the links between changes in stratospheric ozone, UV radiation and tropospheric chemistry?

Whilst understanding and modelling stratospheric chemistry and its role in climate has always been a central component of SPARC, the need to go beyond this perspective to deal with the role of chemistry-climate interactions throughout the whole atmosphere will receive increased attention within SPARC in the future in the context of the Atmospheric Chemistry and Climate (AC&C) Initiative which has recently come into being as a major joint effort of WCRP and IGBP, with the SPARC and IGAC projects leading its implementation. The first phase of this activity involves a modelling effort, which will utilize and build upon the SPARC CCMVal activity, so as to move toward a broader based activity that will utilize modelling and observational activities in a synergistic way to define gaps in understanding, quantifying, and modelling chemistry-climate interactions.

SPARC has played a key role in production of recent assessments of ozone depletion and recovery. For the 2006 WMO/UNEP Scientific Assessment of Ozone Depletion., scientists within the SPARC community served as members of the Assessment Steering Committee, lead and contributing authors, and reviewers (“This report builds upon the previous assessments, research over the last 4 years, reports from SPARC committees, and observations from various field campaigns and new satellite instrumentation”, Chapter 4).

The CCMVal project organized the key element of the assessment process, the Chemistry Climate Model simulations. These simulations were of critical importance in assessing the evolution of ozone, temperature, and trace species in the stratosphere in the recent past as well as in making projections of ozone recovery in the twenty first century. (More information and a list of recent publications is available from the CCMVal web site: [http://www.pa.op.dlr.de/CCMVal/List\\_CCMValCollaborators.html](http://www.pa.op.dlr.de/CCMVal/List_CCMValCollaborators.html))

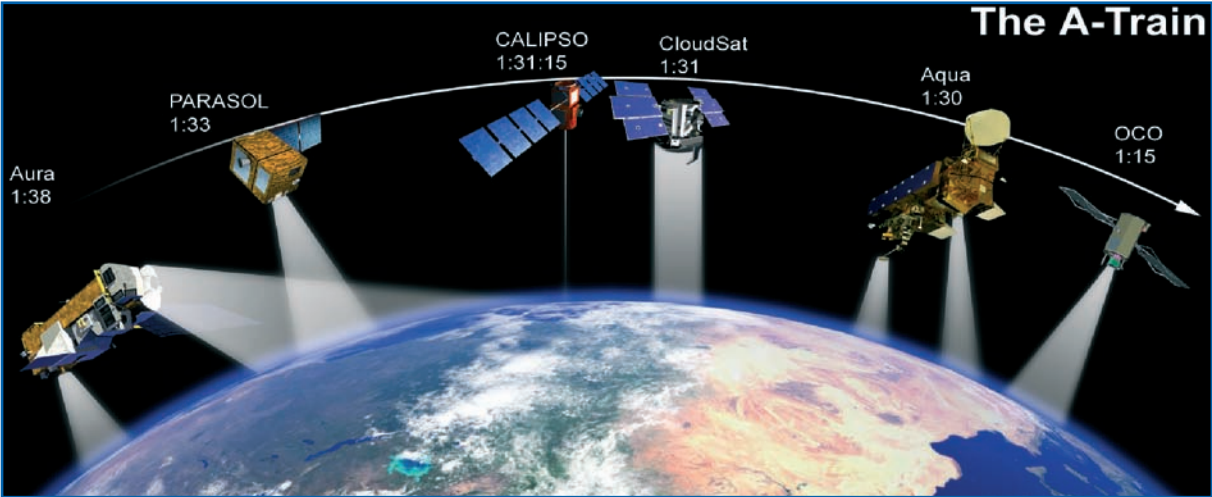
SPARC will continue to play a key role in the WMO/UNEP Ozone Assessment process, and CCMVal is already engaged in planning to ensure an even stronger contribution to the expected 2010 Ozone Assessment. It is now clear that ozone recovery and climate change are so closely linked that future efforts to improve predictions of long term variability and change, for both stratosphere and troposphere, will require taking the role of stratospheric ozone fully into account. It is anticipated that SPARC will, in collaboration with the Working Group on Coupled Modelling (WGCM), become involved in planning and executing modelling activities for future climate change assessments (AR5 and beyond).

# Parasol, Calipso and the A-Train

## Description

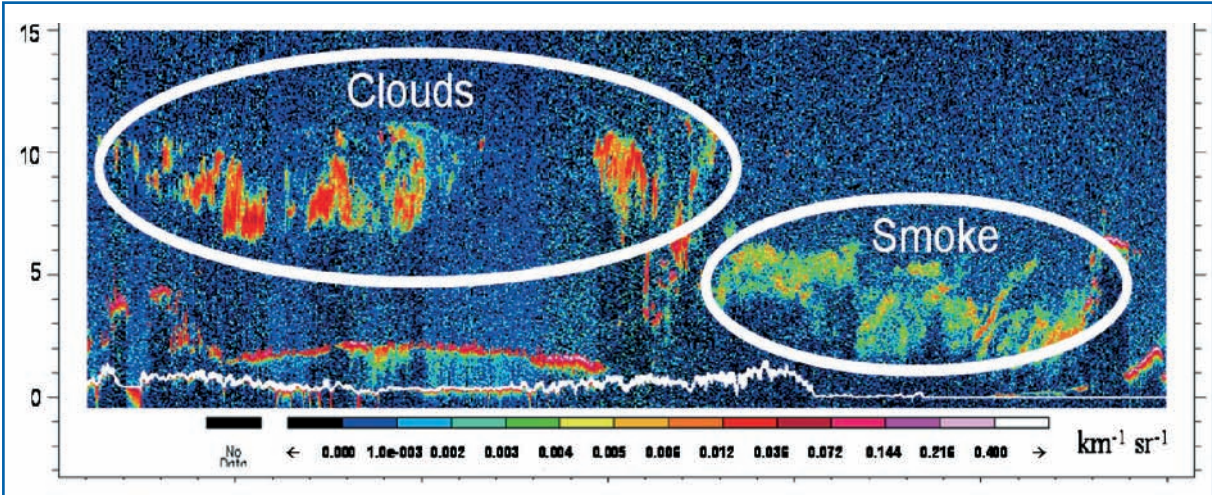
Parasol, a French microsatellite developed by Cnes, has been launched in December 2004 to fly as a part of the A-Train constellation. It is carrying a wide-field imaging radiometer-polarimeter called Polder, the goal of which is to improve our knowledge of the radiative and microphysical properties of clouds and aerosols by measuring the directionality and polarization of light reflected by the Earth-atmosphere system.

Calipso, a Nasa-Cnes satellite, has been launched in April 2006 to fly in tandem with Cloudsat, as a part of the A-Train constellation. The Calipso payload is composed of a backscattering lidar designed to supply vertical atmospheric profiles of aerosols and clouds, a visible camera, and an infrared imager. The goal of Calipso is to measure global vertical profiles of the radiative and microphysical properties of clouds and aerosols.



## Added value

It has been proved that the main uncertainties about climate change predictions are associated to the cloud and aerosols radiative impact. Together with the other A-train satellites, the purpose of Parasol and Calipso is to provide the global measurements of aerosols and clouds required to obtain a better understanding of the aerosols and clouds role in the climate system, and to improve our abilities to predict long-term climate change and seasonal-to-interannual climate variability.



## Relevance to GEO

Parasol and Calipso are mainly relevant for one Societal Benefit Area :

- Climate: Understanding, assessing, predicting, mitigating, and adapting to climate variability and change.

It will contribute to the following GEOSS implementation target:

- “Establish actions securing the provision of key data for climate studies and forecasting from satellite systems”.

## Participants

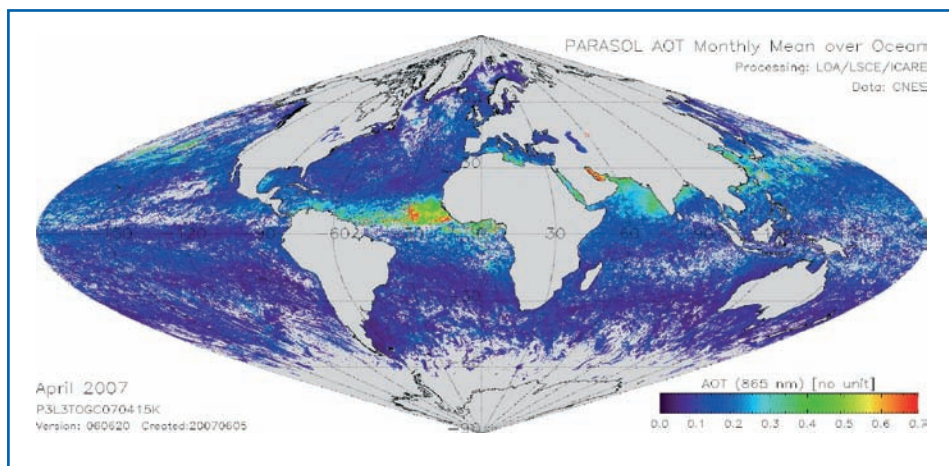
- Cnes
- Nasa
- Laboratoire d’Optique Atmosphérique (Lille),
- Thematic data center Icare (Lille)

## Current status and next steps

Inside the A-Train, Parasol and Calipso currently supply very good and continuous data. Corresponding aerosols and clouds data and products can be accessed on the Icare Web site (<http://www-icare.univ-lille1.fr/>).

An international symposium devoted to A-train observations and modelling results on aerosols and clouds will occur in Lille, October 22-25, 2007

In the absence of failure, Parasol and Calipso should provide useful data on aerosols and clouds until 2009.





## World Climate Research Programme and Seasonal Prediction

### Description

Developing countries are particularly vulnerable to climate change, partly because agriculture, water management and the spread of disease are highly dependent on weather and climate, and partly because of the inadequate adaptive and planning strategies available to properly respond to major climate anomalies.

The WCRP has a long-standing commitment to coordinating international seasonal prediction activities. Recent breakthroughs in seasonal prediction include:

1. the recognition that seasonal forecasts must include quantitative information regarding uncertainty (i.e., probabilistic prediction) and that verification must include probabilistic measures of skill; and
2. that a multi-model ensemble strategy may be the best current approach for adequately resolving forecast uncertainty. Numerical experimentation for seasonal-to-interannual variability and predictability is coordinated by the WCRP/CLIVAR-led Working Group for Seasonal-to-Interannual Prediction (WGSIP), paying special attention to assessing and improving predictions. Seasonal prediction activities cut across all core projects of the WCRP and provide a test bed for evaluating IPCC class models in seasonal prediction mode.



*In monsoon India and many other developing regions the seasonal rainfall is critical to society and human livelihood.*

*Image source:  
International Water Management Institute  
Photographed by Mamta Borgoyary.*

### Added value

Award winning breakthrough in climate prediction:

The 2006 Norbert Gerbier-Mumm International Award was given to Dr Tim Palmer, co-chair, WCRP CLIVAR, and 24 of his collaborators (from 13 institutions and 7 nations) in recognition of their major contribution to ensemble climate prediction applications that significantly improve early-warning techniques including those for malaria outbreaks. Dr Palmer and colleagues' work was published in 2004 in the Bulletin of the American Meteorological Society (Volume 85). In his acceptance speech (June 2006), Dr Palmer thanked the Norbert Gerbier-Mumm foundation, the European Commission for funding and the WCRP for providing fora for the modelling community, noting that ensemble climate predictions were pioneered through and by WCRP. The Award's prize money was recently invested in a project led by the Tanzania Meteorological Agency, studying the impacts of climate variability on malaria in Tanzania. The main objective of the project was to further develop and apply the DEMETER methodology of integrating seasonal forecasts and malaria statistics into an end-to-end early warning system for malaria outbreaks.

A new database of clinical cases was collected and made available for the wider scientific community, the seasonal and interannual cycle of malaria outbreaks since the year 2000 and beyond determined, and the high risk areas in Tanzania identified.



### **WCRP assessed state-of-the-art capabilities and skill in seasonal forecasting:**

Recognizing the importance of seasonal prediction, WCRP has launched a specific effort led by CLIVAR to determine the extent to which seasonal prediction is possible and useful in all regions of the globe with currently available models and data. For this purpose, a task force on seasonal prediction organized an international seasonal prediction experiment in 2007 and co-ordinated analysis of results at a Seasonal Prediction Workshop in Barcelona, Spain (June 2007, <http://grads.iges.org/ellfb/SMIP2/smip.top.html>). The workshop was designed to assess state-of-the-art capabilities and skill in seasonal forecasting with currently available retrospective forecast data sets made available through the Seasonal Model Intercomparison Project (SMIP) and DEMETER.

### **WCRP collaborates with WMO/THORPEX to help develop accurate prediction of high-impact weather and environmental events:**

The challenge of seamless prediction from days to decades, particularly in terms of bridging the gap between forecasting high impact weather events and seasonal variations naturally brings together the activities of the communities of WCRP Seasonal Prediction and the WMO's weather research programme THORPEX to discuss emerging coordination and collaboration. Both programmes have the obligation to help develop relevant scientific knowledge and a science infrastructure to provide society, in particular policy- and decision-makers 'more accurate, and from a socio-economic perspective more useful, prediction of high-impact weather and environmental events'.

### **WCRP advances seasonal prediction for agriculture:**

Climate experts associated with WCRP have significantly contributed to the advances made in several areas especially in the science of climate forecasting, downscaling large area climate forecasts to local applications, integration of climate forecasts in operational crop models to develop alternative scenarios for operational decision making, and capacity building at the local level in all these areas. The climate forecast community is now capable of providing an end-to-end multi-scale (in space and time) integrated prediction system that provides skilful, useful predictions of variables with socio-economic interest. For agriculture, climate forecasts must be interpreted in terms of production outcomes at the scale of decisions if farmers and other agricultural decision-makers are to benefit. Indeed, there have been several successful attempts to link seasonal climate forecasts from general circulation models with crop models.

### **WCRP/CLIVAR-scientists participated in the International Workshop on Climate Prediction:**

Agriculture and Challenges held in May 2005 at WMO and submitted several review articles to the Climate Research Special Issue (Vol. 33: 1) on Advances in Applying Climate Prediction to Agriculture (available at <http://www.int-res.com/abstracts/cr/v33/n1/>). CLIVAR-scientists were also involved in the WCRP co-sponsored Global Change System for Analysis, Research and Training (START), which continues to equip young professionals from developing countries with expertise in agriculture and food security to apply advances in climate prediction to their home institutions' ongoing efforts to address climate-sensitive aspects of agricultural production, food insecurity and rural poverty. START, together with IRI and WMO, recently published a selection of science articles in a book edited by Drs M. Sivakumar and J. Hansen.

### **Relevance to GEO**

Task CL-07-01. Coordinator: WCRP

## The Cryosphere Observing System: Legacy of the International Polar Year 2007-2008

### Description

The International Polar Year 2007-2008 (IPY) provides a unique opportunity to develop polar observing systems and, by doing so, closes one of the most drastic gaps in global observations. The World Climate Research Programme (WCRP) Climate and Cryosphere (CliC) Project and several partners are developing the conceptual framework for the Cryosphere Observing System (CryOS) - a sustained, robust observing system for the cryosphere and a crucial element of the future multidisciplinary observing system. Current observational capabilities, requirements for observations and higher-level products, and recommendations on actions needed to further develop CryOS are documented in the recently approved IGOS-P (Integrated Global Observing System Partnership) Cryosphere Theme Report (<http://igos-cryosphere.org>). The initial phase of CryOS development coincides with IPY. The approach is to engage relevant IPY projects and increase coordination between them with the objective of producing legacy datasets and the capability to continuously extend them after the end of IPY.

The first achievements of CryOS are in the area of coordination of satellite observations of the cryosphere. An IPY project entitled "Global Inter-agency IPY Polar Snapshot Year (GIIPSY)" was created to improve the coordination of space observations in the polar regions during IPY. Some of the requirements will be satisfied through routine operations, but some will call for non-routine tasking, processing, and data distribution. GIIPSY will generate a number of unprecedented datasets contributing to studies of sea-level rise, ocean circulation and polar air-sea interactions, regional climate, polar precipitation and hydrology, permafrost and Arctic aquatic ecosystems, transportation, and hazards.



*(Courtesy of NASA/Goddard Space Flight Center Scientific Visualization Studio)*

The CryOS vision offers high potential to realize a complete picture of cryosphere components within the next 10-15 years. This satellite picture (MODIS) of snow cover, sea ice temperature, glaciers and ice sheets across the Arctic illustrates the diversity of the cryosphere.

## Added value

GEO can assist first by assuring that the IPY Data Legacy goal is fulfilled, and secondly that the requirements documented in the IGOS Cryosphere Theme Report for a sustained and robust observing system are subsequently met in the post IPY timeframe. The key elements requiring attention are to stop the degradation of key in-situ networks and ensure balanced in-situ system capabilities. GEO can help to ensure that gaps in the satellite component of CryOS infrastructure are addressed, and that key missing elements such as solid precipitation, snow-water equivalent, and SAR interferometry of polar ice sheets are addressed via the development of future observing system capabilities. The benefits to GEO are in the development of capabilities to meet key UNFCCC requirements, together with a number of benefits in key societal benefit areas (SBAs).

## Relevance to GEO

Comprehensive, coordinated and sustained observations of, and information on, the cryosphere are essential to improve monitoring of the state of the Earth, increase understanding of Earth processes, and enhance prediction of the behavior of the Earth system. The cryosphere, found in about 100 countries, and is especially important to the GEOSS societal Benefit Areas for Climate, Disasters, Water, and Energy, and makes a significant contribution to Weather, Agriculture, Human Well-Being and Ecosystems. The Polar Regions and the global cryosphere have been shown to play a pivotal role in climate, and improved information is essential to fully assess, predict, and adapt to climate variability and change. Success depends on understanding the mechanisms responsible for abrupt climate change and the contribution of the cryosphere to sea level rise.

The cryosphere, being frozen water, is an intrinsic part of the global water cycle, impacting Weather, Water, Energy and Agriculture. Accurate determination of precipitation, including the solid component, is essential to understanding the global water cycle (but at present accurate determination is not possible at a global scale. Snow- and glacier-melt are critical sources of water for agricultural, domestic and industrial water supply and hydropower production, and directly contribute to flood and drought hazard conditions. Other short and long term hazards directly related to the cryosphere include avalanches, glacier lake outburst floods, subsidence due to thawing permafrost, snowstorms, blizzards, icing, coastal erosion, and of course sea level rise. Lake-, river- and sea-ice directly affect high latitude transportation and ecosystems, including regional and global transportation routes, regional economic development, and the well-being of northern peoples.

GEO Work Plan reference  
CL-06-05. Coordinator: WCRP.

## Participants

Coordination of CryOS tasks by WCRP/CliC and ICSU/SCAR including participation by following other organizations: WMO, CEOS Space Agencies (CSA, ESA, JAXA, NASA, NOAA/NESDIS), and several others.

## Current Status

The Space Task Group for IPY was recently established under the mandate of WMO/ICSU IPY JCOMM. Its purpose is the coordination of polar satellite data acquisitions from major space agencies. The GIIPSY portal for data access has been initiated and several Announcements of Opportunity have been issued. The WMO Congress XV approved the WCRP/CliC proposal to initiate the establishment of a Global Cryosphere Watch as an IPY legacy.

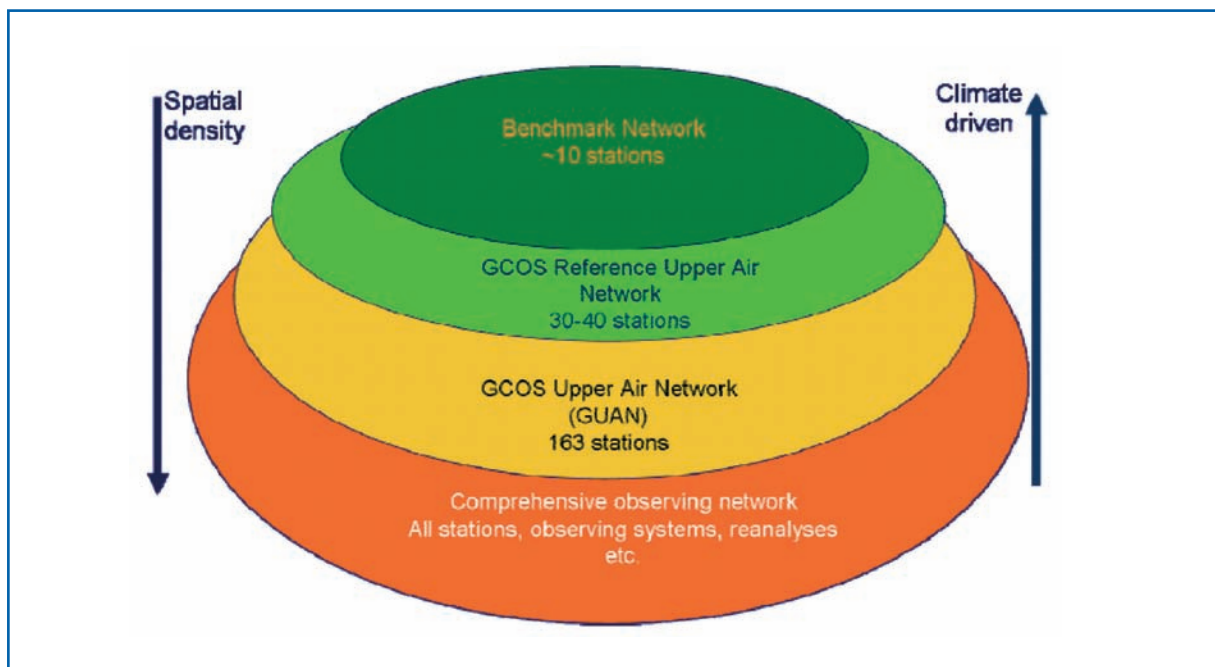
## Next Steps

With the recent establishment of the Global Cryosphere Watch, resources for its initiation must now be identified. Similarly, the search for agents for the coordination and implementation of the IGOS Cryosphere Theme will continue. A meeting to engage more IPY projects into the coordination of observations and data exchange will be planned.

## The GCOS Upper-Air Reference Network, GRUAN

### Description

The GCOS Reference Upper-Air Network (GRUAN), a network for atmospheric reference observations, will form the high quality climate reference sites needed for many applications. Scientific evidence clearly shows that there is a pressing need to implement such a network. It is also emphasized that the GRUAN would be part of a system of networks to which both the GCOS Upper-Air Network (GUAN) and the WMO Global Observing System (GOS) are vital components. The Deutscher Wetterdienst, DWD, will host a GRUAN Lead Centre at its Meteorological Observatory Lindenberg – Richard-Abmann-Observatory for training, education and detailed quality control.



GRUAN tiered-system: Tiered observing system architecture for climate. (GCOS-112)

### Added value

The GRUAN is required to provide the foundation for long-term datasets that can be used to reliably monitor and detect emerging signals of global and regional climate change. Thus the GRUAN is required to provide long-term high quality climate records, constrain and calibrate data from more spatially-comprehensive global observing systems, and fully characterize the properties of the atmospheric column. A successfully implemented GRUAN inter alia will closely coordinate with the user community, have high-quality instrumentation, provide for redundancy of measurements of climate variables at network sites, and manage changes in the network in such a way that non-climatic influences can be accurately adjusted for. The GRUAN will also need to have real-time calibration and validation and a strong lead centre managing the network in conjunction with station operators. Data and metadata from GRUAN should be easily, freely accessible at least bona fide research purposes. GRUAN sites need to fully adhere to the GCOS Climate Monitoring Principles and have complementary measurements from other networks in a collocation database, to enable cross-calibration.

## Relevance to GEO

The idea for a GRUAN is based on an activity outlined in the Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC, the GCOS-IP (GCOS, 2004). This key action in the GCOS-IP asks to establish a high quality reference network of about 30 precision radiosonde stations and other collocated observations. This activity is also reflected in a 2 year target of the climate SBA. In addition the GCOS-IP is recognised as climate module of the GEOSS 10-year implementation. Justification, requirements, siting and instrumentation options for GRUAN are further detailed in GCOS, 2007.

The GRUAN is of special interest to the climate SBA but will support the weather SBA as well. It is reflected in and a contribution to Weather Task WE-06-01.

## Participants

As the GRUAN will be a carefully selected network of high quality upper-air stations, many GEO Members will contribute to this activity. The development of GRUAN is mainly driven by the Atmospheric Observation Panel for Climate (AOPC) of GCOS. The AOPC is co-sponsored by GCOS and the World Climate Research Program (WCRP).

