



IGOS

Integrated Global Observing Strategy



For the Monitoring of our Environment from Space and from Earth

November 2005
An international partnership for cooperation in Earth observations

IGOS: the Integrated Global Observing Strategy

INTRODUCTION

An improved understanding of the Earth System – of its weather, climate, oceans, land, geology, natural resources, ecosystems, and natural and human-induced hazards – is essential if we are to better predict and respond to the expected global changes and the impacts on human civilisation.

Data collected and information created from Earth observations constitute critical inputs to sustainable management of the Earth – providing evidence for informed decision-making, supporting the science which underpins strategies for global environmental governance, and for monitoring our progress on all geographical scales.

The international scientific community is collaborating on an unprecedented global scale to understand the current state of the Earth's environment and to predict its future state. The information necessary for our improved understanding will require additional systematic and sustained observations of the Earth; and the range of global observations that will be needed to understand and monitor Earth processes and to assess human impacts is beyond the capabilities of any single programme, agency, or government. Effective monitoring of our planet on a global scale requires cooperation on a global scale.

What is the IGOS Partnership ?

OBJECTIVES

The IGOS Partnership was established in June 1998 by a formal exchange of letters among the 13 founding Partners for the definition, development and implementation of the Integrated Global Observing Strategy.

The principal objectives of the Integrated Global Observing Strategy are to address how well user requirements are being met by the existing mix of observations, including those of the global observing systems, and how they could be met in the future through better integration and optimization of remote sensing (especially space-based) and in-situ systems.

The Integrated Global Observing Strategy serves as guidance to those responsible for defining and implementing individual observing systems. Implementation of the Strategy, i.e. the establishment and maintenance of the components of an integrated global observing system, lies with those governments

and organizations that have made relevant commitments, for example, within the governing councils of the observing systems' sponsors.

To aid the development of the Strategy, the Partners have adopted an incremental "Themes" approach based on perceived priorities.

MEMBERSHIP

The IGOS Partnership brings together the efforts of a number of international bodies concerned with the observational component of global environmental issues, both from a research and a long-term operational programme perspective.

The partners are:

- **the Global Observing Systems:** The World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) is integrating a number of WMO's research and monitoring activities in the field of the atmospheric environment, focusing on the long-term measurements of the composition of the global atmosphere such as greenhouse gases, including ozone, major pollutants and aerosols. Within the last decade, the Global Observing System of the World Weather Watch (WWW/GOS) and GAW have been complemented by the



GOS/GAW



IGFA



WCRP



THE IGOS PARTNERSHIP

An agreement among the partners for the definition, development and implementation of an integrated global observing strategy

Global Ocean Observing System (**GOOS**) and the Global Terrestrial Observing System (**GTOS**) to produce a set of Global Observing Systems integrating in-situ and remotely sensed data, with each focusing on a major component of the Earth system. **GOOS** is a global system for observations, modelling and analysis of marine and ocean variables to support operational ocean services worldwide. **GTOS** is a programme for observations, modelling, and analysis of terrestrial ecosystems to support sustainable development. It facilitates access to information so that researchers and policy makers can detect and manage global and regional environmental change. The Global Climate Observing System (**GCOS**) integrates the observational needs for climate purposes across all observing systems.

- **the international agencies which sponsor the Global Observing Systems:** The Global Observing Systems are sponsored by a number of international agencies: Food and Agriculture Organization (**FAO**), International Council for Science (**ICSU**), Intergovernmental Oceanographic Commission of UNESCO (**IOC-UNESCO**), United Nations Environment Programme (**UNEP**), United Nations Educational, Scientific and Cultural Organization (**UNESCO**) and World Meteorological Organization (**WMO**);
- **the Committee on Earth Observation Satellites (CEOS):** CEOS coordinates the efforts of space agencies worldwide in

the planning of Earth observation satellite missions and their applications;

- **the International Group of Funding Agencies for Global Change Research (IGFA):** National research funding agencies and ministries involved in funding of global change research collaborate in **IGFA**;
- **international global change research programmes:** The World Climate Research Programme (**WCRP**) and the International Geosphere-Biosphere Programme (**IGBP**) are key international organizations that provide the framework and guidance for planning and coordinating research into global environmental issues.

