An international partnership for global environmental observation

IGOS Integrated Global Observing Strategy

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Editorial

THE IGOS PARTNERSHIP APPROACHES ITS 5TH ANNIVERSARY

by Walter Erdelen & Greg Withee
IGOS Partnership Co-Chairs

As we approach the 5th anniversary of the establishment of the IGOS Partnership, we naturally tend to look at the progress made to date and reflect on our goal to develop a global observing strategy based on integrated satellite and in-situ measurements. In particular, we are delighted to see that many IGOS Themes are likely to achieve the significant milestone of completing Theme Reports this year. This is a key achievement in the IGOS Theme Process as these new Reports will be used by Partners to develop mission requirements, facilitate international cooperation, and lead to greater exchange of both policy and technical information. Furthermore, Theme Reports consolidate a coherent set of user requirements, helping in the transition from "research to operations" in the specific Theme areas.

◀ *Greg Withee (NOAA)*

▲ *Walter Ederlen (UNESCO)*

IGOS Theme Developments:

Below, we would like to provide a few milestones being achieved by IGOS Themes:

- After publishing the Ocean Theme Report in January 2001, a rolling review is underway to revise and update the Theme by 2004. This will be the first rolling review undertaken by IGOS to update a Theme Report, thus bringing a practical demonstration of the entire IGOS Theme Process full circle.
- A dedicated Carbon Theme Team has developed a Report for consideration at the June 2003 Partners Meeting. This Report aims to communicate goals for the near future, and the next 10 years, regarding the need for a more comprehensive carbon observing strategy.
- A draft Water Cycle Theme Report is being finalized for consideration at the June Partners' meeting.
- The GeoHazards Theme developed a Draft Report focusing on volcanoes, earthquakes and ground instability to be presented at the June Partners' meeting. Their final Report will be completed before the end of the year.
- The Atmospheric Chemistry Theme expects to present its Theme Report by the end of the year.
- The Coral Reef Subtheme has prepared a Draft Subtheme Report for consideration at the June Partners' meeting.

We also anticipate a formal go-ahead at the June meeting for the development of an IGOS Coastal Theme, representing a unique area of Earth observations where oceanographic, terrestrial and biological systems converge. Composition of this new Theme Team will include representatives from IGOS and associated NGOs, as well as members from the scientific and socio-economic communities.

Other IGOS Milestones:

While the IGOS Partners have made advancing Theme Reports a top priority this year, we have also been actively hosting Theme workshops and maintaining a notable presence at other Earth observation events. For example, IGOS organized a workshop during the World Summit for Sustainable Development in Johannesburg on the role of global observing systems for sustainable development, addressing the challenging question: *How to integrate environmental observations data with socio-economic information for better decision making?* In another example, UNESCO is planning a High-level Information Meeting on Global Earth Observation for the Ambassadors and Permanent Delegates of UNESCO's Member States in June 2003.

The IGOS Partnership has also played a pivotal role in influencing the development and focus of an Earth Observation Summit the United States is planning to host in late July 2003, with the goal of setting the foundation to move toward establishment of an international, comprehensive, integrated and sustained Earth observation system.

A Best Efforts Partnership:

IGOS Partners have continued to make significant contributions each year to IGOS Themes and the objectives of the Partnership strategy. Now, after 5 years, we are just starting to realize some of the long-term fruits of our labors – and the difference our Partnership can make. ■

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THE SECOND REPORT ON THE ADEQUACY OF THE GLOBAL OBSERVING SYSTEMS FOR CLIMATE IN SUPPORT OF THE UNFCCC

RECOMMENDATION FOR INTEGRATED GLOBAL CLIMATE PRODUCTS

The Global Climate Observing System (GCOS) prepared a first Report on the Adequacy of the Global Climate Observing Systems (GCOS-48) in 1998 for the United Nations Framework Convention on Climate Change (UNFCCC). Since then, the UNFCCC Conference of the Parties (COP), individual Parties and International Agencies have undertaken a range of actions to address the reported inadequacies. In 2002, the Subsidiary Body for Scientific and Technical Advise (SBSTA) to the COP endorsed the preparation of a second report on the adequacy of global observing systems for climate to meet their needs as well as those of the Intergovernmental Panel on Climate Change (IPCC). The goals of this Second Adequacy Report were to determine what progress has been made in implementing climate observing networks and systems since the first report and to assess how well these current systems, together with new and emerging methods of observation, will meet the needs of the Convention. The Report has involved international experts in the analyses of the adequacy of the current global observing systems for climate and provided for an open review process.