## Current status and next steps

The DWD's offer to host the GRUAN Lead Centre has been accepted by AOPC for an initial period or "pilot phase" of five years. During this phase the GRUAN concept will be further refined in cooperation with all partners, leading to the establishment of an initial GRUAN with a limited number of stations.

### References:

*GCOS, 2004:*

*Implementation Plan for the Global Observing System for Climate in Support of the UNFCCC (GCOS-92)*

*GCOS, 2007:*

*GCOS Reference Upper-Air Network (GRUAN):*

*justification, requirements, siting and instrumentation options, GCOS-112*





## Added Value

The combination of data collection, analysis, and reporting on climate conditions through the State of the Climate Report is closely aligned with the scope and principles of GEOSS. With a focus on integrating observing system data to useful and accessible information, the State of the Climate Report serves as a hallmark achievement of GEOSS efforts to use integrated global Earth observations to monitor and enhance the understanding of climate variability and change. It also serves as an avenue for providing information that decision makers can use to better understand changing environmental factors that affect human health and well being and positions decision makers to anticipate and manage future risks associated with climate variation and change.

Since the State of the Climate Report focuses on the earth system as a whole, spatial and temporal gaps in data coverage are more easily identified as well as deficiencies in operational systems that provide access to those data. Solutions for filling those gaps are developed through coordination among scientists from the countries participating in the State of the Climate Report. This coordination exemplifies how experts from numerous and diverse countries can work together on an ongoing basis to provide information which is essential to environmental decision making.

## Relevance to GEO

The State of the Climate Report directly serves several GEO societal benefit areas including climate and health. It provides a clear example of how data from GEO's system of systems can be integrated into useful information, not previously available.

## Participants

Scientists from institutions in twenty one GEO member countries participate in State of the Climate reporting: Argentina, Australia, Brazil, Canada, Chile, China, Costa Rica, Germany, India, Iran, Mexico, Morocco, New Zealand, Niger, Portugal, the Russian Federation, South Africa, Spain, Sweden, the United Kingdom, and the United States. In addition, scientists from countries that are not yet GEO members are also key contributors to this program: Armenia, Bosnia and Herzegovina, Colombia, Cuba, Ecuador, Kenya, Mozambique, Panama, Peru, Poland, Turkey, and Uruguay.

## Current Status and Next Steps

The State of the Climate Report is published annually in the Bulletin of the American Meteorological Society and distributed by the World Meteorological Organization to member nations. Included in the 2006 report was a summary of more than 20 Essential Climate Variables from the beneath the ocean surface to the upper atmosphere in every region of the world.

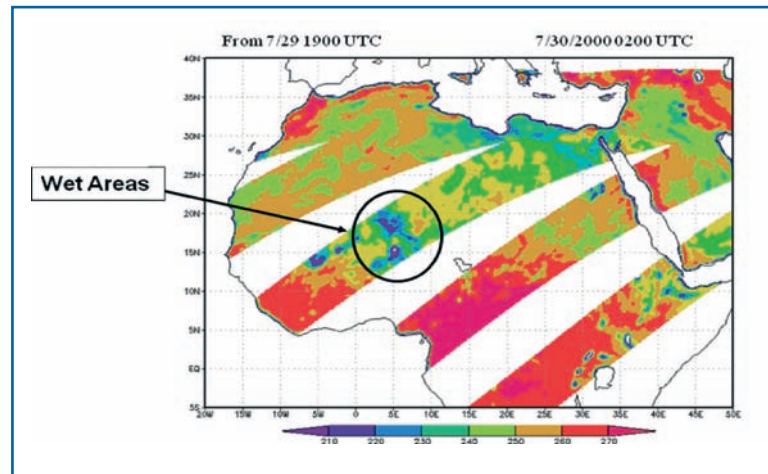
A diverse set of topics that spanned the earth's climate system included, but were not limited to, surface and upper air temperature, precipitation, atmospheric trace gases, ocean salinity, circulation, and ocean carbon content, snow cover, sea ice, sea level, and stratospheric ozone.

The focus of the future is on bringing together new contributing partners from other GEO member countries and further enhancing capabilities associated with the collection, processing, and analysis of data from newly deployed observing systems. Potential linkages with additional GEO Participating Organizations will also be explored, with all efforts focused on enhancing the capacity to observe, analyze, and report on many more Essential Climate Variables in future Reports, providing leaders with an even greater resource for monitoring the earth's climate.

## World Climate Research Programme (WCRP), Earth Observations and Droughts

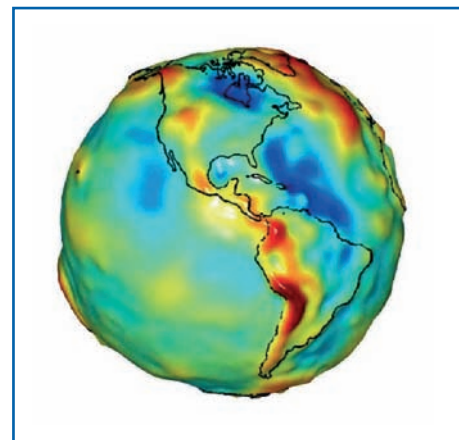
### Description

WCRP, through its Global Energy and Water Cycle (GEWEX) Core project and its Cross-cut project on Extremes, has been undertaking work to monitor, understand and predict droughts. In particular, soil moisture products derived from AMSR-E and TRMM (Tropical Rainfall Mapping Mission) satellite data have been used to provide reliable estimates of upper layer soil moisture and are available on an experimental basis for monitoring drought over Africa. Local data are needed to assist in validating these drought monitoring products.



*This chart shows surface wetness from TRMM data as an indicator of drought intensity (Courtesy of E. Wood).*

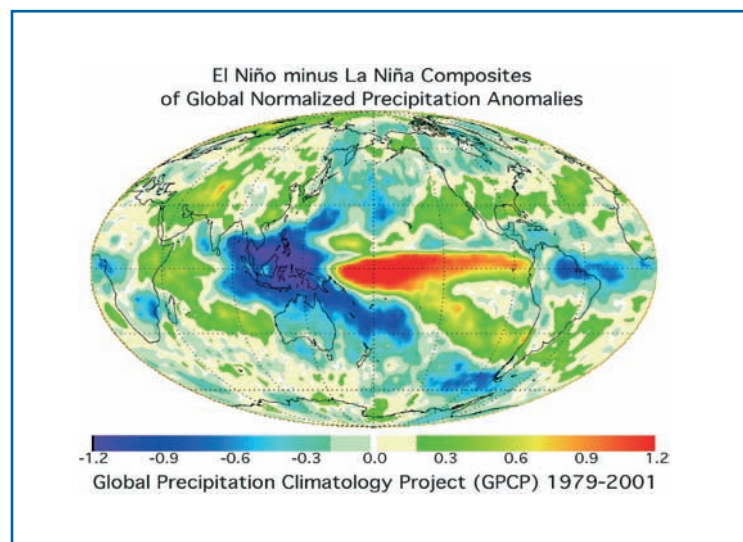
GEWEX is studying the factors that initiated, maintained and terminated a multi-year drought (1999-2005) in western Canada through the Drought Research Initiative (DRI). Satellite data are being used to study the effects of the drought on soil moisture, vegetation and ground water reserves. DRI also supports some model evaluation activities and a number of process studies including several concerned with groundwater-atmosphere interactions during droughts.



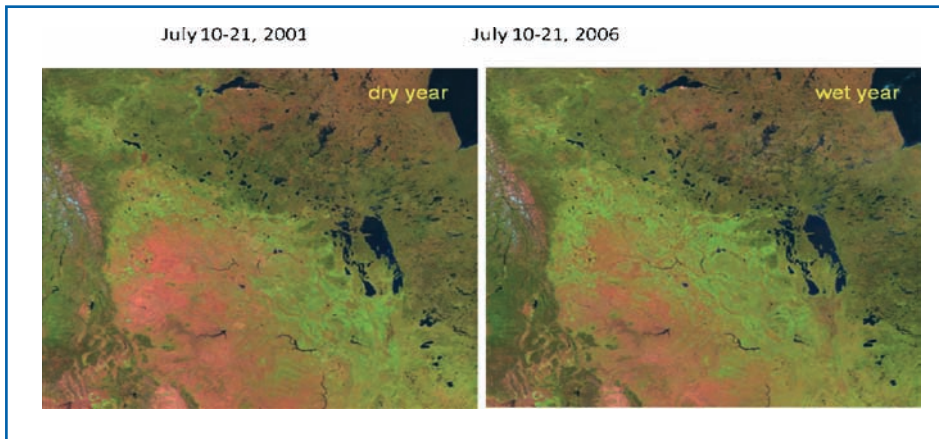
*GRACE (Gravity Recovery and Climate Experiment) satellite data are being used to estimate the changes in the groundwater storage occurring as Canadian droughts develop (Courtesy of Ken Snelgrove).*

Other GEWEX studies are assessing the adequacy of available climate and soil moisture products for characterizing drought in the semi-arid regions of the Canadian prairies and elsewhere. In addition, GEWEX has developed and produced a number of long-term global products derived from satellite data that allow scientists to monitor the severity of droughts and other climate anomalies.

*Global Precipitation Climatology Project (GPCP) products are being used to assess the effect of anomalies in Sea Surface Temperature (SST) such as El Niño events on precipitation anomalies. (Courtesy of Bob Adler).*



Several drought projects are using MODIS imagery to assess the extent of dry conditions. Collaborative work is being undertaken with agricultural agencies to identify the way in which drought thresholds can best be incorporated into their decision making processes. For example, the province of Alberta, Canada, makes use of NDVI products to determine whether or not farmers who have experienced forage losses in their pastures due to drought qualify for compensation from government insurance programs.



*MODIS satellite imagery showing the difference between a wet year and a dry year.  
(Courtesy of A. Trishchenko)*

Within WCRP, drought prediction continues to be a central thrust of research for CLIVAR (Climate Variability and Predictability Project) and GEWEX as they study the roles of Sea Surface Temperatures and soil moisture in drought events. New projects on drought are being developed for eastern Asian and other semi-arid regions as part of the Coordinated Energy and water cycle Observations Project (CEOP)

In summary, remote sensing of the water cycle and surface conditions has become an essential tool in monitoring and predicting drought events. More effort is needed to ensure it benefits operational information systems as well as the research environment where it is being developed.



## Asian Water Cycle Initiative (AWCI)

### Description

There is a rapidly growing concern about the common water issues, including flood and landslide, drought and water scarcity, water pollution and environmental degradation, climate change impacts, in Asia.

Based on the regionally common and sharable ideas on the water-related issues in Asia and their natural and socio-economical backgrounds, a well coordinated regional challenge, "Asian Water Cycle Initiative (AWCI) Contributing to GEOSS", has been organized in cooperation among the 18 countries in Asia based on the series of discussions since 2005 just after the GEO established.



Common Issues on Water Cycle in Asia

The AWCI develops Integrated Water Resources Management (IWRM) approaches for addressing the various water-related issues in Asia comprehensively and effectively and for promoting to share timely, quality, long-term information on water quantity and quality and their variation as a basis for sound decision making of national water policies and management strategies.

### The objectives for AWCI are defined as follows:

- to develop Integrated Water Resources Management (IWRM) approaches;
- to share timely, quality, long-term information on water quantity and quality, and their variation as a basis for sound national and regional decision making;
- to construct a comprehensive, coordinated and sustained observational system of systems, such as prediction systems and decision support capabilities, under the GEOSS;
- to develop capacity building for making maximum use of globally integrated data and information for local purposes as well as for observation and collecting data.

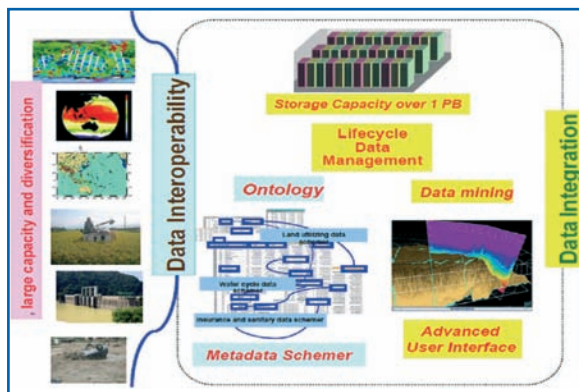


AWCI discussions at the series of meetings

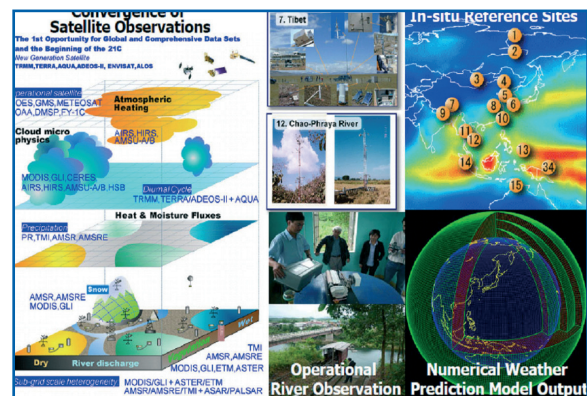


The AWSI is a new type of a scientific challenge. Its uniqueness is described as follows:

- Effective combination of the architecture and data and the capacity building;
- Advanced data infrastructure availability including a river basin meta-data registration system, a data quality control interface, and data-integration and downscaling methods;
- A clearly described data sharing policy agreed among the participating countries;
- Strong linkage among science communities, space agencies, and decision makers;
- Well coordination between the research communities and operational sectors with clear strategy for shifting scientific achievements to operational use;
- Effective cooperation with WCRP/CEOP and IGOS-PIGWCO.



Observation Convergence



Data Interoperability and Data Integration

### Added value

GEOSS/AWCI can directly contribute to the water issue of the UN MDGs and the paragraph 25 and 27 of the WSSD Plan of Implementation.

### Relevant to GEO

“Improving water resource management through better understanding of the water cycle” is one of the nine societal benefit areas of GEOSS. AWCI will directly contribute to WA-06-02, WA-06-07, WA-07-01, WA-07-02 and DA-07-06.

### Participants

- National hydrological and meteorological departments and of services of 18 countries in Asia including GEO Members; Bangladesh, China, India, Indonesia, Japan, Korea, Nepal, Philippines, Thailand.
- Projects and activities of international organizations including GEO Participating Organizations; APN, CEOS, IGOS-P, UNESCO, UNU, WCRP

### Current Status and Next Step

Bangladesh, Indonesia, Japan, Thailand and Vietnam have already started preliminary studies for implementation. The meeting schedule in 2007 is as follows:

- The International Coordinating Group Meeting, Bali, September 2007
- The 3rd Water Cycle Symposium, Beppu, December 2007 (to be held under the framework of the Asia-Pacific Water Forum)

# Drought Watch: Earth Observation Information for Climate Assessment

## Summary

Canada's Drought Watch Program provides timely information on the impacts of climatic variability on water supply and agriculture, and promotes practices to reduce drought vulnerability and improve management during a drought. Drought Watch is a joint initiative between Agriculture and Agri-Food Canada (AAFC), the National Land and Water Information Service (NLWIS) and Environment Canada to share near real-time data for drought monitoring interpretations. NLWIS provides open and free access to data, information and tools over the Internet to support sound land use decision making by Canadians. NLWIS is also generating new information to fill critical gaps identified by user requirements. NLWIS will conform to the Canadian Geospatial Data Infrastructure (CGDI) and international (Open Geospatial Consortium, OGC) standards. NLWIS and AAFC's research community are working together in developing the next generation of Earth observation products to meet ongoing and emerging user needs.

## Relevance to GEO

The climate information provided through Drought Watch meets many of the user needs documented in the Socio-Economic Benefit Areas (SEBAs) identified by the GEO international community, including:

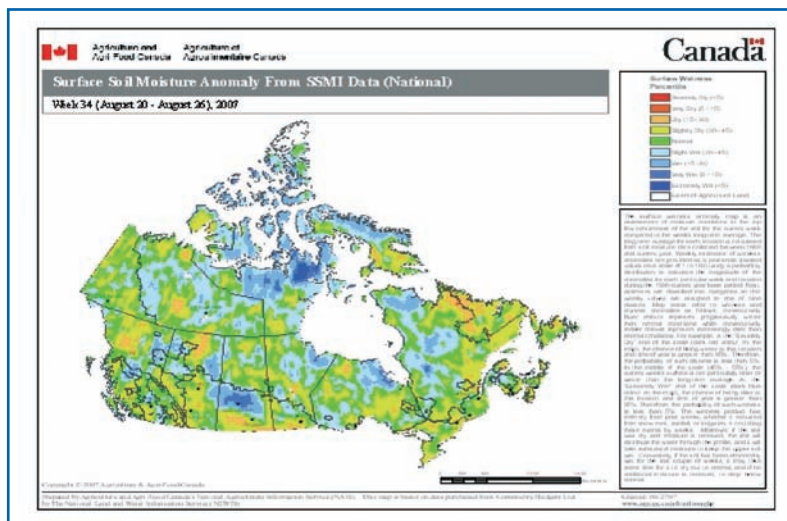
- Reducing loss of life and property from natural and human-induced disasters;
- Understanding, assessing, predicting, mitigating and adapting to climate variability and change;
- Improving water resource management through better understanding of the water cycle;
- Supporting sustainable agriculture and combating desertification;

Some key Drought Watch earth observation initiatives of relevance to GEO are described below.

## 1.1 Soil Moisture Monitoring

### Description

AAFC is currently using enhanced passive microwave data for the development of qualitative coarse-scale information on surface wetness and temperature (Figure 1). Researchers are also developing approaches to using Synthetic Aperture Radar (SAR) and multi-angle radar data that will improve the resolution and provide qualitative soil moisture monitoring data. In the future, soil moisture monitoring in Canada will be based on integrated monitoring networks that incorporate passive microwave systems with SAR and in-situ monitoring networks.



Weekly surface wetness anomalies  
Canada from enhanced passive micro-  
wave data

## Added Value

Knowledge of absolute and relative soil moisture is of critical importance to agriculture. Soil moisture is a sensitive indicator of crop moisture stress and the onset of drought and plays a key role in crop productivity. It influences field activities (tillage, seeding, irrigation) and also is a key indicator of runoff potential and a key input for weather forecast modeling. As such, soil moisture is a critical data requirement to AAFC's monitoring, forecasting and responding needs.

## 1.2 Near-Real-Time Climate Networks

### Description

The extent, location and severity of temperature and precipitation events relevant to agriculture are monitored and analyzed in near real time and distributed on AAFC's Drought Watch Web site (Figure 2), a Canada-USA cooperative service. AAFC is integrating Environment Canada's weather monitoring data and data from provincial networks to provide daily updates on conditions for the industry. Weather data is assembled into a common format, screened and verified where possible before maps showing several analytical products are prepared with GIS technology. The information is a key input for identifying drought and other weather-related disasters and for developing mitigation programs.

### Added Value

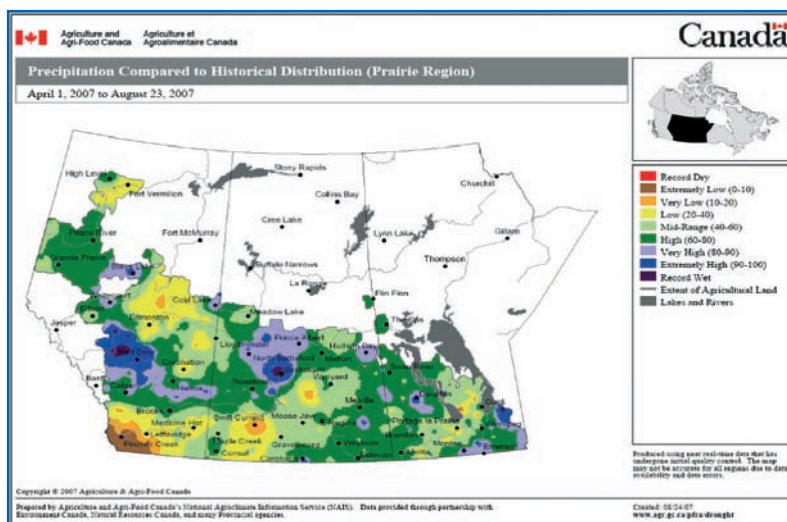
The information helps to address many agricultural sustainability issues, such as drought identification and monitoring, and to support risk management. It contributes to the delivery of AAFC policies and programs on business risk management and environmental sustainability of the agricultural sector.

### Participants

AAFC leads this initiative and is the Canadian author for the North American Drought Monitor. It works closely with Environment Canada, Natural Resources Canada (Canadian Forestry Service), the U.S. National Oceanic and Atmospheric Administration (NOAA), U.S. Department of Agriculture, and several provincial agencies and private companies.

### Current Status and Next Steps

AAFC's *Drought Watch* Web site provides national and regional coverage of the agriculture areas for temperature and precipitation as well as several related products. Discussions with Environment Canada are ongoing toward utilizing its Data Management Framework for data access and quality control. Key outstanding issues include acquiring resources to improve spatial and temporal resolution of the monitoring data, getting products to the user faster, assimilating new networks, identifying data standards for agricultural needs, addressing missing data and developing new tools for risk management and decision support.



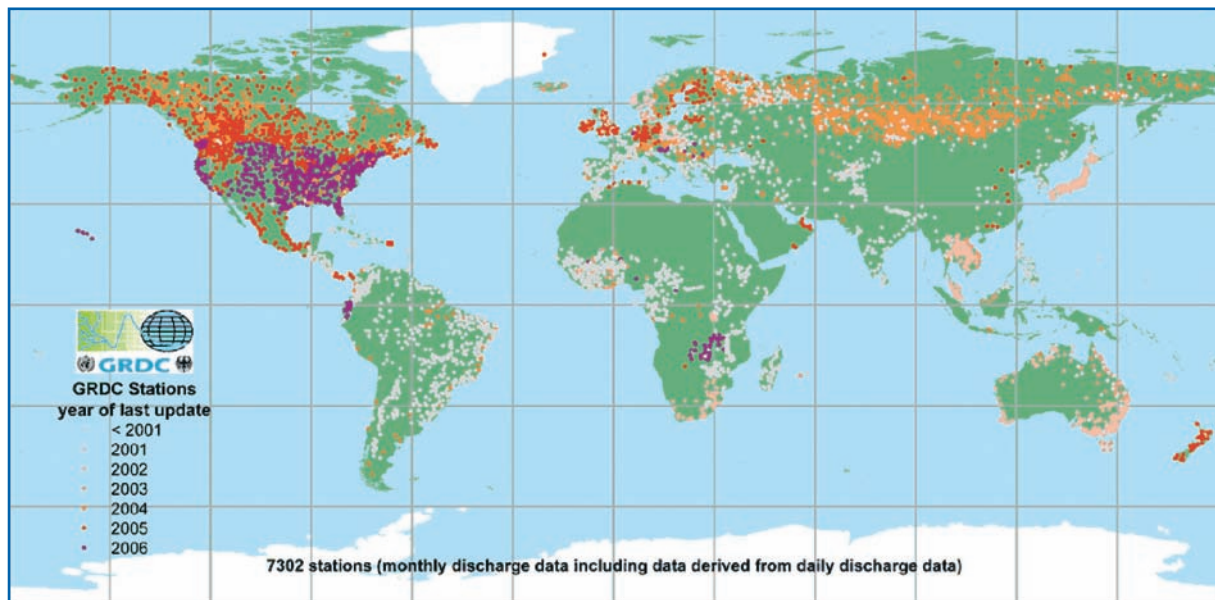
Growing season precipitation compared to historical distribution

## Global Runoff Data Centre (GRDC)

Since 1988 the GRDC operates under the auspices of the WMO and its activities are guided by an international steering committee. The GRDC is funded by the Federal Government of Germany and is located within the Federal Institute of Hydrology (BfG).

### Description

The main objectives of the GRDC are the collection, storage and dissemination of discharge data and associated metadata from rivers around the world. The river discharge data are provided by participating WMO Member State's National Hydrological and Meteorological Services. Currently the database holds more than 270 000 station years of river discharge data for approximately 7300 stations. On average the record length is 37 years. The data are disseminated free of charge to support water and climate related programmes and projects of the United Nations, their specialised agencies and the scientific research community.



### Added Value

GRDC discharge data collection and dissemination is mandated by WMO Resolution 40 (Cg-XII, 1995) and Resolution 25 (Cg-XIII, 1999) emphasising the fundamental principal of «broadening and enhancing the free and unrestricted international exchange of meteorological and related data and products.» Additionally WMO resolution 21 (Cg-XII, 1995) encourages WMO Member Countries «to support the GRDC through the provision of the hydrological data and related information that it needs».