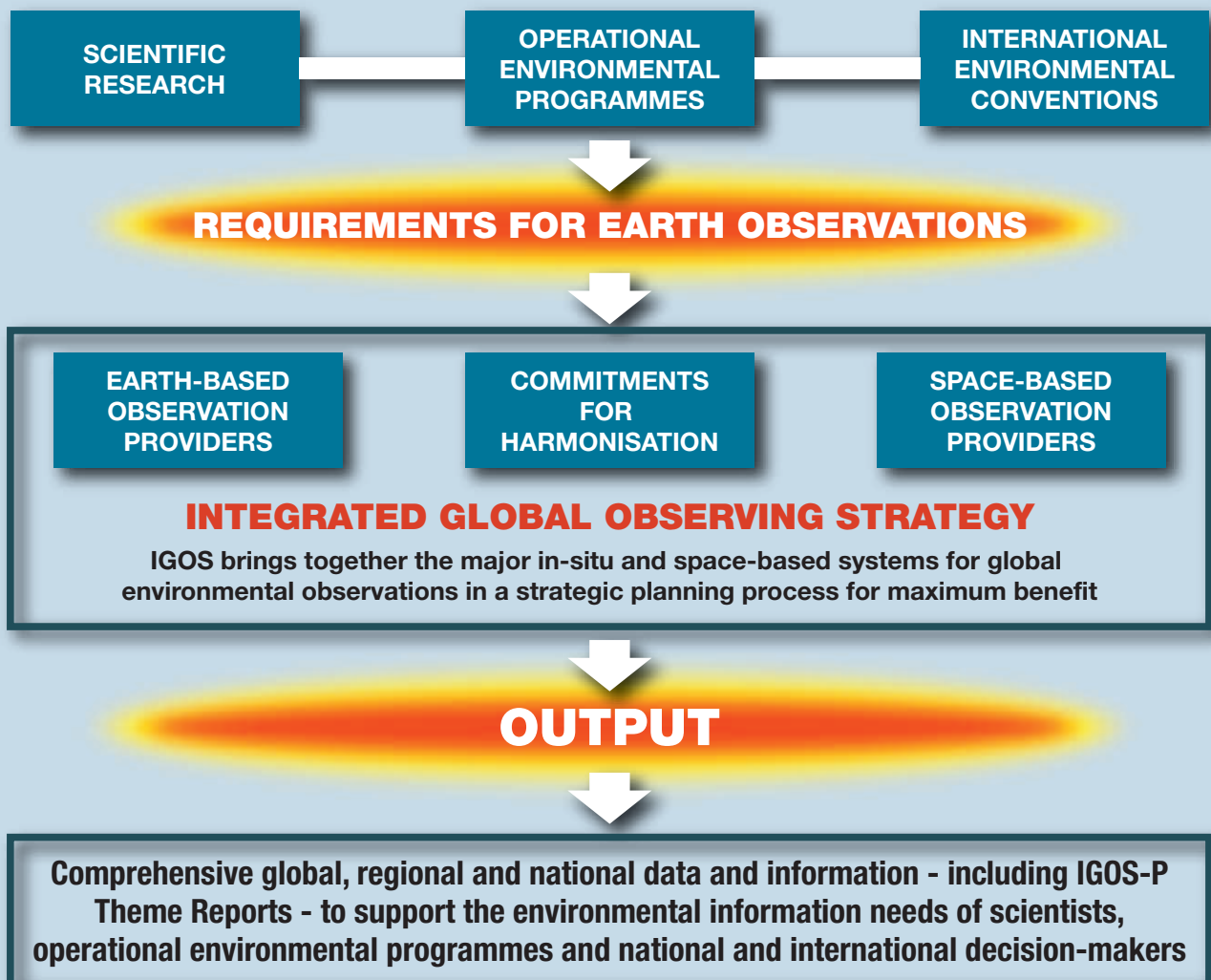
Other organizations prepared to contribute to the development of IGOS may be welcomed as Partners in future. The Partnership provides a continuing mechanism to oversee the development of IGOS. An IGOS Partnership Secretariat has been established in order to ensure continuity in the process, to provide a focus for external interfaces, and to help promote the visibility of the IGOS Partnership in key arenas, such as the environmental conventions.

The IGOS Process

The Integrated Global Observing Strategy brings together the major surface and space-based systems for global environmental observations of the atmosphere, oceans and land in a strategic planning process, in order to facilitate the necessary harmonisation and achieve maximum cost effectiveness for the total set of observations. The relevant observing systems encompass a broad range of different networks of satellite-borne and Earth-based sensors, including ocean buoys, weather stations and atmospheric radiosondes. IGOS recognises that many of these observing systems are in need of improvements, some lack the necessary long-term continuity, and all require strengthened links between the space-based and Earth-based components, as well as between the observing programmes and the processes of scientific and environmental policy-making which define the information priorities.