The Second Adequacy Report concludes that there have been improvements and progress in implementing global observing systems for climate, especially in the use of satellite information and in the provision of some ocean observations. At the same time, the report notes that the global terrestrial networks remain to be fully implemented, the ocean networks lack coverage and commitment to sustained operation, and the atmospheric networks are not operating with the required global coverage and quality. In line with the findings of the IPCC Third Assessment Report, the Second Adequacy Report concludes that there remain serious deficiencies in the ability of global observing systems for climate to meet the identified needs of the UNFCCC.

The GCOS Steering Committee identified four overarching (and equally high priority) areas for action within the Report, including:

1. Adherence to the principles of free and unrestricted exchange of data, particularly in relation to the designated Essential Climate Variables (see **Table 1**) and to the provision of these data to international data centres.

- SBSTA, in consultation with the GCOS Secretariat, should review the guidelines for national communications in relation to research and systematic observation (Decision 4/CP.5) to include, *inter alia*, a specific requirement to report on the exchange of the Essential Climate Variables and associated products and on the submission of current and historical data and metadata to international data centres.

2. Capacity building and system improvements – Need for commitment by countries to the full implementation of integrated global observing systems for climate, sustained on the basis of a mix of high-quality satellite and *in situ* measurements, dedicated infrastructure and targeted capacity-building.

- Countries are encouraged to contribute to a voluntary (non-UNFCCC) funding mechanism to support high-priority needs relating to global observing systems for climate in developing countries and some countries with economies in transition, especially the least-developed countries and small-island developing states.

3. Terrestrial Standards – Intergovernmental agencies consider establishing a mechanism to prepare guidance materials and develop agreements on standards and regulations for terrestrial observing systems, data, and products.

4. Integrated global climate products - Institutionalize appropriate processes for generating and making available, on a sustained basis, a range of integrated climate-quality products relevant to the needs of the UNFCCC, including those based on re-analysis of homogeneous historical data. In doing so, the attention of relevant Parties and intergovernmental agencies should be drawn to the need to address identified deficiencies in the underlying data and observing systems.

Other issues identified in the Report needing attention include:

- Adherence to the GCOS Climate Monitoring Principles;
- Rescue of historical data and metadata;
- Use of climate data as input to decision-making processes;
- Need for national plans for systematic observation and for development of regional action plans and priorities; and

Table 1

Domain	Essential Climate Variables that are both currently feasible for global implementation and with a high impact on UNFCCC requirements
Atmospheric (Over land, sea and ice)	**Surface:** Air temperature, Precipitation, Air pressure, Surface radiation budget, Wind speed and direction, Water vapour. **Upper air:** Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction, Water vapour, Cloud properties. **Composition:** Carbon dioxide, Methane, Ozone, Other long-lived greenhouse gases, Aerosol properties.
Oceanic	**Surface:** Sea-surface temperature, Sea-surface salinity, Sea level, Sea-state, Sea ice, Current, Ocean colour (for biological activity), Carbon dioxide partial pressure. **Sub-surface:** Temperature, Salinity, Current, Nutrients, Carbon, Ocean tracers, Phytoplankton.
Terrestrial	River discharge, Water use, Ground water, Lake levels, Snow-cover, Glaciers and ice caps, Permafrost and seasonally-frozen ground, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Leaf Area Index (LAI), Biomass, Fire disturbance.

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- Special needs of developing countries, particularly the least-developed countries and the small-island developing states, and some countries with economies in transition, to allow for participation in and application of systematic observations.

Integrated global climate products

While observations of the climate variables are an essential pre-requisite, the users of the information require analyzed outputs and products. Such products will usually require the integration of observations over time and often involve data from different sources for the same variable, such as *in situ* and satellite observations. For each global product and related data set, routine product generation will require a dedicated analysis center.

Extracting the maximum amount of useful information from past and current climate observations can be done most effectively through analysis techniques, such as data assimilation and re-analysis that integrate diverse data sets into a comprehensive and internally consistent description of the state of the climate system. These techniques have been applied to atmospheric data covering the past five decades, especially for weather prediction. Improvements are necessary for climate applications, e.g., for monitoring climate variability and trends and for variables related to the composition of the atmosphere and forcing of the climate system. Furthermore, inclusion of historical data and their associated metadata could substantially improve the quality of most products and analyses. It is in this last area that the least-developed countries, small-island states and many countries with economies in transition could benefit from assistance in the rescue of paper records, their transcription into digital form and permanent archiving.