The exchange of data can be widened substantially and maintained on a sustainable level with the agreement and adherence of GEO Members to the GEOSS Ten Year Implementation Plan.

The provision of historical as well as timely discharge data by GEO Member States to the GRDC will enable the clients of the GRDC in the research and modelling community to substantially improve their findings which in turn has a direct impact on the GEO identified societal benefit areas related to the water cycle.

### Relevance to GEO

Water serves as the basis for life on earth and impacts on all GEOSS societal benefit areas. With this in mind, river discharge is not only a key component of the hydrological cycle, but also of paramount importance to sustain life. Changes in river runoff patterns are used to understand and document global changes, but those changes also have a marked impact on all social and economic activities. Therefore timely and reliable information on river discharge on a global scale is critical to the purpose and scope of GEOSS.



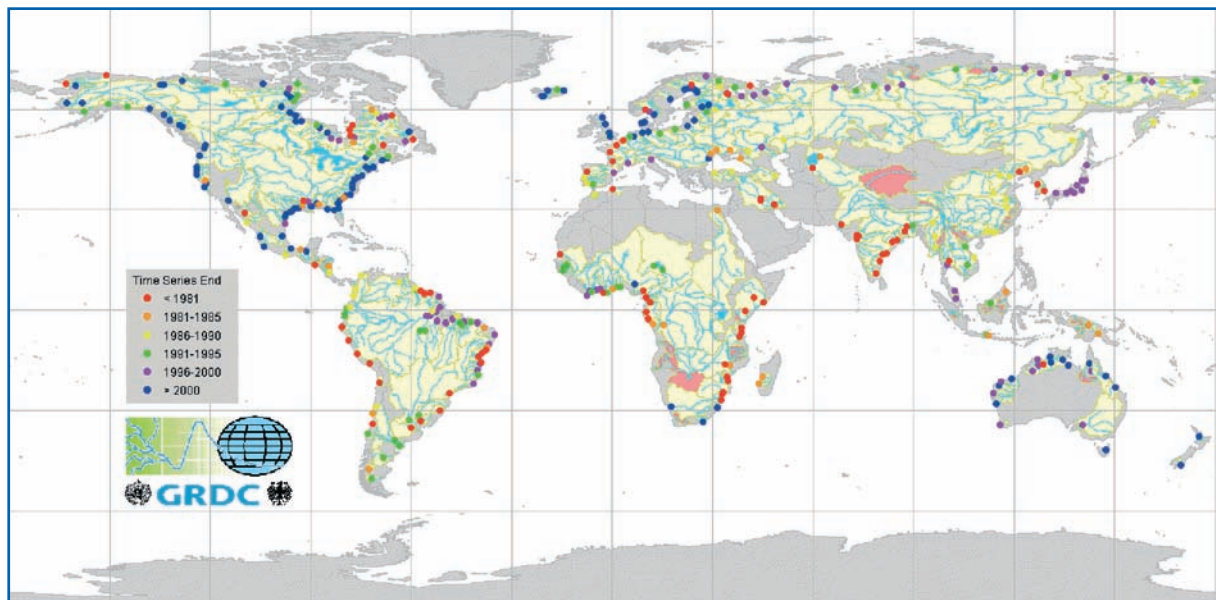
The GRDC represents a direct contribution towards the objectives of task WA-06-05 (“In Situ Water Cycle Monitoring”).

### Participants

All GEO Members are involved through their National Hydrological and Meteorological Services. They are the points of contact for the provision of the river discharge data and associated metadata. The GRDC maintains links to a number of Participating Organisations, namely WMO, WCRP, GCOS, UNEP, UNESCO, ICSU, GTOS and UNFCCC. River discharge data collected and stored at the GRDC serve most of the Participating Organisations as an input into their areas of activity. The Participating Organisations mentioned also directly influence the activities of the GRDC.

### Current Status and next Steps

Currently the GRDC holds only historical river discharge data in its database. A specialised network is planned to capture Near Real Time discharge data. The Global Terrestrial Network for River Discharge (GTN-R) is a GRDC contribution towards GCOS and GEOSS.



The Global Terrestrial Network for River Discharge (GTN-R). It is envisaged to receive timely river discharge data for the identified 380 river discharge stations along the continental coastlines to determine the freshwater flux into the world oceans.

### Contact

Global Runoff Data Centre (GRDC)  
in the Federal Institute of Hydrology (BfG)  
Am Mainzer Tor 1  
56068 Koblenz  
Germany

Phone +49 261 1306 5224  
Fax +49 261 1306 5280  
Email [grdc@bafg.de](mailto:grdc@bafg.de)  
Web <http://grdc.bafg.de>

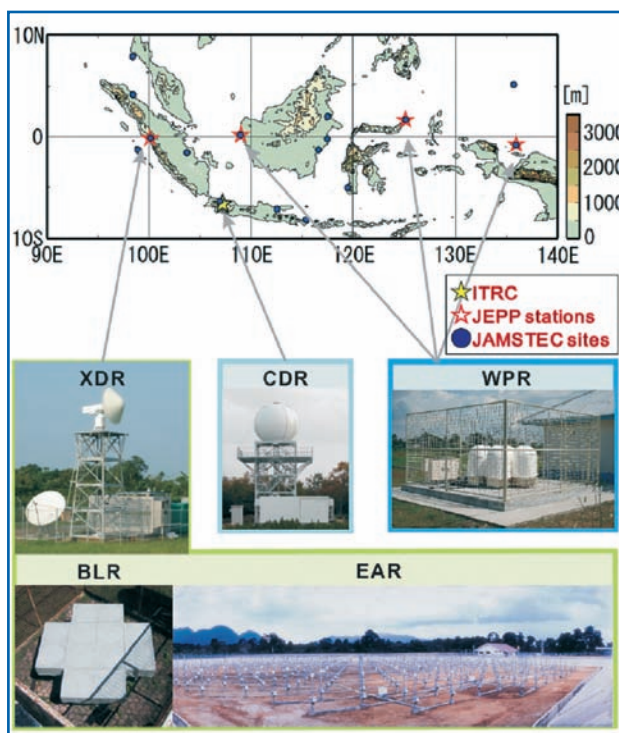
GRDC operates under the auspices of the World Meteorological Organization (WMO) with the support of the Federal Republic of Germany within the Federal Institute of Hydrology (BfG)



## Japan Earth Observation System Promotion Program (JEPP) “Hydrometeorological ARray for ISV-Monsoon AUtomonitoring (HARIMAU)”

### Description

- Radars and wind-profilers are installed in the Indonesian maritime continent (IMC).
- Data are opened on the internet in real time.
- IMC-excited global climate variations such as El Nino are watched.
- HARIMAU has large potential abilities to prevent hydrometeorological/climatological disasters such as flood not only in IMC but also all over the world.



*Distribution of radars and profilers planned by the HARIMAU in addition to preinstalled Japanese equipment they have been operated in collaboration with Indonesian institutions. EAR and BLR are VHF Equatorial Atmosphere Radar and Boundary Layer Radar (UHF), respectively, have been operated in Kototabang, west Sumatera. ITRC shows International Tropical Research Center planned to be established in Jakarta.*

### Added Value

- GEO's recommendations to promote HARIMAU must establish strong and eternal collaborations among hydrometeorological agencies of ASEAN countries and among international organizations promoting/ planning observational projects in/around IMC.

## Relevance to GEO

- It contributes to the following tasks in GEO 2007-2009 Work Plan:
  - CL-06-03: Key Terrestrial Observations for Climate
  - WA-06-05: In-situ Water Cycle Monitoring
  - WE-06-01: Surface-based Global Observing System for Weather
- The rainfall and wind data provided by HARIMAU contribute to three social benefit areas: climate, water and weather, mentioned in 4.1.4–4.4.6 of the GEO 10-Year Implementation Plan.
- These data are opened freely just as emphasized in 5.1–5.4 of this Plan.
- HARIMAU will improve directly capacity building in remote sounding techniques, disaster informatics and natural science research, as in 5.5–5.7 of the Plan, over ASEAN countries which continue observations after HARIMAU.

## Participants

### Collaborating countries:

- Japan
- Indonesia
- Thailand
- Vietnam
- Myanmar

### Related countries:

- Singapore
- Malaysia
- Philippine
- China
- Australia
- India
- USA
- Germany

### Related international bodies and projects:

- WMO
- ICSU
- WCRP (GEWEX/MAHASRI),
- IGBP

## Current Status and Next Steps

- Three major radar/profiler stations have been installed in FY2006 and have started data release.
- Installation of two more radar/profiler stations will be completed until the middle of 2008.
- Because a JEPP project has a five year period until FY2009, a strong request from GEO is needed for HARIMAU to cover the whole ten year period of GEOSS.
- Throughout this next five-year period (FY2010-14) all the observational network and techniques will be shared with ASEAN countries and they will be able to continue HARIMAU by themselves after the GEOSS period.

# The North American Drought Monitor, A GEO Achievement and the Beginning of a Global Drought Early Warning System

## Description

The U.S., Canada, and Mexico established the North American Drought Monitor (NADM) program in 2002 to provide information on drought conditions across the North American continent on an ongoing basis, and in so doing, have helped achieve the GEO vision of a future wherein decisions and actions for the benefit of humankind are informed via coordinated, comprehensive and sustained Earth observations and information.

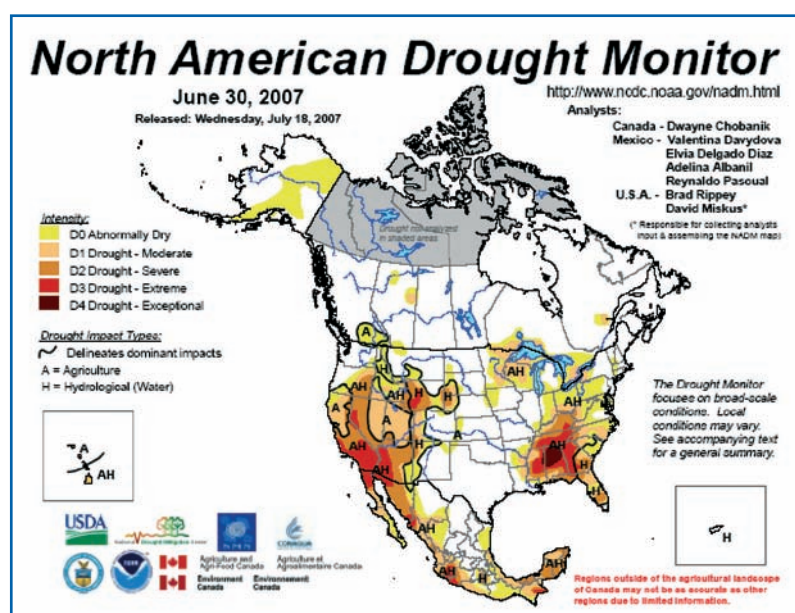
The centerpiece of the NADM is a group of drought experts and database specialists from across the continent working together in an ongoing operational capacity to carefully compile and analyze disparate climate observations at multiple scales. With its indistinct temporal and spatial boundaries, a convergence of evidence is needed to define the boundaries of drought and produce a depiction of drought severity that can be used for decision-making by a diverse group of decision-makers. This evidence is based on great quantities of environmental observations collected across the continent from a myriad of land and space-based observing systems.

Many of these systems are unique to each country, but the data collected from each are openly shared among the three countries and are essential to filling critical gaps in knowledge. When brought together and analyzed by experts familiar with the unique physical aspects of drought within their country, a cohesive picture of drought is produced within and across the borders of each country. This product serves the needs of user communities within sectors as diverse as agriculture and forestry, water resource management, energy markets, and health.

## Added Value

GEOSS principles and functional components formed the basis for development of the NADM program. Close coordination among government leaders and scientists in each country provided the means for identifying critical gaps in existing programs and in establishing methods for addressing deficiencies. Processes were established to facilitate the open exchange of data and information across borders, and the transfer of scientific expertise and data management principles between countries was a key element of building the capacity to monitor drought conditions on an ongoing basis across the continent.

While this effort was successful in improving the delivery of drought information to end users, it also established a precedent for how nations, when working together within a GEOSS framework, can turn disparate observing systems and limited individual resources into an integrated program to enhance decision-making.



## Relevance to GEO

The NADM program directly serves the transverse area of User Engagement under Task US-07-03, Environmental Risk Management. Specifically, this program has established an improved environmental information system for decision-makers and has demonstrated how Earth observations can be used to benefit key societal areas that include disasters, water resources, climate, health, ecosystem management, and agriculture.

## Participants

Participants include :

- the National Meteorological Service of Mexico
- NOAA's National Climatic Data Center
- NOAA's Climate Prediction Center
- United States Department of Agriculture's (USDA) Joint Agricultural Weather Facility
- US National Drought Mitigation Center
- Agriculture and Agrifood Canada
- Meteorological Service of Canada

## Current Status and Next Steps

The North American Drought Monitor is produced operationally on a monthly basis by the participating organizations and made available online at:

<http://www.ncdc.noaa.gov/oa/climate/monitoring/drought/nadm/index.html>.

The U.S., Canada, and Mexico are working toward new enhancements that include increasing the frequency of the NADM analyses from monthly to weekly. Efforts are also underway to leverage the experiences of the NADM and identify ways in which similar collaborative efforts could aid in establishing a global drought early warning system to meet the wider needs of the world community in addressing the growing threat of drought and water scarcity.

A global drought early warning system will ultimately expand upon drought monitoring capabilities by including other critical aspects of an effective early warning system such as drought forecasting, drought impacts, research, and planning and education. This system of systems will be developed to support data and information sharing, communication, and capacity building activities that are essential to effectively take on the growing threat of drought.

A first step toward reaching this ultimate goal is an expansion of the NADM throughout the Western Hemisphere. This expansion would enable drought experts and leaders across the hemisphere to begin the process of interacting and sharing of data and technical expertise necessary for initiating the process of building an effective drought early warning system for the Western Hemisphere and the world.

## WISE – Water Information System for Europe

### Description

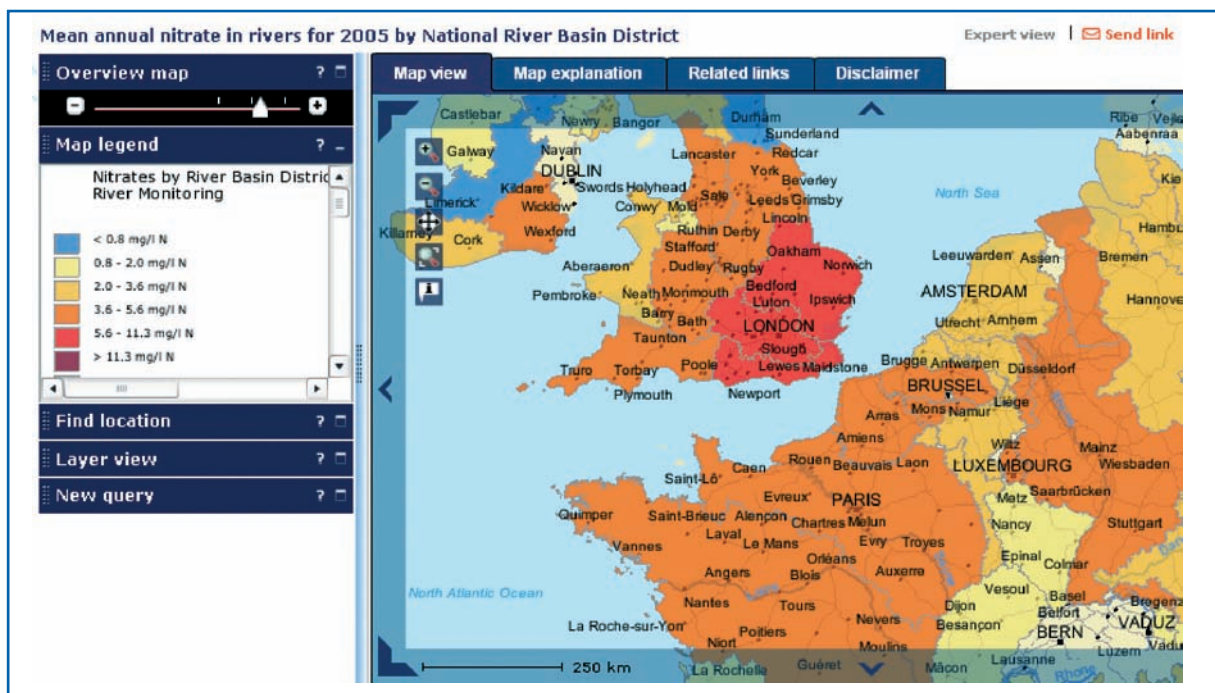
WISE 'Water Information System for Europe' <http://water.europa.eu/> is a shared information system providing water related information available on European level. It stands for modernising and streamlining the collection and dissemination of information related to European water policy. The formal reporting framework for WISE is the European Water Framework Directive.

In its current version WISE delivers web-based information on

- My neighbourhood
- European waterbodies at risk and / or highly modified
- Waterquality (nitrates, phosphates, ammonium, BOD) in rivers and lakes
- Urban waste water treatment
- European bathing water status

As a shared information system of water-related data WISE is combining multiple spatial reference data from different sectors (landcover/landuse, digital elevation model, river networks, catchments, administrative boundaries and statistics).

Implementation of the system is based on ISO and OGC standards. IT tools are freely available. WISE is also the water related component of the European Directive on 'Infrastructure for Spatial Information in Europe (INSPIRE)'



WISE example average nitrate concentration and stations per water catchment in North-western Europe



### Added value

WISE demonstrates how multi-national information on the environment can be stream-lined, harmonized, quality assessed and made public available for mutual benefits using state of the art information technology. As such WISE is a good practice example for how information can be organized in GEOSS on global level and can be part of an operational global network on water quality (GEO task WA-07-01)

### Relevance to GEO

WISE is linked to a number of SBAs of the GEO Workplan, especially to 'Water Resource Management', 'Management and Protection of Ecosystems' and 'Sustainable Agriculture'. The IT-component of WISE is linked to the GEO tasks 'Enabling Deployment of a GEOSS Architecture (AR-07-01)' and 'GEOSS Architecture Implementation Plan (AR-07-02)'. The information hosted in WISE is the European contribution to 'Global Water Quality Monitoring (WA-07-01)'. As such WISE covers both operational managing of environmental data and IT solutions for making it available for public use.

The most important issues for GEO are:

- The concept of a shared information system as it might be used for Geoportal. This means data should be stored at different nodes and information should be shared between all participating nodes.
- Setting up of an interoperable system: For the sake of information sharing and exchange all participating nodes have to be interoperable, data should be exchangeable and services should be able to access and process data from different nodes.
- Following the subsidiarity principle: Data should be maintained at the most appropriate level and shared between all other levels.
- Transparency (open): It should be possible to discover easily data and services. User should be able to determine data's fitness for use and the conditions of usage should be clearly described

### Participants

WISE is a joint activity from European Environment Agency (EEA), its 32 Member States organized in the European Environment Information and Observation Network (EIONET) 24 of them are also GEOSS members, the Joint Research Centre (JRC), Eurostat and the European Commission (DG-Environment). EEA and European Commission are a participating organization of GEO.

### Current Status and Next Steps

WISE is an operational web based service where users can view and download maps and related information on water quality being collected by European and international bodies. The sharing of water-related data will enhance efficiency of data use and improve quality of assessments. WISE is thereby the water-related component of a wider Shared Environmental Information System (SEIS) currently under development following the concept of interoperable distributed data bases (Web 2.0).

Next steps include:

- Future data integration along the WISE implementation plan in the water domain (e.g. including water quantity and management)
- Providing the water related information for assessments based on the more integrated ecosystem approach
- Fully developing the water data centre to act as a model implementation for the shared information system SEIS

## Ensembles of Global Weather Forecasts

### Description

The THORPEX Interactive Grand Global Ensemble (TIGGE) is a key element of the THORPEX programme which aims to accelerate improvements in the accuracy of 1 day to 2 week weather forecasts. THORPEX is an important part of the World Weather Research Programme of the WMO. The objectives of TIGGE are,

- To bring together in 3 data archives (at the Chinese Meteorological Agency, the US National Centre for Atmospheric Research (NCAR) and the European Centre for Medium Range Weather Forecasting) the entire suite of 384 daily global weather forecasts from 10 Numerical Weather prediction centers (out to 14 days ahead) and provide easy access via the internet for research and development and demonstration projects.
- Explore new methods of combining ensemble weather forecasts from different centers and develop a better understanding of forecast errors.
- Test new concepts for producing ensemble based predictions of high impact weather wherever it occurs and evaluate development of a prototype Global Interactive Forecasting System (GIFS)

### Added Value

GEO aids this effort by encouraging global forecast centers to contribute weather forecasts and by supporting meetings/conferences

### Relevance to GEO

This activity is GEO Task WE-06-03. It has general relevance to GEO societal benefit areas that will benefit from access to advanced multi-model global weather forecasts and the derived products, especially in areas related to risk management, disaster mitigation, energy, health etc.,

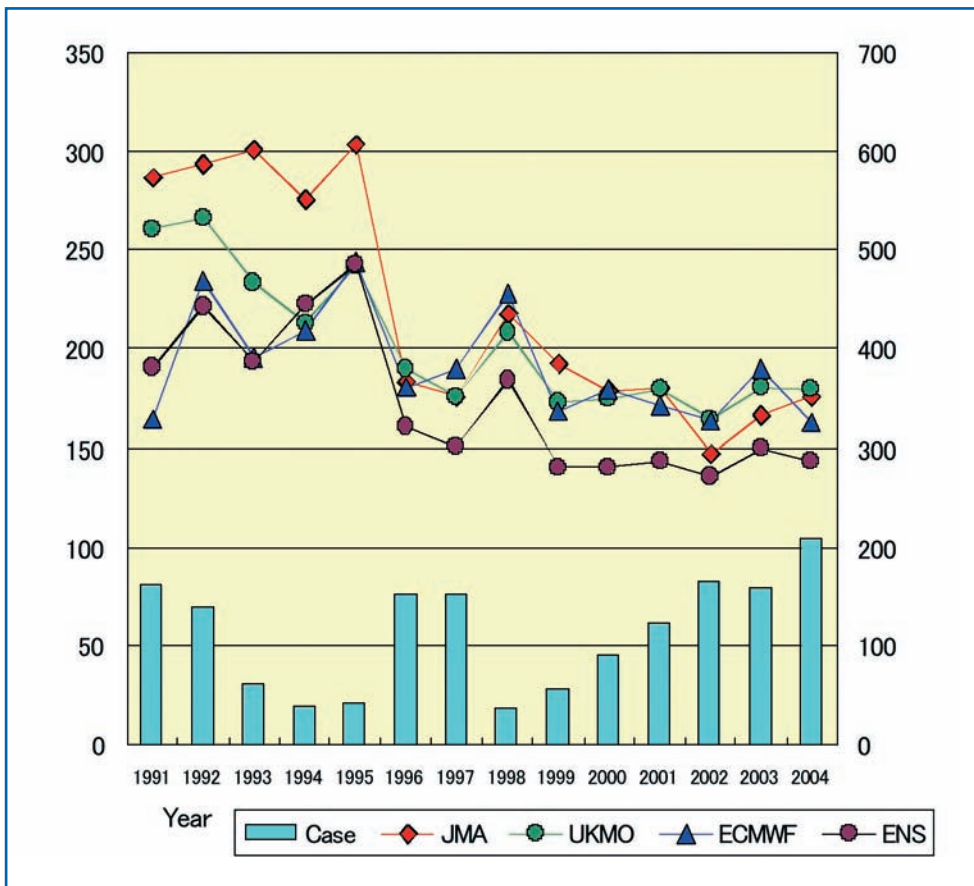
### Participants

The current participants are Australia, Brazil, Canada, China, France, Japan, Korea, USA, UK and ECMWF

### Current Status and Next Steps

The project is currently in the first Phase. Global ensemble weather forecasts from 5 providers are now being received by the 3 archive centers. It is expected that data from all 10 providers will be available by the end of 2007. Around 30 registered users are at present downloading data from the NCAR site and the ECMWF site recently opened. The opening of the CMA site is expected by end 2007. It is expected that the archives will be declared open for general user access in the next few months. A user workshop will be organized in 2008.

Priority is now being given to development of tools to access and manipulate data (e.g interpolation to limited area lat-long grids and further development of the data portals). TIGGE will also help speed the introduction of the WMO Weather Information System (WIS) by early use of the GRIB 2 code. During the second Phase (which still requires funding) the data archives will be distributed over a number of repositories and speed of access will be improved. The data will be freely available over the internet for research and education use about 48 hours after it was initially produced by the originating centre. Real time access can be requested for field experiments and development projects.