IGOS aims to:

- provide an **overarching view** to help improve understanding by governments of the significance of global monitoring;
- provide a **framework for decisions** to ensure continuity in the observation of key environmental variables;
- offer a **sustained forum for exchange of information** on the Partners' relevant activities and to promote dialogue between space agencies, agencies supporting in-situ observing systems and scientific research programmes;
- **identify gaps in existing observation systems** and to seek to address user and stakeholder requirements, including requirements to strengthen the institutional capacity to implement integrated global observations;
- **encourage specific activities** to develop and enhance individual components that will complement and enhance the value of the Strategy;
- promote amongst different user groups all aspects of **Strategy implementation** by national and international agencies, including supporting data policies, enhanced product processing chains, better archiving, improved accessibility to the information products and capacity building for end users.



The IGOS Themes

The Partners recognise that it is not practical to attempt to define a comprehensive global system that would in a single step satisfy all needs for environmental information. Rather, they have adopted a process - **The IGOS Themes - which allows for the coherent definition and development of an overall global strategy for observing selected areas** of common interest among a group of the Partners. Selection of the Themes is based on an assessment of the relevant scientific and operational priorities for overcoming deficiencies in information, as well as analysis of the state of development of relevant existing and planned observing systems.

The IGOS Themes Process involves:

- **agreement by the Partners** on a Theme proposal which must respect certain specified criteria;
- **establishment of a Theme Team with appropriate leadership and resources;**
- **approval by the Partnership of the Theme Team's report,** including agreement on a common set of essential observations and their technical characteristics (such as accuracy and frequency), and commitments from providers of space-based and in-situ observations;
- **establishment of an Implementation Team** with the responsibility and capacity required for the long-term implementation of the necessary operational networks;
- **a formal declaration of commitment to Theme Team** recommendations by the governments and organizations who actually implement, maintain and operate the relevant observing systems;
- **assessment of the value of the Theme.**

The Ocean Theme was the first IGOS Theme report to be approved and published - in January 2001. This Theme is now in the process of being implemented by the governments and organizations who operate the relevant observing systems. Since then a number of Theme reports have been initiated and concluded, and others are in development. The full set of IGOS Themes in implementation or development includes:

- **Ocean;**
- **Global Carbon Cycle;**
- **Geohazards;**
- **Global Water Cycle;**
- **Atmospheric Chemistry;**
- **Coastal;**
- **Land;**
- **Cryosphere.**

Each of these is described in more detail below. All Theme reports are available from the IGOS WWW site: www.igospartners.org



IGOS Theme Reports

IGOS in support of the GEOSS

GEO: The Group on Earth Observations

In what might be considered as a first step towards establishment of the Earth observations component of a far-sighted scheme for global environmental governance, high-level officials from 33 countries, from the European Commission, and from 21 international organisations, including IGOS-P, involved in Earth observations, convened in Washington DC, USA on 31st July 2003 to attend the 'Earth Observation Summit'.

Recalling the urgent need expressed by the World Summit on Sustainable Development (WSSD - Johannesburg 2002) for

coordinated observations relating to the state of the Earth, these governments and organisations adopted a Declaration signifying a political commitment to move toward development of "a comprehensive, coordinated, and sustained Earth observation system".

The Summit led to the establishment of the ad hoc Group on Earth Observations (GEO) which has developed and is executing a 10-Year Implementation Plan.



1st EO Summit

GEOSS: The Global Earth Observation System of Systems

This Plan defines the operating principles, institutions and commitments relating to the establishment of a Global Earth Observation System of Systems (GEOSS). The Group envisages that GEOSS will be:

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

GEOSS will be a distributed system of systems, building step-by-step on current cooperation efforts among existing observing and processing systems within their mandates, while encouraging and accommodating new components.

The 9 Societal Benefit Areas of GEOSS

The GEOSS Implementation plan is structured around nine 'societal benefit areas' (SBAs) agreed as the priority applications for a coordinated global observation system:

- reducing loss of life and property from natural and human-induced disasters;
- understanding environmental factors affecting human health and well being;
- improving management of energy resources;
- understanding, assessing, predicting, mitigating, and adapting to climate variability and change;
- improving water resource management through better understanding of the water cycle;
- improving weather information, forecasting, and warning;

- improving the management and protection of terrestrial, coastal, and marine ecosystems;
- supporting sustainable agriculture and combating desertification;
- understanding, monitoring, and conserving biodiversity.