Table 2

Domain	Variables largely dependent upon satellite data
Atmospheric (Over land, sea and ice)	Precipitation, Earth radiation budget (including solar irradiance), Upper-air temperature (including MSU radiances), Wind speed and direction (especially over the oceans), Water vapour, Cloud properties, Carbon dioxide, Ozone, Aerosol properties.
Oceanic	Sea-surface temperature, Sea level, Sea ice, Ocean colour (for biological activity).
Terrestrial	Snow cover, Glaciers and ice caps, Albedo, Land cover (including vegetation type), Fraction of absorbed photosynthetically active radiation (FAPAR), Fire disturbance.

A strategy for developing and implementing a set of integrated global products is needed for those variables in the **Table 2**:

In conclusion, the Second Adequacy Report identifies a number of high priority areas for future attention by the nations in support of the UNFCCC and other climate-related needs. An urgent need is to develop routine global products with the necessary quality to allow nations to plan for and manage their responses to climate change. ■

THE IGOS WSSD TYPE-2 PARTNERSHIP

by Josef Aschbacher (ESA) and Robert Missotten (UNESCO)

CEOS and IGOS achieved a remarkable success at the Johannesburg World Summit on Sustainable Development. The Plan of Implementation, adopted by Heads of State and Government, contains a number of specific references to the importance of global observations in support of sustainable development. To support the political action, two so-called WSSD Type-2 Partnerships have been launched, one on IGOS itself and one on Earth Observation Education and Training. In addition, CEOS as a key member of IGOS, has initiated a WSSD Follow-up Programme, which carries out concrete actions on water resources management, climate change, disaster monitoring, global mapping, and education, training and capacity building.

The IGOS Type-2 Partnership will serve two main purposes. First, to underline the relevance of the IGOS Themes with respect to sustainable development and, wherever possible, highlight the Theme's activities along the objectives of Johannesburg; and second, to provide a common platform for an increased visibility of IGOS activities vis-à-vis the sustainable development community. The latter will be particularly helpful when highlighting the benefits of CEOS and IGOS for sustainable development to third partners such as the World Bank, regional development banks, GEF, UNDP or similar institutions, which have a long-term strategic mandate to support development activities.

Stimulated by the Johannesburg outcome, a number of organisations have launched concrete actions to support the goals of the Summit. One among these is the TIGER project, initiated by ESA and in the meanwhile joined by a number of organisations, which focuses on water resources management in Africa using earth observation. UNESCO and ESA are establishing a strategic partnership (Satellite Hydrology International Partnership, SHIP) to assure a proper integration of provider and user communities. The TIGER/SHIP initiative has recently been submitted as a Type 2 Partnership, and the goal is to better integrate the TIGER/SHIP activities with the IGOS Partnership and its corresponding activities within the relevant Themes. ■

THE GEOHAZARDS THEME: AN UPDATE

Stuart Marsh (British Geological Survey, Theme Team Chairman) and Rosalind Helz (United States Geologic Survey, Theme Team Member)

The societal impact of geohazards is enormous. Every year they claim thousands of lives, injure many thousands more, devastate peoples' homes and destroy their livelihoods. The damage to infrastructure runs into billions in any currency and is made higher still by the cost of insurance premiums. As population increases worldwide, and more people live or work in hazardous areas, the geohazards are increasingly becoming geo-disasters. To reduce these threats requires an increased understanding of the hazards, as well as better ways to monitor them and manage their effects. In response to this critical situation, the IGOS Partners approved the development of a Geohazards Theme at their June 2002 meeting. The Theme Team has been meeting regularly since then and it aims to publish its report during the second half of 2003.

Scope of the Geohazard Theme

The Theme Team will define a strategy to improve how global society forecasts, monitors and mitigates the effects of earthquakes, volcanic eruptions, landslides and ground subsidence. The ultimate goal is to provide decision makers with timely, reliable and cost-effective information, in order to increase the capacity of all nations to be resilient in the face of these geohazards. The strategy will focus first on ways to improve integration and effectiveness of existing EO and ground-based systems, as well as GIS and modelling technologies, then identify critical gaps in those systems and suggest ways that they might be filled over the next decade.