Early results of the assessment of the benefits of multi-model ensemble forecasts for 72-hr predictions of the tracks of tropical cyclones over North-Western Pacific. An ensemble composed of ECMWF, JMA and UKMO prediction has a better skill than any of the components (Courtesy Y. Takeuchi, JMA)

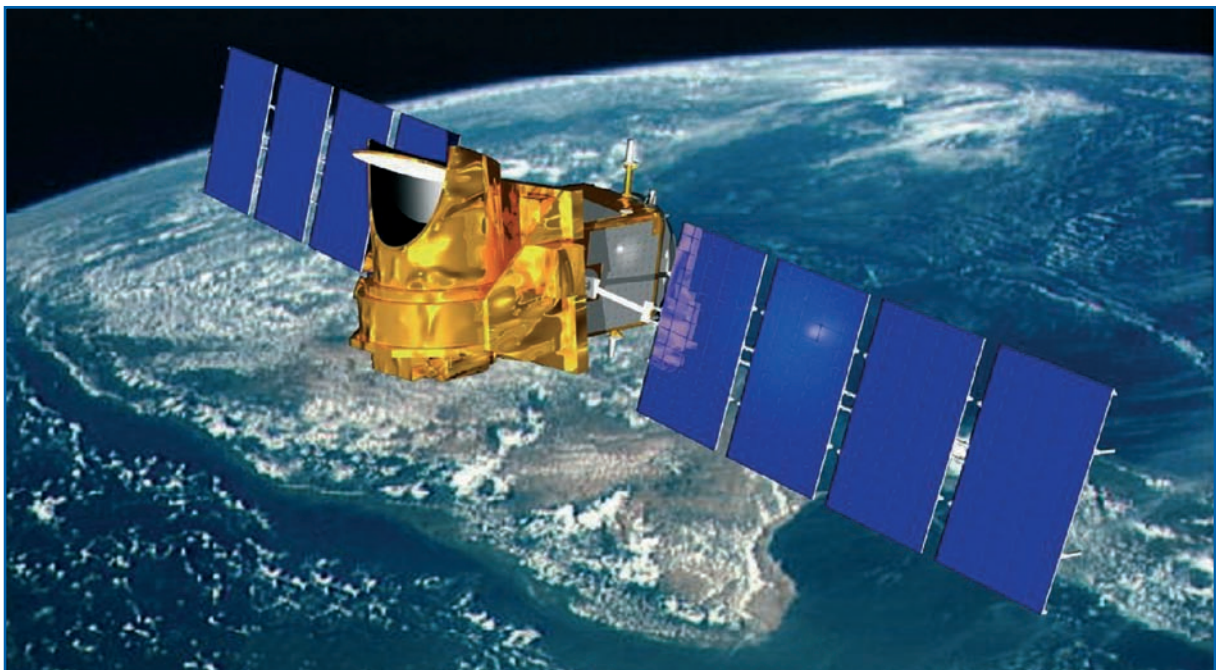
## Megha-Tropiques, GPM and the Precipitation virtual constellation

### Description

Megha-Tropiques is a joint ISRO-CNES spatial mission dedicated to the intertropical zone and focused on the atmospheric energy budget and water cycle. Megha-Tropiques is scheduled to be launched in 2009. In particular, with its Madras microwave imaging radiometer, Megha-Tropiques will be able to monitor precipitation with an enhanced sampling in the Tropics, what will be very useful in the context of GPM and Precipitation virtual constellation.

At the scientific level, Megha-Tropiques French scientists are involved in several international precipitation groups: NASA Precipitation Measurement Missions (PMM) science team meeting, International GPM workshops, International Precipitation Working Group... In all these groups, there is a strong expectation for Megha-Tropiques.

At the programmatic level, contacts have been established between GPM (NASA and JAXA) and Megha-Tropiques (ISRO and CNES) to discuss the introduction of Megha-Tropiques as a component of GPM.



### Added value

Introduction of Megha-Tropiques as a component of GPM would be very profitable to the latter in terms of precipitation sampling in the most rainy regions of the world, the Tropics. The time frame of the missions is still compatible. Reversely, Megha-Tropiques would benefit from the rainfall retrievals of the other satellites of the GPM constellation, especially the mother satellite for intercalibrations. But even alone, Megha-Tropiques would contribute to global precipitation monitoring, with a lot of applications such as climate change assessment, improvement in monsoon forecasts, flood prediction, water resource management.

## Relevance to GEO

Megha-Tropiques is relevant for at least 3 Societal Benefit Areas :

- Climate: Understanding, assessing, predicting, mitigating, and adapting to climate variability and change;
- Water: Improving water-resource management through better understanding of the water cycle;
- Weather: Improving weather information, forecasting and warning.

It will contribute to the following GEOSS implementation target: “Facilitate, with space agencies and research communities, more accurate, frequent (3-hourly), global, high spatial resolution, and micro-physically detailed measurements of precipitation through a global constellation of satellites carrying passive micro-wave radiometers in complementary orbits”.

## Participants

- CNES
- ISRO

## Current status and next steps

The satellite Megha-Tropiques is currently in phase C. Megha-Tropiques scientists are currently developing the algorithms for level 2 data and more.

A trilateral NASA-CNES-ISRO should be organized in 2007 to discuss thoroughly the implications of Megha-Tropiques and GPM partnership. CNES will participate to the 1<sup>st</sup> CEOS Precipitation Constellation Workshop (June 2007).

Scientific work and exchanges will continue in the area of precipitation measurement from space.

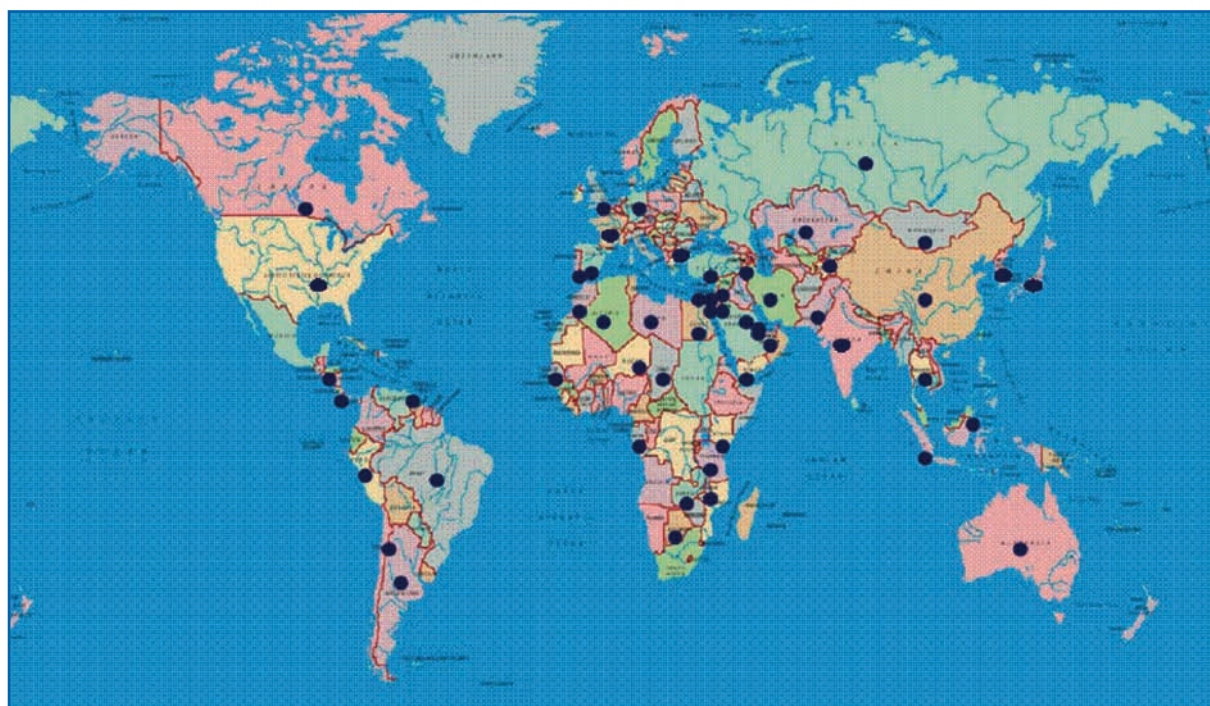


## WMO Sand and Dust Storm Warning System (SDSWS) in support of diseases prevention and improvements in human health

### Description

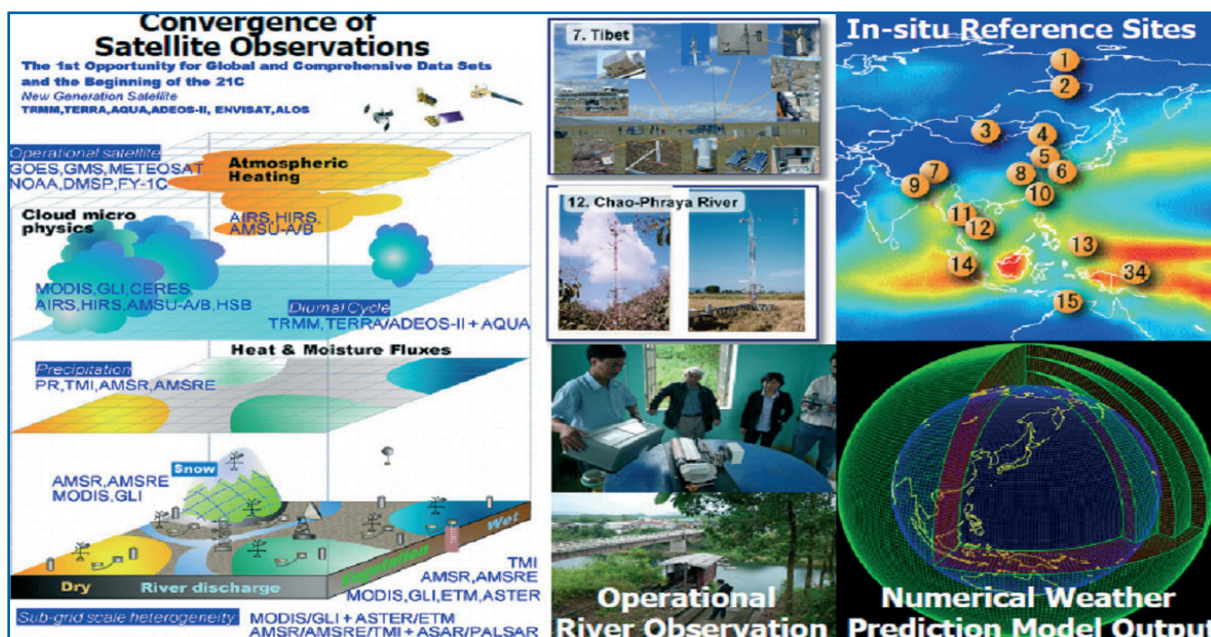
Objective: To establish a forecasting system in order to improve capabilities for more reliable sand and dust storm predictions at a global scale.

*Methods, data, and impacts:* During sand and desert storms, substantial amounts of aerosols are mobilized and transported over long distances, causing risks for human health and affecting societal activities especially in countries in the neighbourhoods of deserts. Dusty weather is likely to be linked to epidemics of lethal meningitis in the semi-arid sub-Saharan Sahel belt. This disease, with outbreaks that usually occur every year between February and May affects 25,000 to 200,000 people per year, particularly children. Sand and dust numerical models for forecasting mineral aerosol transport and deposition may contribute to risk reduction in health and disease transmission.



WMO Member countries participating in the Sand and Dust Storm Warning System

In 2006, WMO established the “Sand and Dust Storm Warning System” project to improve capabilities for more reliable sand and dust storm forecasts. More than 40 WMO country members expressed interest to participate the project. The Warning System project will exploit the fact that 15 organizations worldwide already provide daily forecasts of dust parameters. Within the WMO SDSWS, these activities will be coordinated. In order to study a possible correlation between meningitis occurrence in the Sahel region and dusty weather, the Regional Centre for SDSWS (Spain), has already established daily dust predictions and long-term dust model simulations over Sahel. Through cooperation with WHO, dust simulations/predictions will be correlated with available medical data on meningitis in order to study possible links between environmental conditions and the illness occurrence.



### Added Value

GEO assists studying the impacts of environmental conditions on the incidence and distribution of diseases by improving the flow of environmental data and health statistics, promoting a focus on diseases prevention and improvements in human health worldwide.

### Relevance to GEO

This activity is the GEO Task "Forecasting Health Hazards in Africa (HE-06-03)", which is also a part of the WMO WWRP-THORPEX program for Africa.

### Participants

The current participants:

- WMO (WWRP-THORPEX)
- WMO Regional Centre for Sand and Storm Warning System (Spain) for the Europe/Africa/Middle-East Region
- WHO
- Countries of the Sahel belt

### Current Status and Next Steps

The WMO Dust Sand and Dust Storm system is under development. It is expected that in the beginning of 2008, a web portal for placing dust forecast products over the Europe/Africa/Middle-East will be established; a specialized page will be dedicated to support the above proposed HE-06-03 activities.

# Weather Demonstration Project for the Beijing 2008 Olympic Games

## Description

Establishing strong and effective connection and collaboration between research, operational use, and end users is of particular importance for the success of GEOSS. By bringing together major advanced numerical weather prediction systems, observations and end users, the project including two components, a Forecasting Demonstration Project (B08FDP) and a Research Development Project (B08RDP). In addition, a Real Time Forecast Verification (RTFV) System, developed by the WWRP/WGNE Working Group on Forecast Verification will be tested in the demonstration. Together with the demonstration, capacity building as well as outreach activities will be organized. Major deliverables are as bellow:

- Development of fully operational use nowcasting systems and pre-operational use mesoscale data assimilation and ensemble prediction systems.
- Training workshops for capacity building.
- GEO outreach activities organized during Beijing 2008 Olympic Game.

## Added Value

- Contribution to GEOSS implementation already an indication that GEO is working as a process, this project will demonstrate how the advanced nowcasting and mesoscale ensemble prediction systems can provide an improved weather service to benefit society, show the value of technology transfer and facilitate GEO capacity building as well as communication outreach.
- Credit to be given to countries and organizations that initiated & conducted the Projects.
- Major future opportunities for GEO Members to benefit from Beijing Olympics Projects experience and lessons learned re. nowcasting & EPS capability transfer.

## Relevance to GEO

This activity is GEO Task WE-07-02. It has general relevance to GEO SBAs in areas that will benefit from nowcasting to advanced mesoscale data assimilation and ensemble prediction systems and the derived products, especially in areas related to risk management, disaster mitigation etc.

## Participants

B08FDP: Seven participating systems

- Australia: STEPS and TIFS from Australian Bureau of Meteorology
- Canada: CARDS from Environment Canada, MAPLE/ARMOR from McGill University (co-partner with WDT company, US)
- China: Beijing-ANC from BMB, GRAPES from CAMS, and SWIRLS from HK
- US: NIWOT from NCAR, MAPLE/ARMOR from WDT company (co-partner with McGill University, Canada)

B08RDP Seven participating systems

- Canada: EC's regional EP system
- China and US: BMB, NCAR and NMC's joint 3-hour rapid update cycle data assimilation and short-term forecasting system.
- US: NCEP's new version SREF (based on the WRF model with both NMM and ARW dynamic cores)
- Japan: JMA's NHM meso-scale EP system
- China: NMC's WRF based meso-scale EP system and CAMS' GRAPES based Meso-scale EP system
- Austria and France: ZAMG and Météo-France's joint regional EP system (Austrian weather service ZAMG and Météo-France will be acting as one single partner in the project)
- ECMWF(new):





*B08 FDP/RDP participants during second workshop*

### Current Status and Next Steps

- Initial B08FDP/RDP system trials in August 2006. The 2nd trials in July-August 2007. The second and third B08FDP/RDP workshop was held in Beijing and Qingdao in China after trials. (Fig 1)
- Societal and Economics Impact Assessment: Street survey was conducted in July 2005 for residents and two workshops were held for media and business sectors to broadly identify end users of B08FDP. (Fig.2 A women for street survey, right photo). In Summer of 2007, the survey for B0COG "Good Luck Beijing" Sport events), forecasters, business sectors, general public were undertaken
- The first training workshop of B08FDP was held in April 2007. Forecasters of BMB/CMA were taught to operate the systems, to learn the major functions and product generation in the systems. (Fig.3, right photo). The first training workshop of B08RDP was held in September 10-14 for forecasters on how to use ensemble prediction products
- Major future opportunities, such as 2010 Canada Winter Olympic Games FDP projects and 2010 Shanghai World Fair Weather Project, for GEO Members to benefit from Beijing Olympics Projects experience and lessons learned re. nowcasting & EPS capability transfer.
- Methods of societal benefit access are to be further developed with inputs of end user requirements.



*A women for street survey*

## International Energy Agency (IEA), Solar Heating and Cooling Program (SHC), Task 36 on Solar Resource Knowledge Management, User survey is completed

### Description

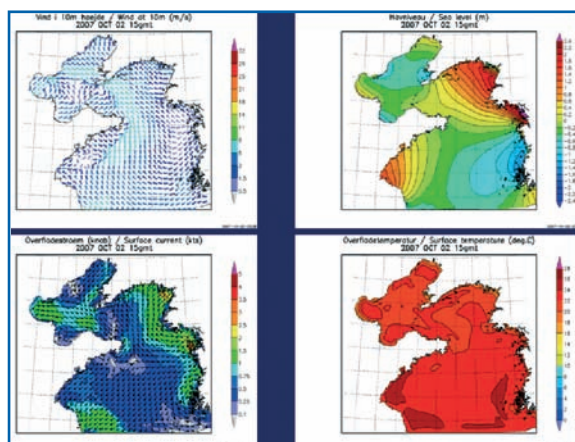
YEOS, an EU FP6 Specific Supported Action for GEOSS, aims to stimulate operational oceanography in Yellow Sea countries by integrating best practices in EU, China and Korea, and address regional challenges on climate change impacts, disaster prevention, coastal zone management etc by demonstrating operational oceanography in the region.

Through integrating best practices in observation, forecasting and information system, a state-of-the-art regional high resolution weather-ocean-ice-wave-sediment transport forecasting system for Yellow Sea can be developed and demonstrated, based on following components:

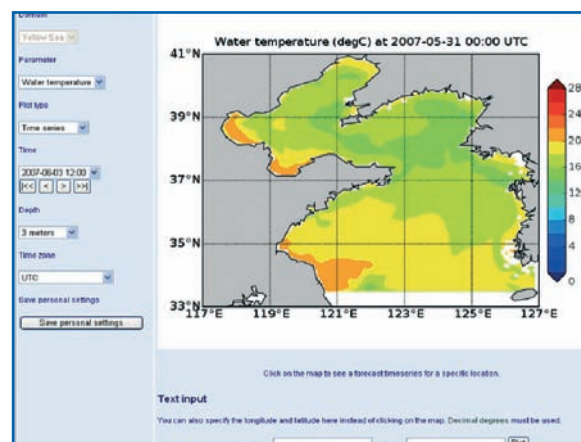
- Denmark: operational weather model (7.5km resolution), coupled ocean-ice model (5km resolution), daily satellite SST (5km resolution, OI&SAF), information systems
- Germany: sediment transport Model
- China: wave model (5km resolution), data assimilation, in-situ observation system
- Korea: in-situ observation system

YEOS will jointly build up a proto-type Yellow Sea observation, forecasting and information system, demonstrate the system in August 2008, when Olympic Sailing competitions will be in Qingdao waters, and disseminate YEOS products in different user levels especially to stake-holders and policy makers.

Thanks to co-funding from Danish Meteorological Institute (DMI), significant achievements have been made. *An operational ocean-weather-ice forecasting system* has been put into place for Yellow Sea (including East China Sea for weather prediction). The system is running in DMI to provide 36 hour high resolution forecast twice a day. *A daily operational SST* product in 5km resolution has been made by DMI. Two information systems have been established (Fig. 1): one for general YEOS information and products (<http://ocean.dmi.dk/yeos>), and the other for user applications with discovery, viewing and downloading functions (<http://ocean.dmi.dk/apps/yellowsea>). *A pre-operational wave model* for Yellow Sea & East China Sea has been set up by China with weather forcing from DMI; The DMI ocean-ice model has been installed in China. German sediment transport model has been coupled with DMI ocean model, and Chinese data assimilation experts are working together with DMI to implement their scheme in DMI ocean model.



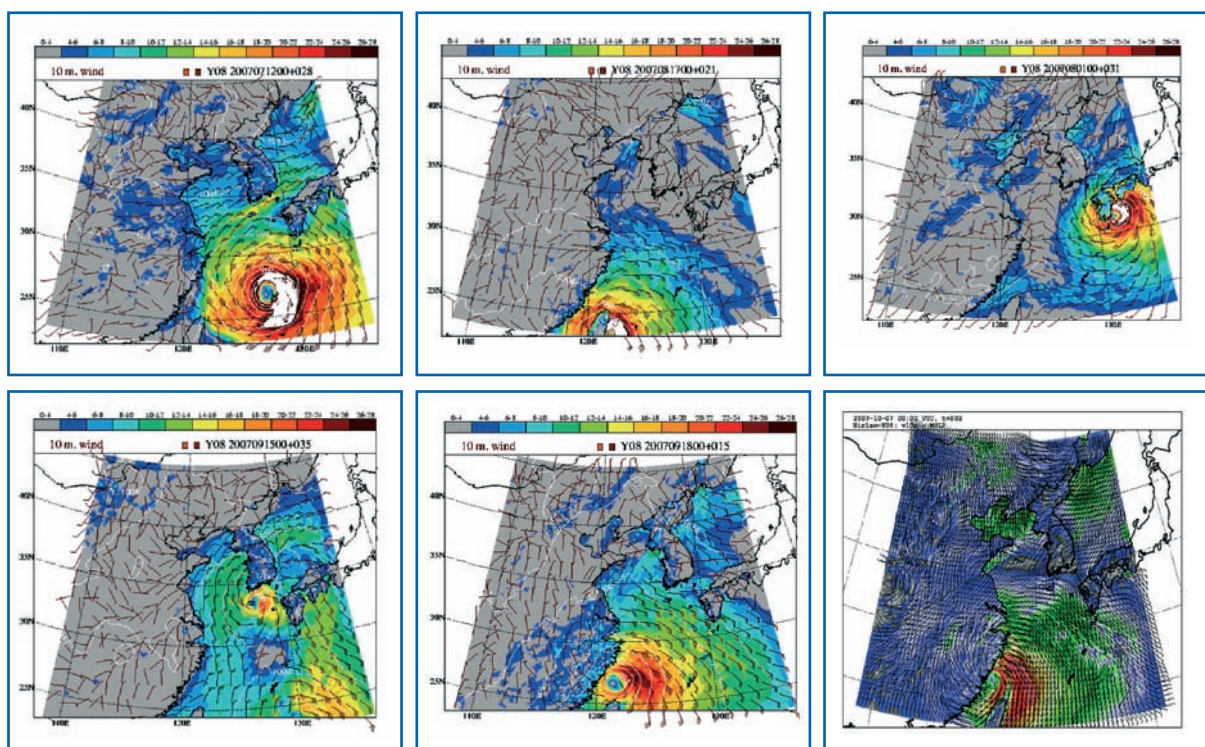
YEOS information system shows hourly forecasts of winds, sea level, currents and water temperature.



User-defined, dynamic discovery, viewing and downloading functions on 3D ocean parameters.



Some examples of predicted typhoons in summer 2007 by DMI are given in Fig. 2.



Wind fields of 2007 typhoons predicted by YEOS system. All typhoon tracks were correctly predicted. Upper panel (left to right): Man-Yi, Sepat, Usaqi; Lower panel (left to right): Nari, Wipha and Krosa.

### Added Value

The project itself is funded as an EU contribution to GEO. GEO will further disseminate YEOS products from Europe to Asia users via GEONETCast (EU FP7 proposal DevCoCast). YEOS is a successful example demonstrating in-depth regional cooperation under GEO, also a combination of data, model and information systems. There are still obstacles in exchanging in-situ observations, which may be an area that GEO can add its impact. A long-term platform under GEO to support such regional cooperation is highly appreciated.

### Relevance to GEO

Relevance to disasters, weather and climate SBA's. Transverse Area as a Regional information System.

### Participants

YEOS is coordinated by DMI (contact: Jun She, [js@dm.dk](mailto:js@dm.dk)), with partners from Germany (GKSS), China (First Institute of Oceanography, China-Korea Joint Ocean Research Centre, Institute of Atmospheric Physics, North China Sea Marine Forecasting Centre, Ocean University of China) and Korea (Korean Ocean R&D Institute).

### Current Status and Next Steps

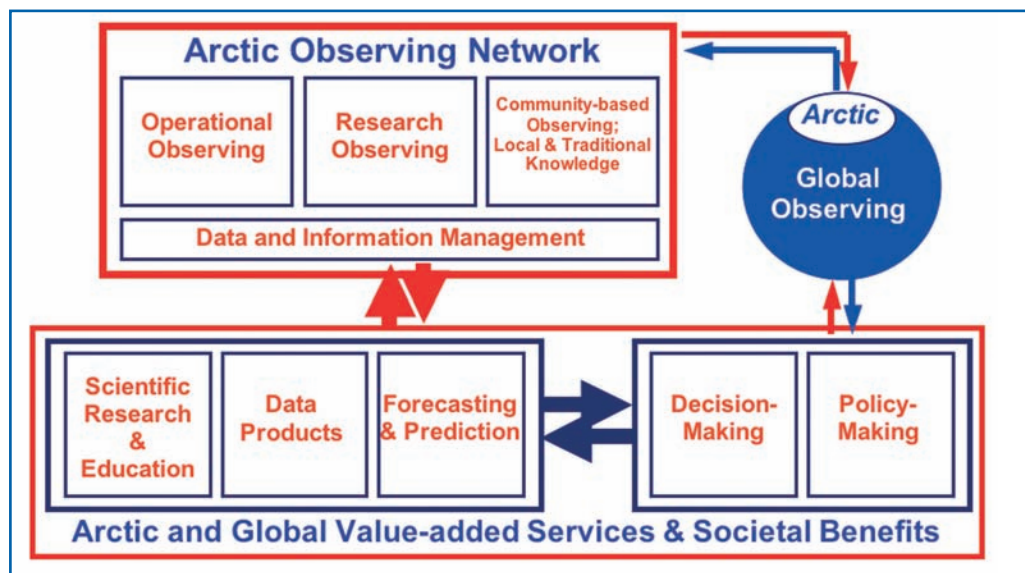
The project duration is 30 months, with a start from 1 April 2007. It is expected that YEOS will demonstrate a state-of-the-art Yellow Sea operational oceanography system. However, it is still a challenging task for how to use YEOS achievements in China/Korea national operational activities since this needs high level decision-making. On the other hand, Southeast Asian countries also urgently requires such a service for storm-surge forecast, coastal engineering and disaster prevention etc, and YEOS system is ready to be extended to cover entire NW Pacific coastal/shelf seas. Finally scientific challenge is huge in order to address regional issues (e.g., typhoon prediction, ICZM etc). A proper platform and funding mechanism should be provided under GEO in order to ensure its sustainability.

## The GEOSS Standards and Interoperability Registry

### Description

The Arctic Observing Network (AON) is an activity being conducted by a partnership among agencies of the U.S. government, their academic collaborators and Arctic residents. The AON was launched in 2007 as a part of the International Polar Year (IPY) and will extend for several years beyond the end of the IPY in March 2009. The AON partners intend that some AON components will be continued for a significant period of time as a “legacy” of the IPY; an Implementation Plan for the legacy effort is being prepared under the auspices of the US Inter-agency Research Policy Committee.

Conceptual diagram of AON and the flows and exchanges of information that represent its contribution to value-added services and societal benefits of regional and global importance, and comprehensive observation of the Earth system.



*Conceptual diagram of AON and the flows and exchanges of information that represent its contribution to value-added services and societal benefits of regional and global importance, and comprehensive observation of the Earth system.*

The AON partners recognize that an international approach is required to achieve the long-term goals of AON, and efforts are underway among several international Arctic science organizations to create a mechanism for an international effort. The international effort is called Sustained Arctic Observing Networks (SAON) and is also being conducted as a project of the IPY. The objective of SAON is to develop a set of recommendations to governments and international Arctic organizations leading to implementation of a coordinated multi-national Arctic Observing Network that will continue in the post-IPY period to support societal goals. SAON will accomplish its objective by conducting a series of three international workshops, starting in November 2007 in Stockholm. A second workshop will be held in Canada in spring 2008 and the final workshop in Finland in fall 2008. These workshops will focus sequentially on three questions:

1. Are current Arctic observing and data and information management activities sufficient to meet users' needs?
2. How will Arctic observing and data and information management activities be coordinated and sustained over the long term? and
3. What actions should be recommended to Arctic governments and international organizations to ensure realization of sustained and coordinated Arctic observations and data and information management?

## Added Value

All of the Arctic countries are members of GEO and all are already engaged in some level of environmental observations in the Arctic. GEO will provide an already-agreed upon framework for organizing an international approach to environmental observations in the Arctic region. The scope of GEO is broad and allows a multi-media, multi-disciplinary approach to environmental observing, which is essential for the Arctic where there are immediate links and feedbacks between atmosphere and surface, land and ocean, physics and biology, and environment and human society. GEO will have the option of embracing a nascent regional observing capability that should be a highlight among GEO's long-term accomplishments.

## Relevance to GEO

The AON will contribute to many existing GEO tasks as defined in the GEO 2007-2009 Work Plan.

The most relevant tasks include:

- CL-06-03 Key Terrestrial Observations for Climate
- CL-06-05 GEOSS IPY Contribution
- CL-06-06 Global Ocean Observing System
- WA-06-05 In-situ Water Cycle Monitoring
- EC-06-01 Integrated Global Carbon Observation
- EC-06-07 Regional Networks for Ecosystems
- EC-07-01 Global Ecosystem Observation and Monitoring Network
- BI-07-01 Biodiversity Observation Network
- US-06-01 Identify Priorities and Synergies Between SBAs
- DA-06-04 Data, Metadata, and Products Harmonisation

## Participants

The international expression of AON will include the eight Arctic countries (Iceland, Denmark/Greenland/Faroes, Finland, Sweden, Norway, Russia, Canada, United States) and other countries having interests in Arctic observations (e.g., United Kingdom, Germany, France, Poland, Spain, China, Korea, Japan).

The Arctic Council and several international Arctic science organizations are involved in the initiation of the international AON.

## Current Status and Next Steps

Within the U.S., the National Science Foundation (NSF) has recently funded 21 new Arctic observing projects as part of AON and the IPY. Several other U.S. agencies (e.g., the National Oceanic and Atmospheric Administration (NOAA), the U.S. Geological Survey (USGS) and the National Aeronautics and Space Administration (NASA)) are continuing several Arctic observation projects that are candidates for inclusion in the AON. These and other agencies have agreed to prepare an AON Implementation Plan that will define the initial state of an observing network that meets U.S. and international needs in the Arctic region. This plan will be available in early 2008.

Simultaneously, through the international SAON process, scientists representing many agencies and international organizations are developing a set of recommendations that, if implemented, would result in the formation of a coordinated and sustained set of observations in the Arctic region focused on meeting needs of Arctic residents and decision- and policy-makers at all levels. These recommendations will be available as a product of the IPY in spring 2009.

Both efforts will identify existing observing efforts that are likely to be continued, will evaluate the most important gaps, and will suggest ways that continued observations can be conducted on an international basis in well coordinated and efficient manner.

## Census of Marine Life: Contributions to GEO Societal Benefit Areas

SBA: Climate (CL-06-05), Ecosystems (EC-06-02), Agriculture (AG-06-02 and AG-07-01), Biodiversity (BI-07-01, BI-06-02, and BI-06-03), User Engagement (US-07-02 and US-07-03), Data Management (DA-06-04), Capacity Building (CB-06-04), and Outreach

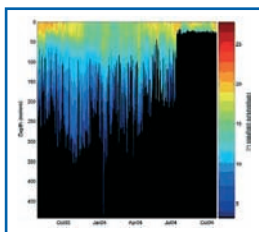
### Description

The Census of Marine Life contributes directly to several of the GEOSS Societal Benefit Areas. In particular, through its research and data management programs, the Census provides information, technologies and approaches that are critical for the understanding and management of marine ecosystems. The Census of Marine Life also maintains an extensive and effective outreach program which could contribute substantially to the GEO Outreach Plan. Further discussion will take place to find areas of productive collaboration. According to the United Nations Atlas of the Oceans, in 2001 over half the world's population (more people than inhabited the entire globe in 1950) lived within 200km of a coastline. Moreover, the rate of population growth and demand for food from the marine environment in coastal areas is accelerating. Management of marine fisheries is thus an increasing area of conflict between developed and developing nations through competition between industrial and artisanal fisheries. Over-fishing and climate change exacerbate the conflicts. Monitoring the physical and chemical environment of fisheries and associated ecosystems is as important as accurate data on stock assessment and migration.

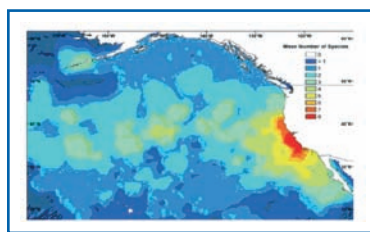
Three areas of specific importance are used below as examples of the Census' contribution to GEOSS Societal Benefit Areas:

#### 1. Fisheries Tracking:

The Census of Marine Life has sponsored a number of programs for tagging and tracking fish, mammals, turtles and birds in several oceans, including the Pacific, Atlantic, Southern Ocean, Gulf of Mexico and Mediterranean. The tracking system not only provides information on the migrations of key marine species, but returns vast amounts of oceanographic data as well (Figure 1).



*Depth and temperature data sampled by a bluefin tuna is one example of the low cost autonomous measurements that can be collected by tagged animals. Courtesy of Barbara Block, Tagging of Pacific Predators.*



*Mapping the tracks of tagged animals shows where oceanic predator density is highest and potential hotspots of diversity. Courtesy of the data management team of the Tagging of Pacific Predators program.*

#### 2. Ecosystem and Habitat Documentation:

The Census of Marine Life, through its sub-programs on ecosystems of coral reefs, oceanic ridges, and the open ocean, is defining potential protected areas in the North Atlantic related to fish habitats, deep sea corals and predator hotspots (Figure 2). The Census of Antarctic Marine Life is documenting how ecosystems under the Antarctic ice, near the Larsen Ice Shelf, are changing as the ice breaks up. The Census also supports a program on the History of Marine Animal Populations in order to understand past states of oceanic biodiversity.

#### 3. Marine Biodiversity Data Management and Exchange:

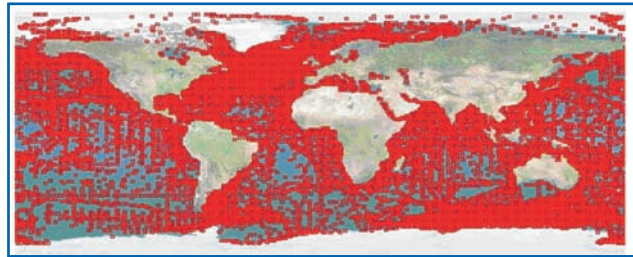
The Census of Marine Life has established an Ocean Biogeographic Information System, which leads international efforts in online marine biological data publication and interoperability. The Ocean Biogeographic Information System encompasses marine biology related metadata development in cooperation with the International Oceanographic Data and Information Exchange (of the Intergovernmental Oceanographic Commission) and Global Change Master Directory (of the U.S. National Aeronautics and Space Administration) that builds on the International Standards Organization and Federal Geographic Data Committee standards. At present, the Ocean Biogeographic Information System has published over 13 million records of about 80,000 species from almost 400 datasets (Figure 3). At its present rate of progress OBIS will contain distribution data on all marine species by 2010.

Together, these areas contribute to eleven of the GEO tasks, ranging from biodiversity, ecosystems, and agriculture to capacity building and user engagement.



### Added Value

Work in acoustic tracking of salmon from the Columbia River is revealing the impacts of both dams and oceanic climate change on this important fishery. Observation of bluefin tuna migrations are being used to restructure management of this endangered stock in the Gulf of Mexico, North Atlantic and Mediterranean.



*Distribution of the species location records published through the Ocean Biogeographic Information System ([www.iobis.org](http://www.iobis.org)). Each square represents a 1x1 degree grid cell where at least one distribution record is available from OBIS.*

The ecosystem data collected through the Census is being used by fisheries management agencies all over the world, e.g. to help set areas of reduced fishing by the North East Atlantic Fisheries Commission. The coral reef information is providing a critical baseline for gauging the impacts of rising temperatures and ocean acidity on this habitat. For many developing countries fisheries around coral reefs are a critical part of their economy. Studies of past oceanic biodiversity and abundance provide information for fisheries managers on the status of stocks prior to or in early stages of exploitation.

Beginning with publication of marine species locations, including depth and time, the Ocean Biogeographic Information System is expanding its interface to allow a range of geographic and biogeographic search options, including open source maps of national Exclusive Economic Zones and seas and oceans based on the International Hydrographic Office standard.

### Relevance to GEO

The programs in fisheries tracking are a direct contribution to GEO Task AG-06-02: Data Utilization in Aquaculture, AG-07-01: Improving Measurements of Biomass, BI-07-01: Biodiversity Observation and Monitoring Network, US-07-02: Millennium Development Goals, US-07-03: Environmental Risk Management, and CB-06-04: GEONETCast. The sensors carried by the animals provide low cost autonomous measurements of ocean properties down to substantial depths (~1000m) (Figure 1). Together with remote sensing of ocean surface properties, these observations are being assimilated into ocean circulation models.

The programs collecting ecosystem and habitat documentation are a direct contribution to GEO Tasks EC-06-02: Ecosystem Classification, BI-07-01: Biodiversity Observation and Monitoring Network, BI-06-03: Capturing Historical Biodiversity Data, and US-07-03: Environmental Risk Management. The Census of Antarctic Marine Life is a direct contribution to GEO Task CL-06-05: GEOSS IPY Contribution.

The Ocean Biogeographic Information System is collaborating with GEOSS in the development of marine habitat and ecosystem classifications to facilitate data exchange. Its growing global network of self-sustaining regional nodes meshes with both the national ocean data centers of the International Ocean Data and Exchange and national nodes of the Global Biodiversity Information Facility. This program is a direct contribution to GEO Tasks EC-06-02: Ecosystem Classification, BI-06-02: Biodiversity Requirements in Earth Observation, BI-06-03: Capturing Historical Biodiversity Data, DA-06-04: Data, Metadata and Products Harmonization, and CB-06-04: GEONETCast.

**Participants** Census of Marine Life program scientists

### Current Status and Next Steps

GEO can bring much added value to the Census of Marine Life. The long-term viability of these measurements is at risk since today virtually all ocean monitoring networks are only funded as research projects. Census of Marine Life funding is expected to terminate in 2010. Filling the gaps and long term continuity will depend on long-term support within a GEOSS framework. By emphasizing the societal benefits of global systematic biodiversity measurements and associated data systems, GEO can bring awareness at the ministerial level of the need for long-term stable funding for these programs. At the same time, the breadth of GEO will enable collaborations to develop between the Census and related biodiversity programs to identify and fill remaining gaps so that the societal benefits of GEO can be met.



## The Continuous Plankton Recorder (CPR) survey

GEOSS consists of existing and future Earth observations. The CPR survey is an existing operational survey that was in place well before GEO or GEOSS were conceptualised, but with respect to the North Atlantic has followed a parallel vision for more than 75 years. More recently a North Pacific survey and a number of sister CPR surveys have been established, including the Southern Ocean CPR survey operated by Australia and Japan and the USA NMFS CPR survey. Other pilot or new surveys are in development.

A key element of the success of the CPR is the low cost to obtain large amounts of information from remote ocean areas by using merchant ships to tow the sampling machine; second, the methodology of collection and analysis has changed little in over 75 years and third a wide global use is made of the data by researchers, modellers, private and NGO companies and government agencies. The data is used to address a wide range of issues e.g. fisheries, biodiversity, Harmful Algal Blooms, strategic environmental assessments, contaminant/eutrophication impacts and indicators of change.

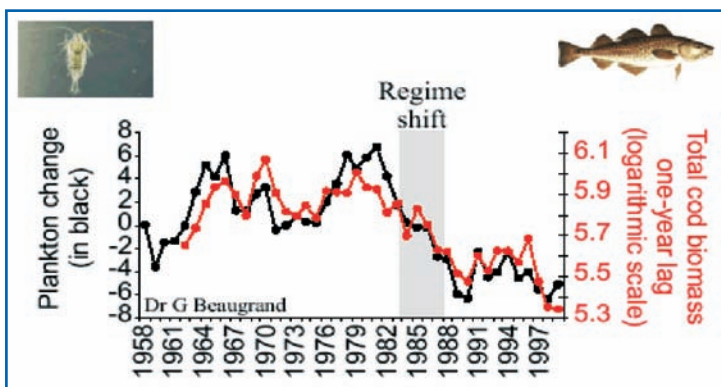
As part of the Initial Observing Programme of GOOS the Survey automatically comes under the umbrella of GEO and is a model example of a proven operational observation programme with many outputs, that address six of the GEOSS Societal Benefit Areas (Health, Energy, Water and especially Climate, Ecosystems and Biodiversity). The survey is fully compliant with GEO and GOOS data protocols and operates an open data policy <http://www.sahfos.ac.uk/datapolicy.htm>.

An acclaimed web-based outreach programme has helped promote the work and research results from the survey to a wide international audience and can be integrated into the developing GEO outreach plans.

### Changing ocean ecosystems

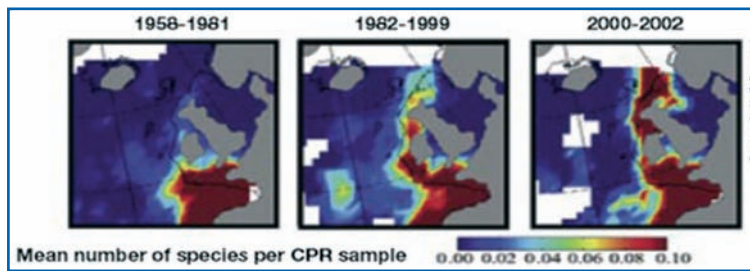
#### Description

Large changes have been observed in the plankton of the North Atlantic, at times with step-wise changes in abundance. Chlorophyll has increased by 60%; changes that have impacted all trophic levels (plants to fish and birds) in regional marine ecosystems. The tonnage of fish within a given ecosystem is dependent on the abundance and composition of plankton, and recruitment of new stock to the fisheries is governed by the timing/matching of occurrence of fish larvae with suitable planktonic food. A large decrease in total zooplankton and especially the dominant copepod *Calanus finmarchicus* has had a major impact on cod stocks in the North Sea (Figure 1). Declining returns of salmon to home waters have also been shown to be closely correlated with the changing composition of plankton in the North Atlantic from the mid 1980s and many other changes in fish abundance occurred at about the same time.



North Sea plankton food index (black) and cod biomass (red), 1958-1999. Note that changes in food supply had an effect on cod biomass with a one- to two-year lag. See Beaugrand et al. 2003, *Nature*.

Superimposed on the above changes has been a major northward shift in warm water plankton communities in the eastern North Atlantic by 10° latitude (1000 km) between 1958 and 1999 (Figure 2) a trend that has occurred to the present day with subtropical plankton species occurring at levels 6 standard deviations above the long-term mean in 2005.



*Biogeographical changes to the west of Europe of warm temperate plankton assemblages spanning five decades. Warm water plankton are moving north and cold water plankton are moving out of the North Sea. Based on Beaugrand et al. 2002 Science.*

In terms of climate such large changes in the plankton are likely to affect the extent to which the oceans take up CO<sub>2</sub> from the atmosphere. Understanding the mechanisms and effects of these changes is important.

### Added Value

To fully address the societal benefit needs of GEO the few sister CPR surveys need to be expanded to all ocean basins so that the impact of biological changes in the oceans on humankind and vice versa can be properly assessed on a global scale. New funding mechanisms need to be put in place to ensure long-term sustained support of the CPR and its sister surveys within a GEOSS framework and GEO could assist with helping to put in place such a mechanism as well as supporting necessary expansion.

### Relevance to GEO

This work contributes directly to the GEO tasks: Health HE-07-02, Energy EN-07-02, Climate CL-06-05, Water WA-07-01, Ecosystems EC-06-02, EC-06-07 and Biodiversity BI-06-02, BI-07-01 and Outreach as well as providing parallel observations of relevance to GEO tasks covering distributional and time series studies in the terrestrial sphere.

The multidecadal CPR time series gives a high socio-economic return at low cost by providing a 'barometer' against which the scale and impact of current and future global change can be assessed at temporal and spatial scales in the oceans that would otherwise be impossible. Results from the survey are used by a number of governments to support policy under the headings fisheries, biodiversity and environmental assessment and quality as well as the production of indicators. The data is also used for the validation of remote sensed data and ecological and climate change modelling. Work from the survey has provided input to the IPCC AR4 Climate Change report, OSPAR, ICES, EEA and national environment authorities. The data is being extensively applied by the Hadley Centre and Norwegian/Faroes modelling groups as input and for validation of advanced climate models and by conservation agencies in the development of their marine programmes. The survey forms an integral part of the Canadian Atlantic Zone Monitoring Program (AZMP) and the UK National Marine Monitoring Programme. The Southern Ocean CPR survey contributes information to CCAMLR, the Marine Biodiversity Information NetWork (SCAR-MarBIN) and is an endorsed SCAR project.

### Participants

In the last decade supported by UK, Canada, Iceland, Faeroe Islands, Finland, Denmark, Netherlands, France, Ireland, Portugal, Spain, USA, EU, EEA, IOC, Gulf of Guinea LME, BCLME and in the case of the Southern Ocean CPR survey, Australia, Japan, Germany and New Zealand, UK and SCAR.

### Current Status and Next Steps

The CPR survey was temporarily closed down in 1989 and is now operated by a charity, the Sir Alister Hardy Foundation for Ocean Science (SAHFOS), with funding contributions from 12 countries plus the European Union and the Intergovernmental Oceanographic Commission (IOC) over the last decade. Maintaining consortium funding of the survey has been a major problem and new mechanisms need to be put in place to ensure operational survival of the survey and its sister surveys into the future. If the CPR survey had been closed the world would probably not be aware of the scale and speed of the biological changes that are taking place in the North Atlantic. There is virtually no information available to determine if similar changes have occurred elsewhere in the oceans, which cover ~71% of the surface of the Earth. Poor global coverage of biological measurements is a major gap in current ocean observation systems that has high relevance to assessing the rate and scale of global change.

## MERSEA, a precursor to GMES Marine Core Service

### Description

#### Objectives:

the overall objective of the MERSEA (Marine Environment and Security for the European Area) project is to develop an integrated service to intermediate users and policy makers in support of safe and efficient off-shore activities, environmental management, security and sustainable use of marine resources. The service relies on an integrated European operational system of global monitoring and forecasting of the ocean and a coordinated network of regional systems for European waters. The project is a precursor of the GMES European Marine Core Service (MCS) that will deliver a set of basic, generic information products based upon common-denominator physical and bio-geochemical state variables.

Although the services are developed primarily to fulfil the reporting, monitoring and forecasting requirements of European agencies and stakeholders, they do have a global scope. The provision of services is based on access to ocean products and information, such as long running data sets to define the mean, fluctuations, and past trends in the state of the marine environment; to record its evolution and the success or otherwise of policy responses and, with predictions of future change, to establish baselines for effective environmental management.

#### Methods:

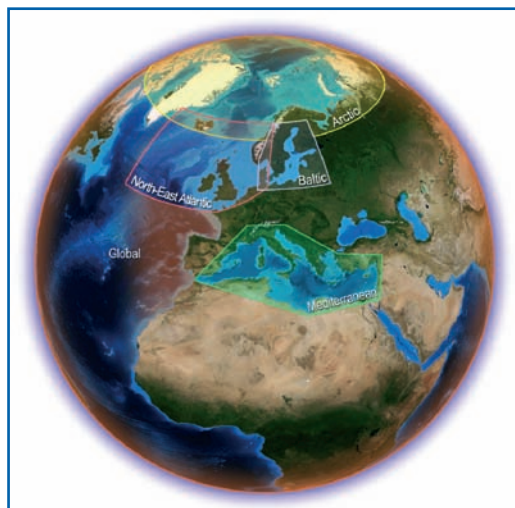
the basic method is to merge and assimilate diverse data from space-borne sensors and in situ measurement networks into high-resolution ocean models in order to monitor the ocean physics, bio-geo-chemistry and ecosystems and to provide forecasts on prediction time scales ranging from days to months. The system relies on a network of Monitoring and Forecasting Centres, Thematic Data Assembly Centres, and the associated information management infrastructure. The present pre-operational system comprises global and regional (Arctic, North-Atlantic and European shelves, Baltic, and Mediterranean) Centres, and Data Assembly Centres for satellite altimetry, ocean colour, sea-ice, sea-surface temperature, and forcing fields; and in situ data. Atmospheric analyses and forecasts are provided by the ECMWF (European Centre for Medium Range Weather Forecasting) and NWS (National Weather Services).