Earth Surface Deformation: the Common Thread

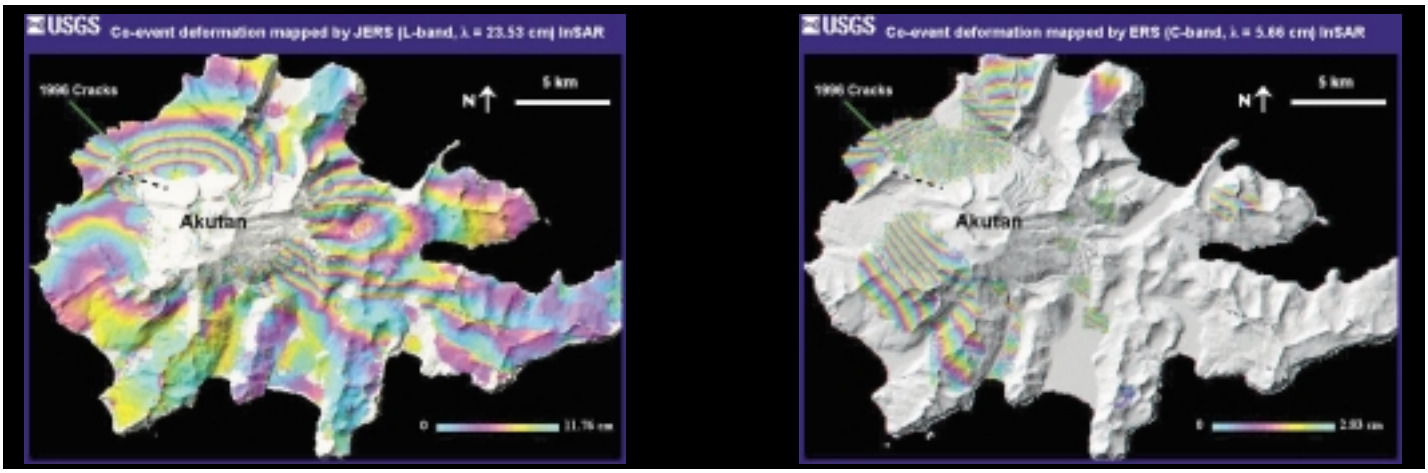
Whilst they create similar problems for society, no two geohazards are exactly alike in the way they behave. Earthquakes and volcanoes are driven by processes deep within the earth, beyond human control. While volcanoes generally awake gradually, exhibiting precursory activity that we can monitor, as yet we have no comparably reliable indicators for impending earthquakes. By contrast landslides and subsidence include a large suite of shallow crustal and surficial processes, often with a significant anthropogenic component. Despite these differences, however, all these hazards have two things in common: first, they involve deformation of the earth's surface, and second, each can occur on a scale that is catastrophic for the local population.

Within the past 10 years, our ability to monitor surface deformation has been revolutionized by the development of GPS monitoring networks and SAR interferometry. We are poised on the verge of broader deployment, testing and application of both techniques. Hence the time is ripe for an integrated strategy on how best to achieve global observation of the surface deformation associated with these geohazards in particular, alongside a number of other key parameters like temperature and surface composition. This strategy will also address the challenge of spreading best practice from a few well-observed situations to all important geohazard sites, considering issues beyond the science and technology like data access, knowledge transfer and training.

SAR Interferometry: a Critical Piece of the Strategy

Interferometric Synthetic Aperture Radar (InSAR) allows us to detect, measure and monitor subtle changes in the shape or relative position of the Earth's surface. The results enable us to see whether the target area is deforming, how much deformation has occurred and how it is distributed. Our ability to test and benefit from this technique is limited both by the scarcity of appropriate imagery and by the current absence of satellite radars having the longer L-band wavelength. As the two interferogram images below show, L-band SAR can produce coherence over a wider range of vegetated and unconsolidated natural surfaces than the shorter C-band radars currently in orbit. The Geohazards IGOS will emphasize two key recommendations: the need for a more robust and varied SAR data stream; and the need for cross-validation between this technique, which offers periodic measurements over wide areas, and deformation data from GPS and other ground-based techniques, which yield continuous data for specific points.

Left, interferogram of Akutan Volcano in the Aleutians, made from C-band ERS imagery (Lu and others, JGR, 2000) is only locally coherent (rainbow areas). Right, interferogram made from L-band JERS data (Lu and others, GRL, 2003) has fewer fringes, but achieves coherence over almost the entire surface of the island, allowing us to see the entire deformation pattern. To date, the JERS SAR mission has not been followed up with a new L-band instrument and so such observations are not currently possible.



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