#### Data and results:

the system is critically dependant on the availability of Earth Observation data from satellites, whose continuity is absolutely indispensable. Likewise, *in situ* networks, such as the Argo array and other moored and ship borne data, and coastal systems, must be maintained to provide input into the monitoring and forecasting systems. The MERSEA system validates combines and merges all available data to elaborate higher level fields. It produces regular and systematic reference information on the state of the ocean, of known quality and accuracy for the global and regional European Seas. The information delivered presently covers physical ocean state variables; the number of environmental variables produced will increase over the period 2008-2013. The products include observational and model data, real time mapping and forecasting. Ocean bulletins, indicators, synthesis, and statistics are elaborated. Baseline data are obtained from long-term retrospective analysis.

#### Impact:

as outlined below, the MCS developed by MERSEA provides information relevant to most of the GEO societal benefit areas. It delivers the common denominator data for all users in the marine sector, in other words the information for existing and new downstream services. The applications domains range from Climate to Marine Environment, Seasonal and Weather forecasting, Coastal and local monitoring, Offshore operations, Maritime transport and safety, Fisheries, Research, General Public.



The targeted users are European agencies and policy authorities, national agencies (e.g. NWS, coast-guards), local authorities, private adding-value companies, research laboratories...

### **Added value**

The added value is the transformation of data into information, ocean products, and services.

The MCS mission is to provide with a European added-value:

- Operational Production of Ocean Core Data;
- Dissemination of Products;
- Assessment and expertise;
- Tools development and maintenance
- Training and research coordination.

The services are critically dependant on GEO data and need GEO support in the continuing availability of such. In turn, the MCS enhances the data from the GEO components, by offering real-time and long term 3D description of the oceans from top to bottom. New advanced products (indicators) synthesising the information available provided by the integrated systems (modelisation+assimilation) of the MCS. Forecasts are also a unique contribution of the MCS.

### **Relevance to GEO**

Relevance to SBA can be highlighted by several examples:

- Reducing loss of life and property from natural and human-induced disasters:
  - forecasting for maritime operations, upper-ocean information for hurricane prediction, coastal management.
- Understanding environmental factors affecting human health and well-being:
  - coastal water quality monitoring, harmful algal blooms.
- Improving management of energy resources:
  - support to offshore operations
- Understanding, assessing, predicting, mitigating, and adapting to climate variability and change:
  - the role of the ocean in all climate issues is paramount and obvious (heat, sea-ice, carbon cycle).
- Improving water resource management through better understanding of the water cycle:
  - role of the ocean in the global water cycle, evaporation-precipitation.
- Improving weather information, forecasting and warning:
  - extended weather forecasts need high quality ocean information.
- Improving the management and protection of terrestrial:
  - coastal and marine ecosystems.
- Understanding, monitoring and conserving biodiversity:
  - for the ocean realm.

Transverse areas:

MERSEA is developing all components of the MCS in line with the transverse areas concepts, in particular architecture, interoperability and data management standards.

### **Participants**

- France, Germany, EC, Denmark, Cyprus, Germany, Greece, Italy, Norway, United Kingdom and several other European countries, with close coordination with international partners.
- Associated GEO organizations include: ECMWF, EEA, ESA, EUMETSAT, GOOS, IOC, POGO, WMO, WCRP.

### **Current Status and Next Steps**

The four-year MERSEA project will end in mid-2008, at which time it will deliver a prototype, pre-operational system as a contribution to the GMES MCS. Next steps will transition to full operational standards and sustained operations. Gaps (potential):

- Continuity of space observations and in situ networks are crucial for the future.

## Evaluating African Protected Areas

### Description

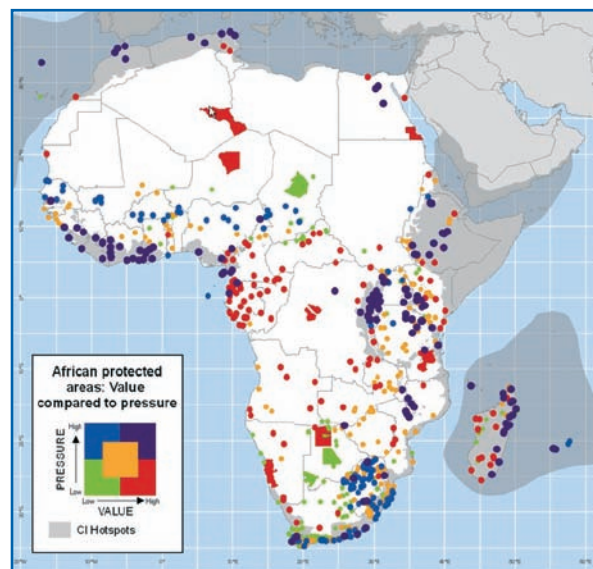
The EU has made significant commitments to halt the loss of biodiversity and in assisting developing countries in addressing the issue of the continued loss of biodiversity.

The EC recognizes the crucial role of Protected Areas in biodiversity protection, conservation and the sustainable use of natural resources. From the late eighties the EC commitment in supporting Protected Areas and conservation policies at national and regional level has regularly increased and the EC is now an essential donor and stakeholder for biodiversity issues in most of the African countries. Most of the biggest and successful programmes to support conservation and PAs management - i.e. ECOFAC in Central Africa (€ 115M in 15 years) and ECOPAS in Western Africa (€ 24M in 7 years), among others - have been funded by the EC.

The EC is therefore targeting significant sums towards protected areas in Africa, but often without access to the necessary information to address critical issues such as:

1. Identify the key questions for long- term decisions
2. Evaluate the current value of PAs
3. Evaluate the current threats on PAs
4. Evaluate the future threats on PAs
5. Adapt the distribution of PAs

In response to this need for effective information to support policy planning and monitoring, the Global Environment Monitoring Unit (GEM), in the context of the work of the African Observatory, has created a dynamic system which integrates heterogeneous data (geospatial, statistical, observations) to develop composite indicators of vulnerability (<http://www-tem.jrc.it/PA/index.html>).



This initiative aims to provide African Nations and Official Development Assistance programmes with a systematic, impartial and quantitative system with which to characterise biodiversity value, ecosystems and threats, and to inform users about the status of, and pressures on Protected Areas in Africa.

In situ data from various sources such as the African Mammals Databank document geographical extent of bird, amphibian and mammal species are combined with routine, and archived environmental observations from satellite, such as fire occurrence and vegetation condition along with climatic data, and threats are determined by measurements of agricultural expansion and population/transport infrastructure.

Biodiversity data are cross referenced to The Environmental Performance Index from CIESIN/Yale/JRC; The World Development Indicators from The World Bank; The Millennium Development Goal assessments, and; EarthTrends from the World Resources Institute.

These data are available on website <http://www-tem.jrc.it/PA/index.html>

This system improves capacity to judge effectiveness of local protected areas, including local management decisions and improves capacity to monitor pressures and threats to existing Protected Areas.



## Relevance to GEO

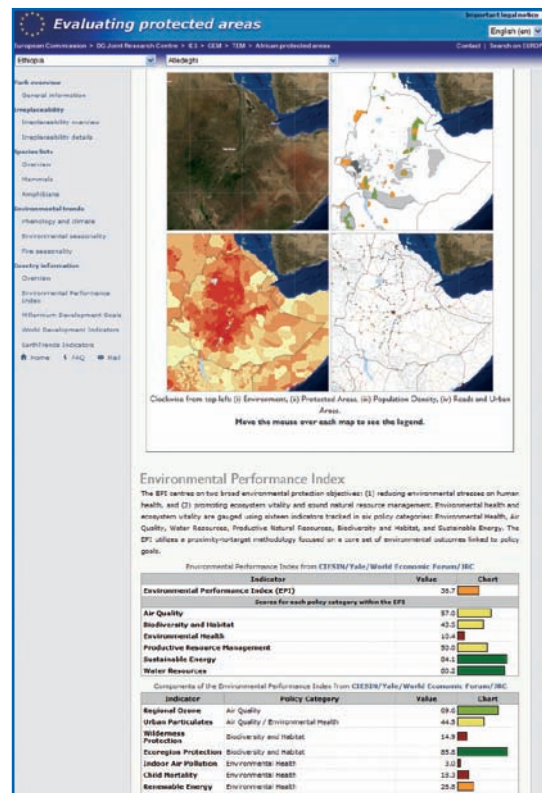
The system is highly relevant for at least the following two GEOSS Societal Benefit Areas:

- Biodiversity – Understanding, monitoring, and conserving biodiversity
- Ecosystems – Improving the management and protection of terrestrial, coastal and marine resources

It assures flow of environmental variables as observed from satellite, improve acquisition of in situ observations and improve access to results.

It contributes to the GEO Work Plan

- BI-07-P1: Biodiversity observation and monitoring. Implement coherent biodiversity observation strategies within the context of an agreed ecosystem classification system based on EC-06-02 and the strategic plan of BI-06-04. Facilitate the establishment of monitoring systems that enable frequent, repeated, globally coordinated assessment of trends and distributions of species and ecosystems of special conservation merit. Facilitate consensus on data collection protocols and the coordination of the development of interoperability among monitoring programs.
- BI-07-P2: Protected Areas Mapping and Monitoring. Apply Earth observation to the characterization, mapping and monitoring of global protected areas consisting of World Heritage sites, natural areas, sites of cultural, geological and archaeological significance. Use earth observation and other geospatial data to support the delineation and update of protected areas boundaries. Improve dissemination of earth observation data to protected area planners and managers



## Participants

- European Commission
- UNEP WCMC,
- Birdlife Africa Partnership

## Current Status and Next Steps

Currently the system includes 741 Protected areas across the whole of Africa and Madagascar. Current analysis includes 1591 bird, mammal and amphibian species – all checked with the most recent IUCN Red List of Threatened Species. Environmental status is based on near real time continent-wide satellite image processing and archived material

Long-term continuity is needed for the satellite image acquisitions and data processing, and also for in situ species observations within protected areas.

Currently gaps/challenges are:

Satellite observation of more environmental variables; improved National data collection, e.g. on species distributions; expansion to other geographic regions beyond Africa and to Marine ecosystems.

## Large-Marine Ecosystem Indicators of Global Change

### Description

**Objective** – NOAA's Large Marine Ecosystem (LME) Program is linking GEO goals, objectives and products with international LME projects monitoring changing conditions in five key ocean ecosystem component-productivity, fish and fisheries, pollution and ecosystem health, socioeconomics, and governance.

**Methods** – Collaboration is underway with 110 developing countries in Africa, Asia, Latin America, and eastern Europe in partnership with the Global Environment Facility, the World Bank, Regional Development banks, five UN agencies and two NGO's for implementation of LME projects to reduce degradation of linked watersheds, marine resources and coastal environments from pollution, nutrient over-enrichment, habitat loss, over-fishing, and climate change.

**Data** – With NOAA's scientific and technical support this international collaboration is presently providing data and information from 16 LME projects on productivity, coastal oceanography, nutrients, climatology, fish and fisheries, pollution and ecosystem health. This data supports LME – wide management decisions made by the participating countries for recovering depleted fish stocks, restoring degraded habitats, reducing and controlling nutrient over-enrichment, adapting to climate change, and restoring and sustaining ecosystem goods and services.

**Results/Impact** – The LME projects are “country-driven” efforts to meet the World Summit on Sustainable Development (WSSD) targets for reducing coastal pollution, introducing an ecosystem-based approach to resource management by 2010, establishing a network of marine protected areas by 2012, and restoring depleted fish stocks to maximum sustainable levels by 2015. Movement toward these goals is underway by the 110 participating countries. The 16 LME projects are supported with \$1.8 billion in financial assistance from the GEF, World Bank, and other donors. In each of the projects, the participating countries have adopted a Strategic Action Plan, which is adjusted for the unique LME conditions and moves the countries toward the WSSD marine targets. Results are reported through established Program Coordinating Units, and are available globally through an existing LME electronic network.

### Added Value

1. The LME approach supports large scale environmental monitoring of the world's coastal waters. The LME projects maintain large data banks, and metadata that support data networks, and allow for analyses and scenario testing, in support of management decisions for the restoration and sustainability of LME goods and services. The multiplier effort from replication of the LME five module assessment and management strategy is of global significance in a growing movement toward the realization of the WSSD marine targets.
2. **Cost Saving:** The LME projects can link with GEO to reduce redundant data collection, management and analyses.
3. **Integrated Analysis:** Data sharing, complementarily, and interoperability among partners allow for global scale analyses that would not otherwise be performed.
4. **Capacity Building:** This will provide data, decision and support tools for monitoring changes in LME productivity, fish and fisheries, pollution and ecosystem health, and the effects of climate change for improved ecosystem-based management in the world's 64 Large Marine Ecosystems.

## Relevance to Societal Benefit Areas and Transverse Areas

The world's 64 LME's are areas of ocean characterized by distinct bathymetry, hydrography, productivity, and trophic interrelationships. They annually produce 95% of the world's marine fish catch. They are natural and regional focal areas of the global effort to recover depleted fish stocks, restore damaged habitats and reduce and control coastal pollution. The data and information provided by the GEF-supported LME projects contribute significantly to:

- Improve the management and protection of coastal marine ecosystems;
- Improve the socioeconomic benefits to coastal communities in Africa, Asia, Latin America and Eastern Europe from LME goods and services;
- Improve global scale assessments of climate change in relation to the variable effects at the LME scale;
- Improve the capacity of developing countries to join the community of nations in monitoring, assessing and predicting the effects of environmental factors effecting human health and well being.

## Relevance to GEO

LME projects will improve the management and protection of terrestrial, coastal and marine ecosystems, which will ultimately improve the information content needed to address the nine societal benefits (Work Plan Task Numbers indicated):

- Engaging Donors (CB-07-01a)
- Building National and Regional Capacity (CB-07-01d)
- Seamless Weather and Climate Prediction System (CL-07-01)
- DEM Interoperability (DA-07-01)
- Higher Level Data Product Tools (DA-07-05)
- Environment and Health Monitoring and Modeling (HE-07-02)
- Millennium Development Goals (US-07-02)
- Environmental Risk Management (US-07-03)

## Participants

Institutions, Government Agencies, and Ministries of the Environment, Fisheries, Energy, Tourism, and Finance from 110 countries around the world, as well as partnerships underway with NOAA and the GEF, World Bank, UNIDO, UNEP, UNDP, IOC- UNESCO, FAO, IUCN and WWF.

## Current Status and Next Steps

- Long term continuity – The start up funding of \$1.8 billion is expected to increase to \$3.0 billion during the next 24 months. Each of the LME projects is programmed for two phases of 5 years each. At the conclusion of 10 years these projects are expected to continue with self-financing provided by national and trans-boundary stakeholders including the fishing industry, petroleum industry, transport industry, tourism industry, and other revenue streams justified on the basis of the \$12.6 trillion annual economic contribution from the goods and services of LMEs to the global economy.
- Gaps – The LME approach to the assessment and management of marine resources and their environments is targeted for an increase of \$230 million by the GEF International Waters focal area during the GEF 2007-2010 replenishment period. Among the LMEs in the funding pipe-line is the West Bering Sea LME, presently stressed by ice melt, and the Sulu-Celebes LME, under stress from coastal pollution, habitat loss, and over-fishing.
- Next Steps – The northern hemisphere countries are expected to lend their assistance to developing countries in the \$1.2 billion expansion of ongoing GEF-supported projects over the next 24 months, in a planned effort by UN agencies to stimulate North-South and South-South collaboration in LME projects.

## Ocean Observations, Modelling, Ocean Data & Information and Advisory Services

### Description

The Indian National Centre for Ocean Information Centre (INCOIS) was conceived in 1999, the Ministry of Earth Sciences (MoES) Govt. of India to provide ocean information and advisory services to society, industry, government agencies and scientific community through sustained ocean observations, information management, modelling and constant improvements through systematic and focused research.

INCOIS has a vision to emerge as a knowledge and information technology enterprise for the oceanic realm with a focus on:

- Developing capability to forecast critical ocean parameters, processes and phenomena, which have significant societal, economic and environmental benefits
- Providing scientific and technical support for ecosystem-based management for sustainable use of resources.
- Defining and deploying satellite- and in situ-based ocean observing system to support forecasting and ecosystem-based management system.

Within a short time, INCOIS carved out a niche in the national scene by successfully conceptualizing and implementing:

- Potential Fishing Zone (PFZ) Mission to understand the status and trends of living resources abundance and distribution
- Early Warning System for Tsunami & Storm Surges for increasing resilience to natural hazards
- Ocean & Coastal State Forecast for enabling marine operations
- Implementation of Ocean Observing System in the Indian Ocean and initiating Ocean Modeling activities to understand the ocean's role in climate change
- Coral Reef, and Chlorophyll Mapping (ChlorOGIN Project) to monitor and assess ecosystem health
- Developing National and Regional Oceanographic Data Centre for providing Data Services
- Providing Web and Location-based Services

Further, INCOIS emerged as a key player in the Indian Ocean region as the Secretariat for the Indian Ocean Global Ocean Observing System (IOGOOS), Basin level Coordinator and Regional Data Centre for International Argo project in Indian Ocean.

### Added Value

- How will GEO aid this effort, how will it impact GEO and be impacted by GEO?

INCOIS has been implementing the Ocean Observation System in the Indian Ocean. The in-situ and remote sensing observations are being effectively utilised for providing Ocean Information and Advisory Services in real time for the benefit of the society. Further, a new phase of modelling efforts was initiated focusing towards the end goal of achieving ocean predictability and enabling climate predictability mode with concomitant efforts in modelling, data assimilation and validation.

INCOIS being the implementing agency of Ocean Observing System in the Indian Ocean and also the prime mover for Ocean Modelling efforts, the programmes of INCOIS have great impact on GEO efforts towards realising its objectives. Also, every effort of GEO will have an impact on the programmes of INCOIS in providing socio-economic benefits to the end user.

## Relevance to GEO

- Relevance to GEO and SBAs to transverse areas, Socio-economic value
- Contribution to 10 year plan
- GEO Work plan reference (SBA, Task, Target)

INCOIS programmes viz. Ocean Observation System, Ocean Modelling and Ocean Data has direct relevance to the GEOSS Programmes envisaged in its 10 Year Plan such as Observations and Modelling, Data Management, Interoperability and Capacity building.

INCOIS programme is related to the GEOSS 10 Year Plan particularly in the areas of Disasters (DI-06-04, DI-06-07, DI-06-08, DI-06-09), Climate (CL-06-06), Ecosystems (EC-07-01), Agriculture (AG-06-02), Data management (DA-06-04 and DA-06-05).

## Participants

- List of GEO Members and Participating Organisations

Synergy and knowledge networking with national centres of excellence in ocean sciences, atmospheric sciences, space applications and information & communication technology as well as translating this scientific knowledge into useful products and services became the cornerstones of INCOIS in its pursuit for organisational excellence, national relevance and international significance.

INCOIS being playing a lead role in IOGOOS, member of POGO, IODE and OGC, it would effectively make use these programmes to expand its activities and build capacity in those areas at regional as well as global level. Further, keeping in view the responsibilities of INCOIS, we have collaboration with other major international programmes/bodies such GOOS, JCOMM/WMO, GODAE, IOCCG, IOTWS, ISPRS etc.

## Current Status and Next Steps

INCOIS has been continuously providing the Ocean Information and Advisory Services viz. Potential Fishing Zone advisory services, Ocean State Forecast and Early Warnings for Tsunami and Storm Surges, implementing the Ocean Observing System (Argo, Drifting Buoys, XBT, Current Meter Moorings Arrays, Moored Buoys, Tide Gauges etc.) in the Indian Ocean and addressing the Ocean Modelling activities on a national mission.

INCOIS has plans for continuing the activities on Ocean Information and Advisory Services, Ocean Observing System and Ocean Modelling on a long term by continuously adopting the new technologies to provide ocean information advisory services timely and effective manner and also strengthening the dissemination chain.



## The POSTEL Land Surface Thematic Center

### Description

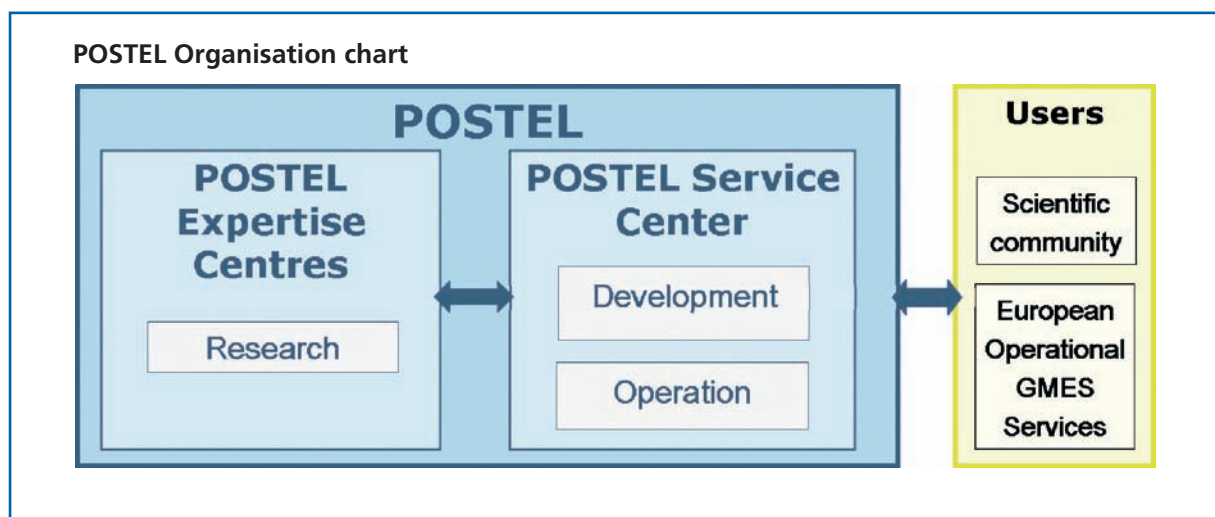
The POSTEL Thematic Centre is part of a national effort to federate scientific expertise and to pool the means to be implemented in order to produce validated maps of variables derived from Earth Observation satellite data. POSTEL addresses the Land Surfaces thematic area, while ETHER and ICARE (see reports therein) address respectively atmospheric chemistry, and atmospheric aerosols and clouds.

The POSTEL Thematic Centre intends to become an element of the Land Monitoring Core Service (LMCS) of the European GMES programme to be implemented in 2008 and beyond. The consortium that is in charge of developing POSTEL at the French scale currently includes CNES, Météo-France, CNRS/INSU, IRD and INRA. As it is expected to quickly gain a European standing, other institutions are liable to join it.

The role of POSTEL is to transform the images acquired by remote sensing earth observation satellites in spatially distributed indicators describing land surface soil and vegetation properties (“biogeophysical variables”).

The Thematic Centre revolves around two types of bodies:

- Scientific Expertise Centres, which are laboratories or research organisations that contribute to designing and validating Earth Observation derived products. Such Expertise Centres manage all the scientific activities related to the Thematic Centre.
- A Service Centre. Its mission consists in designing operational processing lines, and assuring the operational production of products and their distribution to the users. The Service Centre is located at Medias-France in Toulouse.



The user community benefiting from the Service Centre products and services is the international science community as well as the emerging GMES European environmental services which will formally be part of the LMCS and of the Land Surface Downstream Services.

POSTEL provides spatialized biogeophysical variables produced in various projects (ESA, EC, national) in three areas :

Continental vegetation and soil:

- Leaf Area Index
- Fraction of vegetation cover,
- Fraction of radiation absorbed for photosynthesis
- Land cover,
- Vegetation Index
- Burnt Areas
- Surface Reflectance

Radiation cycle:

- Albedo
- Bidirectional Reflectance Distribution Function,
- Downwelling Short-wave and Long-wave radiation fluxes
- Land Surface Temperature.

Water cycle:

- Precipitation
- Soil Moisture
- Evapotranspiration
- Water Bodies
- Water Level

All products are available free of charge for non-commercial users through the POSTEL Web site, at <http://postel.mediasfrance.org>.

The detailed product catalogue as well as additional information on algorithms, formats and other relevant information can also be found on this Web site.

## PUMA, AMESD and GMES Africa: promoting the use of Earth Observation for Sustainable development in Africa.

### Description

Two activities have been initiated to foster the use of Earth Observation data in Africa: PUMA and AMESD.

#### PUMA

The Meteosat Second Generation (MSG) has been the catalyst for an exceptional collaboration in Africa: the PUMA Project (also known as the Meteorological Transition in Africa Project). 53 countries in Africa have participated in this 'globalised information society' project to transform meteorological services over the continent. PUMA created a network of 53 African countries and five regional centres in Africa, equipped them with satellite data receiving station infrastructure, assisted them with, technical and thematic training programme and supported application to obtain and use data for a multitude of purposes. Each participating country benefited from:

- equipment to ensure continuous direct reception of the new meteorological and environmental satellite data stream, through GEONETCast;
- software to operate the equipment and derive usable products (such as weather forecasts, estimates of rainfall, real-time observation of fires and measurement of sea surface temperature);
- training for improved use of the data;
- support to the development of useful products and improvement of their ability to work coordinately, collectively providing a more effective and user-focused service;
- execution of five Pilot Project (one in each African Regional Economic Communities) in non-meteorological application to experiment the operational use of MSG data in sustainable development programme.



#### AMESD

Defined as "the next step after PUMA" and the "precursor of GMES in Africa", the AMESD (African Monitoring of Environment for the sustainable Development) programme is to improve decision and policy-making processes for environmental management at national, regional and continental level in Africa, by facilitating the access to relevant EO information sources, and by increasing the overall information management capabilities.

The AMESD objectives will be achieved through four main lines of action,

1. Maintenance and upgrade of the PUMA infrastructure, namely the GEONETCast station,
2. Creation of five thematic networks (one for each African region) around specific priority areas, namely,
  - Water Resources Management (CEMAC),
  - Cropland and Rangeland Management (ECOWAS),
  - Land Degradation, Mitigation and Natural Habitat Conservation (IGAD),
  - Coastal and Marine Management (IOC),
  - Agricultural and Environmental Resource Management (SADC),
3. Provision of specialised training on the use of EO data for Environment management.
4. Institutional development activities aiming at helping the African Union in the coordination of the implementation of environmental policies in Africa.

### Added Value

Through PUMA and AMESD, the use of Earth Observation in Africa is greatly encouraged and facilitated. Various African users are equipped and trained to receive Earth Observation data and products disseminated via EUMETCast and GEONETCast. In addition, PUMA and AMESD encourages the participating African partners to developing their own products based on Earth Observation and In-situ data to serve several applications relevant to various SBAs.

### Relevance to GEO

PUMA and AMESD are mainly relevant to the following SBA: Climate, Weather, Water, Agriculture, Ecosystems.

They clearly contribute to the Capacity Building efforts of the 10-years Implementation Plan, and more particularly to the achievement of the following tasks:

- CB-06-04: GEONETCast (through the deployment of receiving stations)
- CB-07-01a: Engaging Donors
- CB-07-01d: Building National and Regional Capacity



### Participants

The following GEO members participate in PUMA/AMESD effort:

- EUMETSAT
- European Commission
- WMO

Other participants contributing to the achievement of these two programmes include:

- ACP (Africa, Caribbean and Pacific)
- Group of States, the Commission of the African Union,
- African Regional Economic Communities (ECOWAS, COI, SADEC, IGAD, CEMAC)
- African States and various African institutions like AGRHYMET, IGAC, CICOS

### Current Status and Next Steps

The GEONETCast receiving stations deployed all over Africa in the frame of PUMA, are now used on an operational basis by trained African persons. These GEONETCast stations allow Africans to have a direct access to all products disseminated through GEONETCast. AMESD is now on-going with the detailed definition of the various thematic and the building of the necessary capacity.

For the next steps, the African institutions (African Union, Regional Economical Communities and ACP Secretariat) have called for a Long-term continuity through the Maputo Declaration, which request the extension of European GMES to African, Caribbean and Pacific countries, known as the GMES Africa initiative. This initiative would be a good way to link African countries with the GEO process.

# Smithsonian Institution Global Earth Observatory Initiative (SIGEO)

## Description

Objective: The Smithsonian Tropical Research Institute (STRI) will expand the development of its network of tropical forest plots to become a system of Smithsonian Institution Global Earth Observatories (SIGEO), which will provide scientific data about ecological, hydrological, soil, and meteorological processes openly and quickly via the world wide web to scientists, politicians, and other people around the world who need to monitor climate change, carbon budgets, nutrient cycling, and biodiversity.

### Methods:

- 1. Expansion of Forest Dynamics Plots into the Temperate Zone;
- 2. Biodiversity Inventory and Assessment; and
- 3. Monitoring Forest Health from Space.

### Data:

This international collaboration is now monitoring the growth and survival of 3.5 million trees at 20 sites in 15 countries - over 12 percent of all known tropical tree species. In addition, it will integrate temperate plots into the network of tropical forest plots and conduct focused surveys of vertebrates, invertebrates, and microbes across the Global Earth Observatories. These surveys will also include an assessment of vertebrate health and physiologic change as a sentinel for the impact of environmental change on human and domestic animal health.

### Results/Impact:

SIGEO is poised to critically monitor the effects of anthropogenic increases in atmospheric CO<sub>2</sub>, nitrogen, and general air pollution at local, regional and global scales. Global Earth Observatories will provide a concerted effort to help solve real-world problems based on the real-time dissemination of critical data and cutting-edge science.





## Added Value

1. SIGEO promotes large-scale environmental monitoring, and maintains enormous banks of data and metadata that galvanize advanced data networks and sophisticated analyses from single forest plots to outer space;
2. Cost Saving: can link with current GEO tasks to reduce redundant data collection, management and analyses;
3. Integrated Analysis: Data Sharing and Interoperability among partners allows for analyses that would not be performed; and
4. Capacity Building: providing data and decision support tools for monitoring biodiversity, climate change for better management of terrestrial ecosystems and biodiversity conservation.

## Relevance to GEO

Societal Benefit Areas and Transverse Areas:

- Understanding environmental factors affecting human health and well-being.
- Understanding, assessing, predicting, mitigating, and adapting to climate variability and change.
- Improving the management and protection of terrestrial, coastal and marine ecosystems.
- Understanding, monitoring and conservation biodiversity.

GEO Work Plan reference (SBA, Task, Target):

- Biodiversity Observation Network Task #B1-07-01
- Capturing Historical Biodiversity Data Task #B1-06-03

## Participants

Institutions and universities from 15 countries around the world as well as developing partnerships with:

- EPA
- NASA
- NOAA
- USGS
- U.S. Forest Service.

## Current Status and Next Steps

Long-term continuity:

There is long-term institutional commitment to the project demonstrated by the continued monitoring of the network's oldest plots over the past 25 years.

Gaps:

The purpose of SIGEO is to have a complete observatory with few, if any, gaps, hence the desire for establishing strong partnerships.

## The establishment of the South African Environmental Observation Network (SAEON)

### Description

SAEON was established to function as a comprehensive and sustained South African Earth observation network that delivers long-term reliable data for scientific research and informs decision-making for a knowledge society and improved quality of life. Funded by the Department of Science and Technology and managed by the National Research Foundation, SAEON has initiated a series of actions to improve the coordination and facilitation of in situ long-term observation and monitoring systems, to increase understanding of environmental processes, and to enhance prediction of the behavior of the natural systems. Based on three pillars in terms of its mandate - observation, information and education - SAEON has made considerable progress towards addressing the challenges of:

- Collecting, archiving, providing and integrating long-term observation data to inform research and predictions of environmental change
- Providing accurate, high-quality, long-term and timely information to inform evidence-based decision-making by policy-makers, civil society and private sector
- Facilitating the full and open exchange of data, metadata and information products
- Building vital capacity in the environmental sciences



A national summit involving all the major SAEON stakeholders and scientists in the field was held in 2006 to map out a way forward and to evolve a structure for integration between the long-term observation activities and the various players involved. The summit advanced multidisciplinary cooperation in addressing South Africa's long-term environmental concerns and re-emphasised SAEON's commitment to improving societal well-being and underpinning national priorities. Following intensive consultation with all stakeholders involved, the SAEON Ndlovu Node (savanna biome), Elwandle Node (coastal-inshore zone), Fynbos Node (Cape floristic kingdom) and node for marine-offshore systems were established and are operational. The nodes for the arid regions and wetlands-grasslands-forest mosaic have been designated and are being developed. A node is an office with capacity to implement programmes focused on achieving SAEON's objectives. The nodes provide SAEON with geographical coverage.

Like GEO, SAEON is committed to substantial capacity building efforts in human resources, institutions and observational infrastructures, particularly in developing countries. SAEON's environmental science education outreach initiative has become a recognised leader in its field. Partnering with industry, government (the Department of Education), science councils and conservation bodies, the program is designed to enhance science education by providing educator support. One of the main objectives of the program is to stimulate an interest in environmental science as a career. SAEON has also established a vibrant Graduate Student Network to provide a student-managed network where graduate students can network, present their work and undergo training to develop essential observation understanding and skills.

As in the case of the GEOPortal, special attention is devoted to the development of information systems to facilitate archiving and dissemination of long-term and related environmental data. The SAEON information system provides interoperability among the distributed data holdings of its participating members and is regulated by a flexible data policy that promotes a culture of data sharing. SAEON coordinates the Southern African Data Centre for Oceanography (SADCO) and is also involved in the process to establish a national Antarctic data management centre.

Nodes are designed to provide strategically placed infrastructure (staff, sites, equipment and services) for the coordination of observation and data systems that will be shared by visiting researchers and their students, both local and international. By forming strategic partnerships with other research institutions, the nodes provide a unique framework for enhancing dialogue and working to leverage and contribute to the development of comprehensive, coordinated and sustained environmental observations, guided SAEON's core science plan.

The SAEON concept of an institutionalized network of organizations pooling intellectual, physical and financial resources has been lauded as an innovative approach to research management. SAEON has forged strategic partnerships with most of South Africa's premier research organizations, conservation agencies and industries. These include:

- Obtaining advice at three levels (policy, scientific and node management) from the full range of national stakeholder organizations
- Long-term agreements with four independent organizations for hosting SAEON Nodes
- General collaborative agreements with a growing number of universities, science councils and conservation bodies
- Specific collaborative agreements on several observation, research, product development and capacity building projects
- A collaborative agreement on the development of a shared information system and spatially enabled portal and Digitization of databases currently on paper
- Successful externally sponsored collaborative science awareness events
- Joint workshops and conferences with partner organisations and agreements to share observational equipment and data
- Co-supervision of research students

From its position at the tip of Africa, SAEON collaborates with relevant international players in environmental observation, to coordinate global and regional observations, fill gaps in existing systems and identify new observations to minimize gaps. Spawned by the International Long Term Ecological Research Network (ILTER), SAEON has in turn become a driving force behind the establishment of ELTOSA (Environmental Long-Term Observatories of southern Africa) and the development of a joint research program for it.

### **Relevance to GEO**

Having been established in 2002, the year before GEO, SAEON is a parallel national initiative in full support of the ideals for GEOSS, and indeed one of its building blocks. SAEON is already operative in several of the GEO societal benefit areas and its observations and research will eventually be relevant to all of them.

### **Current Status and next steps**

In the five short years since its inception, the South African Environmental Observation Network (SAEON) has become the leader in long-term environmental research and observation in South Africa. The need for SAEON in South Africa has been reflected in the continued and increased funding for the project by the Department of Science and Technology.

Next steps include the delivery of the SAEON data portal and all its intended capacities, growing the SAEON Nodes and participants; delivery of a core science plan supported by the stakeholders; delivery of products for science and policy; developing additional data centres; promoting data collection, sharing and accessibility; creating functional connectivity to GEOSS; and, linking the education-outreach program to the GLOBE program. Gaps include repatriation of data holdings held abroad; a metadata system incorporating ontologies; and sufficient bandwidth for efficient online research and data sharing.

For further information, visit [www.saeon.ac.za](http://www.saeon.ac.za)

# Canada's National Land and Water Information Service: Providing Land Information for Canadians

## Summary

Many of the goals associated with the intergovernmental *Group on Earth Observations* (GEO) are being met on behalf of Canada's agricultural land community through implementation of the National Land and Water Information Service (NLWIS), led by Agriculture and Agri-Food Canada (AAFC). NLWIS provides open and free access to data, information and tools over the Internet to support sound land use decision making by Canadians. The originators of these data and derived information products include all levels of government as well as non-government organizations. NLWIS is successfully bringing these communities together, developing partnerships with multiple agencies to permit sharing and access to data and products for the benefit of the broad Canadian user community. NLWIS is also generating new information to fill critical gaps identified by user requirements. NLWIS will conform to the Canadian Geospatial Data Infrastructure (CGDI) and international (Open Geospatial Consortium, OGC) standards. NLWIS and AAFC's research community are working together in developing the next generation of Earth observation products to meet ongoing and emerging user needs.

## Relevance to GEO

As with GEO, NLWIS is heavily driven by user requirements. The data, information and tools being provided by NLWIS meet many of the user needs documented in the Socio-Economic Benefit Areas (SEBAs) identified by the GEO international community. Through the provision of land and water data and information, NLWIS land information supports the broad goals of the following SEBAs:

- Understanding, assessing, predicting, mitigating and adapting to climate variability and change;
- Improving the management and protection of terrestrial, coastal and marine ecosystems;
- Supporting sustainable agriculture and combating desertification;
- Understanding, monitoring and conserving biodiversity.

The new agricultural policy framework being developed for Canada – *Growing Forward* – sets out a vision, objectives and policy direction of an agriculture, agri-food and agri-products sector that is profitable, innovative, competitive, market-oriented and able to seize opportunities while meeting the needs of Canadians who are increasingly health conscious and environmentally aware. NLWIS is committed to being the authoritative source of geospatial data to support monitoring, forecasting and response programs. As part of this commitment, NLWIS is developing and making available land cover information to support agri-environmental land use decision making in Canada.

## 1.1 Land Cover Monitoring

### Description

NLWIS is developing medium-resolution land cover monitoring information for agricultural regions of Canada (30m-resolution LandSat data). The work currently includes a circa 2000 baseline inventory (Figure 1).

### Value Added

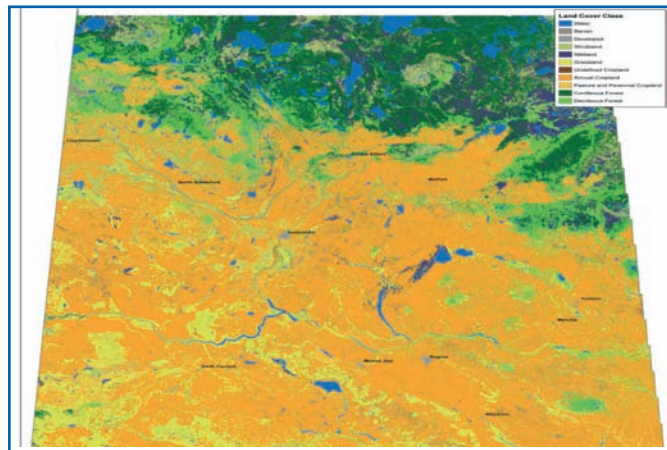
Land cover monitoring supports a range of agri-environmental information and application needs, including decision making and monitoring for land use and management; production insurance; development of agri-environmental performance indicators; climate change monitoring plus carbon and greenhouse gas accounting and verification; biodiversity monitoring; environmental farm planning and incentive programs for the adoption of beneficial management practices.

### Participants

The production of a national land cover map is led by AAFC in collaboration with Natural Resources Canada (Canadian Forest Service), GeoBase, the Inter-Agency Committee on Geomatics, the Canadian Space Agency and Environment Canada (Canadian Wetland Inventory).

### Current Status and Next Steps

Production of a baseline circa 2000 land cover map of western Canada is near completion and will be distributed through NLWIS. Future work will produce baseline information for other parts of Canada, as well as information on land cover changes.



*Medium-resolution land cover map, Province of Saskatchewan, Canada, circa 2000*

## 1.2 Land Use/Crop Type Inventory

### Description

Earth observation technology provides an efficient approach to large area mapping of crop information. AAFC has developed a methodology that integrates data from radar and optical satellite sensors to classify crops across Canada's agricultural landscape (Figure 2). Integration of radar data in the methodology improves the reliability of delivering an annual crop inventory.

### Value Added

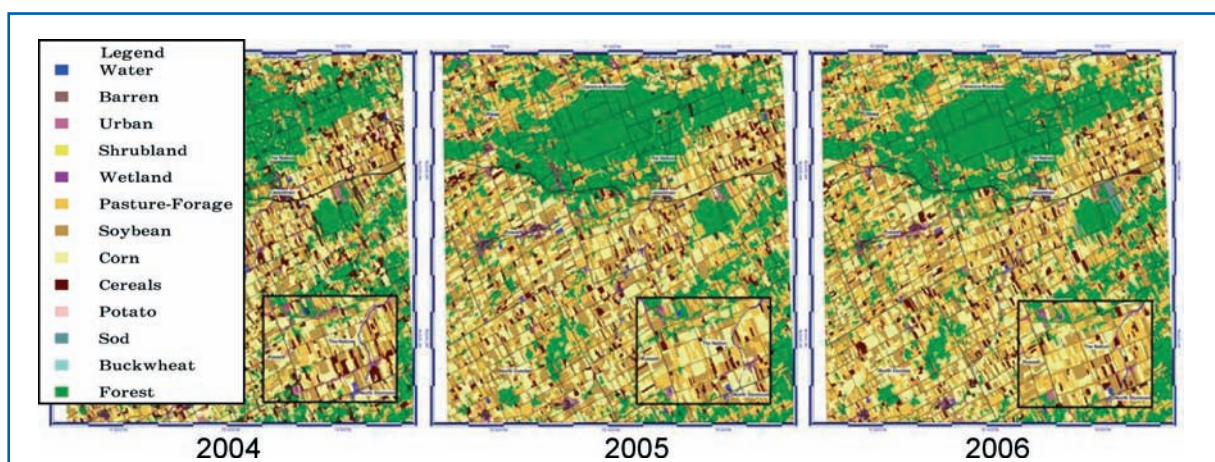
Annual crop inventories are of value to a diverse user community. Annual information on crops will support programs to understand, assess, predict, mitigate and adapt to climate variability and its associated risks, contribute to sustainable agriculture and improve land management decisions.

### Participants

AAFC research scientists and NLWIS worked together to develop the crop inventory methodology with support from the Canadian Space Agency.

### Current Status and Next Steps

The crop classification approach has been tested for multiple years over multiple sites across Canada. NLWIS will continue piloting the production of these products while automating the methods and assessing other operational requirements.



*Cropping monitoring to obtain information on state and change in crop acreage and rotations*



## Crop Conditions from Medium-Resolution Imagery

### Summary

Canada's Crop Condition Assessment Program (CCAP) is developed and maintained by Statistics Canada and is delivered to the public free of charge through Agriculture and Agri-Food Canada's National Land and Water Information Service (NLWIS) and National Agroclimate Information Service (NAIS), led by Agriculture and Agri-Food Canada (AAFC). NLWIS provides open and free access to data, information and tools over the Internet to support sound land use decision making by Canadians. NLWIS is also generating the next generation of CCAP products to ensure the future delivery of crop condition information. NLWIS will conform to the Canadian Geospatial Data Infrastructure (CGDI) and international (Open Geospatial Consortium, OGC) standards. NLWIS and AAFC's research community are working together in developing the next generation of Earth observation products to meet ongoing and emerging user needs.

### Relevance to GEO

The Crop Condition Assessment Program supports many of the user needs documented in the Socio-Economic Benefit Areas (SEBAs) identified by the GEO international community, in particular:

- Understanding, assessing, predicting, mitigating and adapting to climate variability and change;
- Improving the management and protection of terrestrial, coastal and marine ecosystems;
- Supporting sustainable agriculture and combating desertification;

### Description

Canadian crop conditions are required regularly in near real time for crop condition assessment purposes. AAFC currently uses Advanced Very High Resolution Radiometer (AVHRR from NOAA)-derived 1km-resolution Normalized Difference Vegetation Index (NDVI) data for crop assessment on the prairies (weekly composites) and across the country (10-day composites). Due to field size variability in Canada, AVHRR is too coarse for some applications, and there are concerns about the continuity of these data. As a result, AAFC has developed a system for processing 250m-resolution NDVI data for both weekly composites and multiple time-period composites for all of Canada from Moderate Resolution Imaging Spectroradiometer (MODIS from NASA). NLWIS is developing an operational system that can create weekly NDVI datasets with a three-day lag for posting on the Internet (Figure 1). The system will be operational for the 2008 growing season.



Weekly crop condition imagery (NDVI) from the MODIS satellite sensor

### **Added Value**

Crop condition monitoring contributes to policy outcomes by supporting water resources management, reducing vulnerability to risk, and supporting production risk programs. It is a particularly important contributor to several agri-environmental information and application needs, especially monitoring of drought and other risks to sustainability.

### **Participants**

The MODIS data processing and analysis system for crop condition assessment is led by AAFC working in close collaboration with Statistics Canada and the Canada Centre for Remote Sensing of Natural Resources Canada.

### **Current Status and Next Steps**

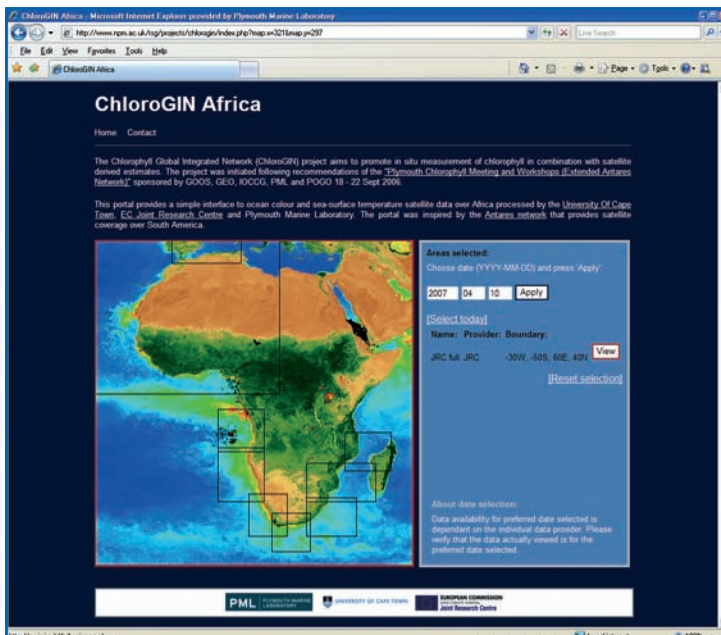
The system to produce near-real-time NDVI composites is in place. Work is under way to prepare the Web delivery tool and investigate other products that can be developed from MODIS data.

# Building a Chlorophyll Ocean Globally Integrated Network (ChlorOGIN)

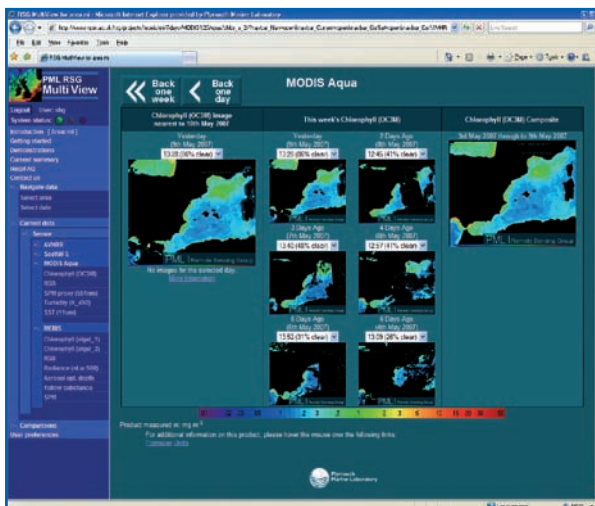
## Description

The aim of the project is to deliver products, namely maps of ocean chlorophyll and sea surface temperature, as indicators of the state of the ecosystem needed for ecosystem and fisheries management, and at some sites, a measure of light penetration into the ocean, which is needed, along with the other two variables, to calculate plankton primary production.

The project has identified three initial principal regional centres, in Latin America, southern Africa, and India linked by good communications to three northern centres in UK, the European Commission, and USA. During the first five-year phase, map products would be regularly updated regularly on a web site at each centre, while the infrastructure was improved and personnel trained at new centres. During the second five-year phase, the existing centres would become fully operational with a range of products suited to local needs, and new centres developed.



Website of ChlorOGIN Africa



Contributing Site at PML, UK

### Added Value

- GEO facilitates the transition from regional networks to a globally integrated network
- ChlorOGIN will provide GEO with an effective example of integrated networking of regional capabilities with specific focus on capacity building in less developed regions

### Relevance to GEO

The ChlorOGIN activity is linked explicitly to a task under the Ecosystem SBA (see below). However, the activity also has implicit links with other GEO SBAs including: for the Climate SBA tasks on Essential Climate Variables and GOOS and for the Water SBA on coastal water quality tasks.

Ecosystems: EC-06-07 and EC-06-02;  
Agriculture AG-06-02.

### Participants

- Argentina
- Australia
- Brazil
- Canada
- Chile
- China
- EC
- India
- Mexico
- Namibia
- Peru
- Philippines,
- South Africa
- Sri Lanka
- Switzerland
- Tanzania
- Thailand
- Venezuela
- Vietnam

### Current Status and Next Steps

- The ChlorOGIN activity has a fundamental requirement in the long-term availability of Ocean Colour satellite observations for coastal regions of the world's ocean.
- Initial seed funding is envisaged through institutional budget of the participation organizations and through research funding through various national and international research programmes. Initiatives to secure long-term funding will be sought through the World Bank, LME programme, regional development banks and other international donor organizations.
- Related web sites: <http://www.ocean-partners.org/meetings/ChIPML.htm>  
<http://home.antaes.ws/>  
<http://www.npm.ac.uk/rsg/projects/chlorogin/>  
<http://www.rsmarinesa.org.za/>  
<http://amis.jrc.ec.europa.eu/>

## **GEOSS Energy Community of Practice on-line survey on users' requirements of wind energy information**

### **Description**

Canada is a large country, approaching a billion hectares in size. With over 400 million hectares of forested land that contributes \$37 billion dollars to the balance of trade, Canada is determined to be a good steward of this renewable resource. Ensuring effective resource management requires current and reliable forest information. In support of national and international reporting requirements, Natural Resources Canada-Canadian Forest Service (NRCan-CFS), in partnership with the Canadian Space Agency, is using space-based, earth observation (EO) technologies to monitor the sustainable development of Canada's forests through an initiative called the Earth Observation for Sustainable Development of forests (EOSD). The initiative has produced a land cover map of the forested ecozones of Canada using circa year 2000 Landsat satellite data. Inputs from EOSD are an important data source in the National Forest Carbon Accounting Framework and Canada's new plot-based National Forest Inventory. The National Forest Information System is used to integrate and synthesize applicable data and products.

### **Added Value**

The EOSD team has worked with the international land cover community and GEO since 2005 to build the foundations for land cover observations as an integral part of a Global Earth Observation System of Systems (GEOSS). GEO offers opportunities for improvement and has been driving observation progress through: highlighting the societal needs and relevance of land cover observations; providing a forum for advocating land cover and change observations as a key issue; fostering integrated perspectives for continuity and consistency of land observations, in particular for joint international efforts; and finally by helping to develop international partnerships involving producers, users and the scientific community to make better use of existing datasets.

### **Relevance to GEO**

The GEO, in its 10 year reference document, emphasizes the importance of land cover for all societal benefit areas. In Canada and around the world, reliable land cover observations are of crucial importance to understanding climate change and mitigating its impacts. Land cover information is therefore relevant to natural resources management, conservation of biodiversity, and understanding of ecosystems and biogeochemical cycling.

A specific task in the GEO 2007-2009 work plan (DA-07-02) addresses land cover issues, with the overall goal to provide a suite of global land cover datasets, initially based on improved and validated moderate resolution land cover maps and eventually including land-cover change at high resolution. Canada's EOSD land cover team is contributing to this task.

Using single scenes of Landsat data to produce land cover information is not uncommon. However, combining several, or even hundreds of Landsat scenes for the development of a large area land cover map, remains a challenging task. To cover the forested areas of Canada EOSD mapped approximately 800 Million ha, requiring over 475 images. The classification approach for EOSD is based upon a hyperclustering, cluster merging, and labeling approach. The new approaches to land cover mapping used in EOSD contribute to improvements in global mapping. Conversely, international approaches benefit national land cover mapping. For example, the legend used for EOSD complies with the international Land Cover Classification System (LCCS).

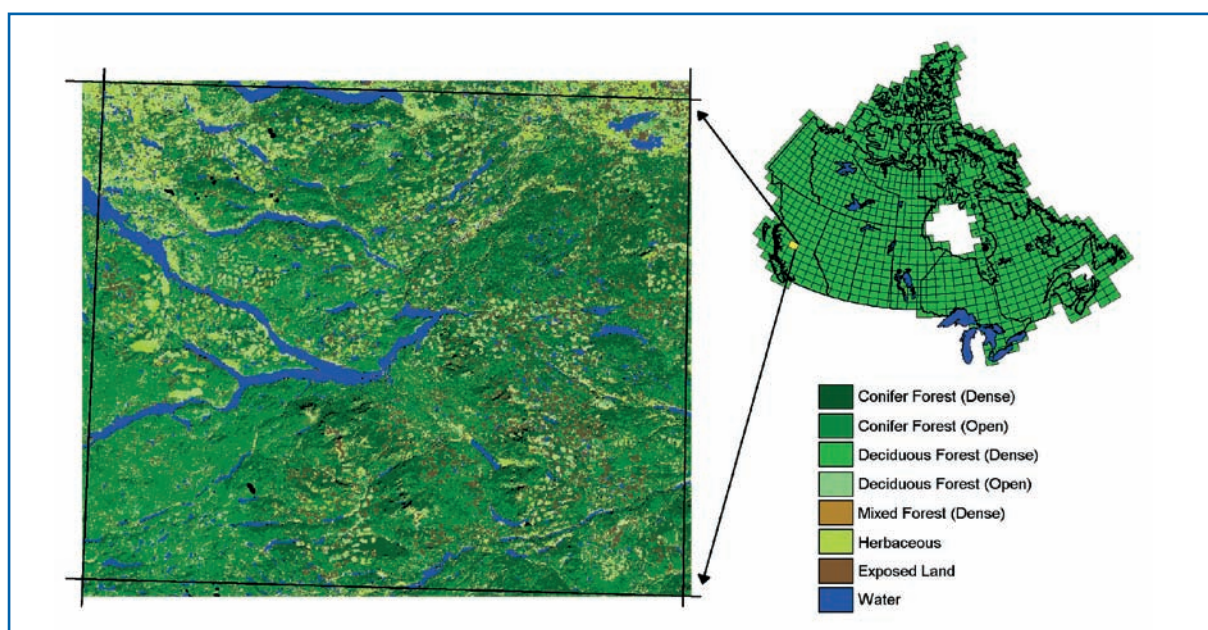


## Participants

Natural Resources Canada, Canadian Forest Service; Canadian Provinces and Territories; Canadian Space Agency; universities; crown corporations; industry; Global Observation of Land and Forest Cover Dynamics (GOFC-GOLD)

## Current Status and Next Steps

Over 610 1:250,000 scale map sheets are required to cover the forested ecozones of Canada; all are complete and available for download via the EOSD Land Cover portal termed SAFORAH [http://eosd.cfs.nrcan.gc.ca/cover/implementation/index\\_e.html](http://eosd.cfs.nrcan.gc.ca/cover/implementation/index_e.html). A protocol for addressing the accuracy of the national EOSD product based upon a stratified random sample is being tested.



*Sample EOSD land cover classification product, representing same area as NTS 1:250,000 map sheet 93F (Nechako River, B.C., Canada).*

EOSD will contribute to meeting Canada's national and international reporting requirements related to climate change and sustainable forest management by mapping the forested areas of Canada. This task required the support and concerted efforts of many partners to complete. Cooperation and communication among various levels of governments within Canada and with international organizations such as GEO, provide an opportunity to share resources and work towards common objectives.

## Global Invasive Species Information Network Pilot System

### Description

1. Completion, distribution, and analysis of the *Global Invasive Species Information Network (GISIN) Needs Assessment*

2. Completion of an alpha version of the *Global Invasive Species Information Network*, which is developing strategies for implementing cross search functionality among existing online invasive species information systems from around the globe (see figure at right).

3. Organization of a *GISIN data providers workshop* to code Web services for invasive species data sharing, to take place 13-16 November 2007. Participants are expected from Argentina, China, New Zealand, Philippines, Poland, United Kingdom, and the United States.



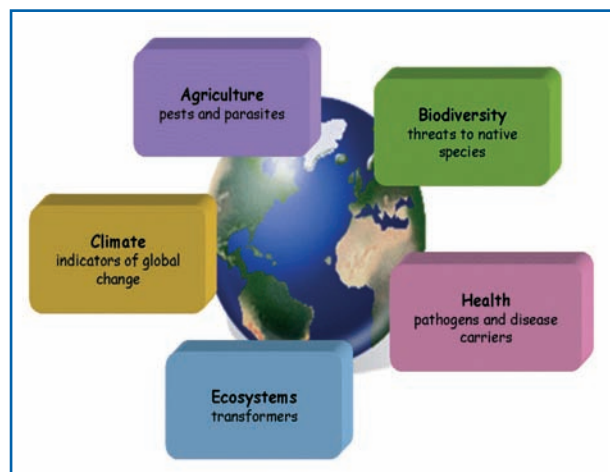
### Added value

GEO has been the one of the main drivers for achieving the standardization of the visual components of the GISIN. Related to the progress reported, GEO has:

- Provided the forum for advocating invasive species monitoring observations as a critical issue;
- Promoted a shared vision within the invasive species information management community and involved global actors;
- Advocated joint participation in ongoing invasive species global mapping activities, regional networking and capacity building in developing countries, by providing funding for the data providers workshop
- Helped to develop international partnership involving invasive species data providers and organizations consuming the data for modeling and other analyses, to better use existing datasets.

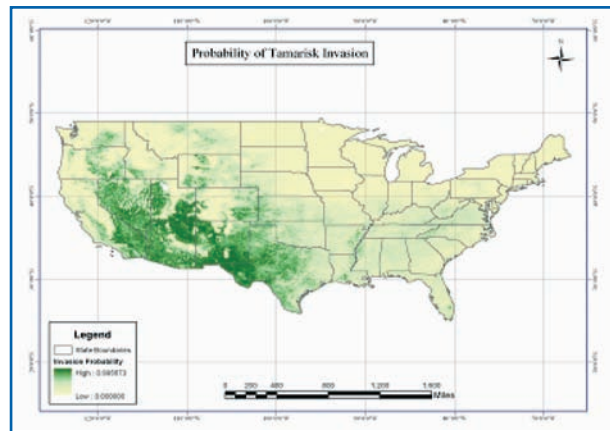
### Relevance to GEO

SBA's and 10 year work plan The GEOSS 10-Year Plan, Section 4.1.7, states that 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. Invasive species threaten biodiversity resources and exert a tremendous cost on society for prevention and eradication. It is therefore necessary to characterize, monitor and predict changes in the distribution of invasive species, which are a cross-cutting issue in today's changing world. The figure on to the left states only a few examples of the effects of invasive species across five GEO SBA's.



## Preliminary Visualizations by Two GISIN Participant Organizations

The United States Geological Survey (USGS) *National Institute of Invasive Species Science (NIISS)* (<http://www.niiss.org>) and Colorado State University have developed a Global Organism Monitoring System (GODM) which is a sophisticated, real-time, online mapping system designed to map, monitor, and predict known and likely locations of invasive species globally. NIISS/GODM also hosts the Tamarisk Cooperative Mapping Initiative (Tmap). To the left you can see a map based on this information predicting the probability of tamarisk invasion. Tamarisk is a riparian shrub native to Asia that consumes large quantities of water and secretes salt, thus causing a severe impact in the dry southwestern US, where it is an invader. This map is a predictive surface representing the probability of tamarisk invasion in 48 US states. It was created using presence and absence points obtained by the USGS NIISS and the Natural Resource Ecology Laboratory (NREL) at Colorado State University in conjunction with the NASA Invasive Species Forecasting Service (ISFS).



GISIN partner *Discover Life* (<http://www.discover-life.org>) serves more than a million species pages and currently receives 8 million hits per month on its Web-based information system. Their Global Mapper image at right, created with a partnership from TopoZone.com, shows 1249 occurrence records on a global level for *Rosa multiflora* (invasive in North and Central America and native to Asia). Data points are from Plant Bug (1); Blogger Bioblitz (2); US Southeast Exotic Pest Plant Council (203); Invasive Plant Atlas of New England (451); Missouri Botanical Garden (59); Concord Public Works (523); Western Kentucky University (10).



## Main Participants in GEO task BI-07-02

Annie Simpson (US National Biological Information Infrastructure), Jeff Morisette (NASA), Jim Graham (Natural Resources Ecology Laboratory, Colorado State University), Michael Browne (IUCN Species Survival Commission's Invasive Species Specialist Group), Shawn Dalton and Pam Fuller (US Geological Survey's Florida Integrated Science Center), John Pickering (Discover Life), Brian Steves and Greg Ruiz (Smithsonian Institution).

## Current and Next Steps

- User testing of the pilot GISIN system
- Testing and utilization of the system by data providers is ongoing.
- Development and distribution of GISIN data provider toolkits
- Funding is anticipated for toolkit development during 2008.
- Recruitment and training of additional data providers
- There are more than 200 online systems that could be added to the system over the next ten years.
- Providing and drawing data layers from other task groups
- Georeferenced invasive species information is becoming available through several GEO task groups in Ecology, Biodiversity, and Agriculture SBA's. Protocols to exchange meaningful information in both directions via web services are being developed with significant breakthroughs anticipated within the next two years.

## Interoperability Process Pilot Project (IP3): Biodiversity/Climate Change

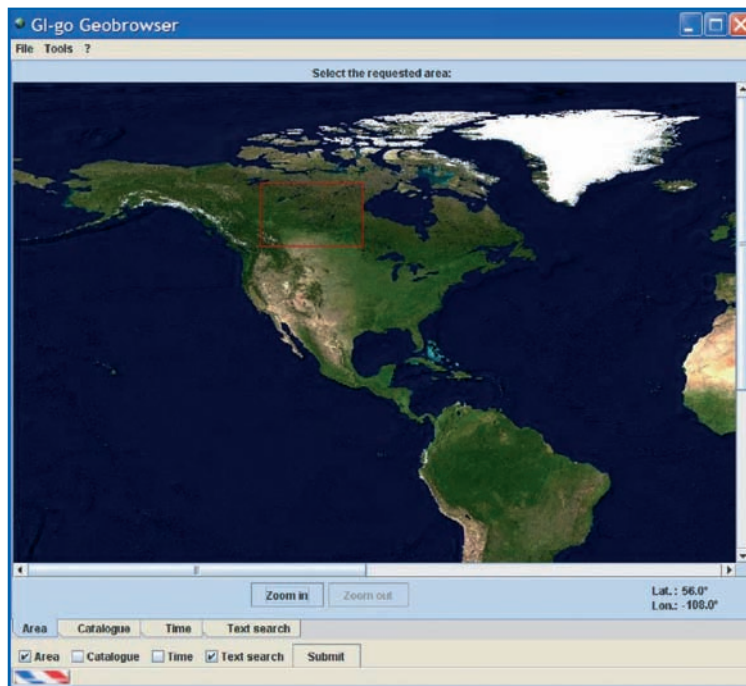
### Description

Species' Responses to Climate Change: GBIF and WIS data, Ecological Niche Modelling, and Web services.

A partnership among the Global Biodiversity Information Facility (GBIF), the World Meteorological Organisation (WMO), the Italian National Research Council, and the Universities of Florence, Ottawa and Helsinki is demonstrating the ability we now have to predict the response of species to climate change.

Data integration via database interoperability, in conjunction with an analytical technique known as Ecological Niche Modelling (ENM), can be used to make such predictions. As an example, this demonstration will map out likely changes in distribution of Canadian and Alaskan butterfly species in response to various climate change scenarios.

The project is possible because adequate primary species occurrence data are openly available through the GBIF network, and climate data can be publicly accessed from the WMO Information System (WIS). At the IT level, a «web client» can integrate data from disparate sources, if they provide «web services», such that a user can acquire all necessary data, as well as the analytical tools, via a single point of access.



*The GI-go Geobrowser interface is part of the web client suite under development by the Italian National Research Council and the University Of Florence that will incorporate GBIF and WIS data, and ENM tools.*

**Added value**

This activity allows species data to be readily integrated with climate, physical and biological data to support the characterization, forecasting, monitoring and modelling of biodiversity.

**Relevance to GEO**

This activity supports a wide range of GEO Tasks including Capturing Historical Biodiversity Data (BI-06-03), the GEO Biodiversity Observation Network (BI-07-01), Invasive Species Monitoring (BI-07-02).

**Participants**

- Global Biodiversity Information Facility (GBIF)
- World Meteorological Organisation (WMO)
- Italian National Research Council (CNR-IMAA)
- University of Florence
- University of Helsinki
- University of Ottawa

**Current Status and Next Steps**

The web client developed for this IP3 demonstration project, which accesses GBIF and WIS data, and ENM tools, will be accessible on the Internet by September, 2007.



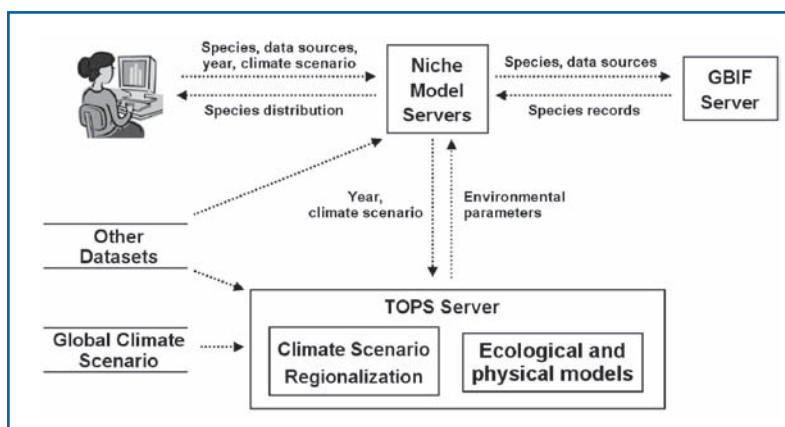
## Towards a global biodiversity observation network

### Description

1. To start the process of monitoring biodiversity on a global scale, a workshop in October 2006 (Geneva, Switzerland) established the GEO Biodiversity Observation Network (<http://www.bioobservation.net/>) which is a global partnership to collect, manage, analyze and report on the status and trends of the world's biodiversity. The network will first provide a framework for global biodiversity monitoring, and then generate biodiversity data and information from many different provider communities (e.g. museum collections, organism observations, remote sensing systems, intensive plot-type biodiversity measuring and monitoring systems, etc.), ascertain data requirements of user groups, review and prioritize research, facilitate interoperability among information system components and the interconnectivity of databases, generate regularly repeated assessments of global biodiversity trends, design decision support systems that integrate monitoring with ecological modelling and forecasting, and make data and reports available to users via the internet using the GEOSS framework. It is made up of many relevant programs and networks, e.g. Census of Marine Life, DIVERSITAS, GBIF, GTOS, IUCN, NASA, UNESCO-MAB and 2010 BIP, to name just a few (see also <http://www.twentyten.net/partnership.htm>).

The task of the network is to assess biodiversity at both the species and ecosystems level, and thereby identify unique or highly diverse ecosystems and those supporting migratory, endemic or globally threatened species, those whose biodiversity is of socio-economic importance, while taking into account the results of the Millennium Ecosystem Assessment and progress towards the CBD 2010 Targets. DIVERSITAS and NASA are leading the early planning stages for the Network, and for this purpose, DIVERSITAS has assembled an expert group of monitoring and modelling scientists under its bioDISCOVERY Core Project which will develop a scientific framework to improve global biodiversity monitoring.

2. The Ecological Forecasting Program at NASA is developing the concept of an Ecological Model Web (see Figure below), which would be an open-ended system to improve ecological forecasting abilities via improved model interoperability. Largely through the use of web services, and following the GEOSS architecture, the Model Web would allow various computer models and databases covering a broad range of processes to interoperate and so increase the range of questions they can answer. Currently, model interoperability is limited by both technical and non-technical barriers, thus limiting their potential uses and users. The Model Web would lower such barriers so that global access to sophisticated ecological modelling and forecasting becomes a reality.



*Simplified view of the initial Ecological Model Web demonstration system. A user first selects a species and climate scenario. This information is then used to build a model correlating species distribution with present climate variables. Next, a global climate scenario is combined with other ecological and physical models by the Terrestrial Observation and Prediction System (TOPS) model framework. TOPS then passes the future climate scenario back to the Niche Model which then calculates the species' future distribution. This can then be used for conservation*

3. The USGS, NBII, and other governmental and non-governmental institutions are developing the following tools to improve analyses of biodiversity data:

- the Global Integrated Trends Analysis Network (GITAN) is developing a Global Data Toolset (GDT, <http://rockyitr.cr.usgs.gov/gitan/>) which is an operational and easy to use on-line polygon data entry tool to facilitate an organization's ability to engage their network in the entry and/or validation of digital data (e.g. protected areas, species distributions, Important Bird Areas);

- Rapid Land Cover/Ecosystem Mapping Tool: an on-line technique to manually interpret satellite imagery for mapping land cover;
- Integrated Taxonomic Information System (ITIS): a taxonomic crosswalk to operationally compare, integrate, and apply global biodiversity data sets; and
- TerraLook (<http://terralook.cr.usgs.gov/>): a joint NASA/USGS project that expands and broadens the remote sensing user community by providing user-selectable collections of satellite images from three historical epochs (circa 1975, 1990, and 2000), as well as current images.

4. The 2010 Biodiversity Indicators Partnership was established in direct response to the need for global biodiversity indicators to track progress toward the 2010 biodiversity target. The Partnership brings together the numerous organisations and agencies working on developing and communicating biodiversity indicators in support of the 2010 target, and will facilitate the regular delivery of global biodiversity indicators into the CBD and other relevant fora in order to help track progress toward the 2010 target.

### Added value

As described above, GEOSS-related activities have helped to improve data access, sharing, and use, and to establish forums for interdisciplinary collaboration and community building within the observation community, thus providing tools to advance biodiversity science and its applications. In the near future, the biodiversity science community, through the GEOSS framework, will define an implementation strategy for a biodiversity observation network; increase capacity building; develop more tools for policy making to be used in decision-making; develop cross-links with other GEOSS «Societal Benefit Areas», e.g. land use change, coastal zones, water management, health, etc.; and further integrate monitoring activities and modelling exercises.

### Relevance to GEO

Biodiversity is one of the nine «Societal Benefit Areas» of GEOSS because biodiversity contributes both utilitarian values (e.g. ecosystem goods and services) as well as intrinsic values (e.g. aesthetic enjoyment) to human well-being. Moreover, it is inextricably linked to the other eight «Societal Benefit Areas» and to at least three of the Millennium Development Goals. The functional connections between the elements of biodiversity make up the life-support system of the biosphere, and thus monitoring the global status and trends of biodiversity is integral to the mission statement of GEOSS. More specifically, the development of long-term monitoring sites and programs, of improved analysis of remote data, of accelerating digitization of observation data, of increased interconnectivity of databases, of global conservation priorities, and of more reliable biodiversity indicators, are to a large part the result of the work initiated by the CBD 2010 Targets and the establishment of GEOSS. The activities related to the Biodiversity Task are making GEOSS a more reliable system for analysis, prediction, conservation management, and policy making.

### Participants

Neville Ash, Norbert Jürgens, Anne Larigauderie, Paul Leadley, Georgina Mace, Harold A. Mooney, Robert J. Scholes, Bruno A. Walther (DIVERSITAS), Meredith A. Lane (GBIF), Douglas Muchoney (GEO Secretariat), Gary N. Geller, Woody Turner (NASA)

### Current status and next steps

Further GEOSS-sponsored workshops are planned for December 2007 and early 2008, while the associated initiatives are all continuing their work through workshops, reports and ongoing tool development. Efforts are ongoing to establish several working groups advised by a steering committee and the development of tools (such as the Global Data Toolset, Rapid Land Cover/Ecosystem Mapping Tool, ITIS, TerraLook and the Ecological Model Web) continues. A demonstration system is being developed that will test the viability of the concept and provide a core onto which further components and tools can be added.



GEO Secretariat  
Av. de la Paix 7 bis  
CP 2300  
CH-1211 Geneva 2  
Switzerland  
Tel : +41 22 730 8505  
secretariat@geosec.org  
[www.earthobservations.org](http://www.earthobservations.org)