The IGOS Partnership in support of GEOSS

Since the very beginning of the development of the GEOSS 10-Year Implementation Plan, there has been a heavy reliance on the work already accomplished by the existing IGOS Themes. The Partnership has been working with the new GEO Secretariat and its Work Programme Team to highlight the synergies between the approved Theme implementation plans and the two, six and ten year objectives for the GEOSS SBAs. Conscious of the need to ensure maximum efficiency in the coordination process, the IGOS Partners are in the process of identifying how the existing Themes can evolve in support of the implementation of the nine GEOSS SBAs – which are recognized as a high-priority for co-ordination efforts by the international community.

As a sign of the recognition of the valuable role played by the IGOS Partnership, the GEO Executive Committee recently encouraged the IGOS Partnership to conduct studies towards establishing new themes in the Health and Energy areas. This will likely necessitate an expansion of the Partnership and there are ongoing discussions with relevant health and energy agencies. It is very evident that the proven experience and expertise found within the IGOS Partnership will further contribute to the goals and objectives set by the Group on Earth Observations in establishing GEOSS. GEO Member countries now number 59, plus the European Commission. There are also 43 Participating Organisations - including IGOS-P.

Further information about GEO: <http://earthobservations.org>

Outreach

To achieve their goals, the IGOS Partners recognise that they must ensure there is a widespread awareness and understanding of IGOS and its benefits among the scientific communities studying the Earth system, policy-makers promoting agreements for action, the funding agencies planning future observing programmes and the public at large.

The Partnership has a number of outreach activities:

- **the IGOS website (<http://www.igospartners.org>)** which provides an accessible and up-to-date source of information on IGOS, its activities, events and output;
- **the IGOS Brochure** of which this document is the latest edition;
- **special sessions or exhibits at key events.**

IGOS Partners have made special efforts to develop discussions on possible contributions to help meet the information and data needs of the various environmental conventions, including:

- reporting to the Intergovernmental Panel on Climate Change (IPCC) and to the Conference of the Parties of the United Nations Framework Convention on Climate Change (UNFCCC), and its Subsidiary Body for Scientific and Technological Advice (SBSTA), on the adequacy of existing and planned climate observing systems;
- exploring possible contributions of IGOS to the Scientific and Technological Subsidiary Bodies of international environmental conventions, including how to encourage co-ordinated approaches and so reduce the burden on national governments of reporting to many different conventions;
- organising information events on IGOS, for example at the ninth session of the UN Commission on Sustainable Development (CSD9) in New York (April 2001) and at the Earth Observation Summit II in Tokyo (April 2004);
- participation in the preparatory process for the World Summit on Sustainable Development (WSSD 2002), including registering as a 'Type 2 partnership' – with the aim of supporting future initiatives to implement Agenda 21.



The IGOS WWW site

The way forward

The advent of GEO marks an era of new opportunity for the IGOS Partnership and the IGOS Theme process. The increased political exposure provides renewed hope of the ability to implement the observing systems required for essential observations – and therefore a new sense of purpose for the IGOS Themes.

At the time of writing (Sept 2005) a number of initiatives are being led by the IGOS Co-Chairs in order to maintain the currency of the IGOS process and to align the efforts of the Theme teams with the priorities expressed within the GEOSS Implementation Plan – structured along the nine societal benefit areas:

- a scoping study is underway to explore the possibility of establishing two new IGOS Themes: one on 'Health' and another on 'Energy' in support of the GEOSS Implementation Plan; the IGOS process offers a proven and effective mechanism for bringing together the key players in a given domain and for defining the relevant observational requirements and capabilities – culminating in a Theme report defining the implementation process;
- scoping studies on the process for evolution of those Themes which are already quite closely mapped to equivalent societal benefit areas – namely:
 - Water Cycle (IGOS) and Water Management (GEOSS);
 - Geohazards (IGOS) and Reduction and Prevention of Disasters (GEOSS).

The scope of the Geohazards Theme for example (currently limited to land-based geophysical hazards - namely earthquakes, volcanoes and land instability) might be broadened to encompass other types of hazards and to serve as a possible foundation for the equivalent SBA.

The mapping of the remaining IGOS Themes (Ocean, Carbon, Atmospheric Chemistry, Coastal, Land, Cryosphere) onto the GEOSS societal benefit areas is currently under study. Should GEO wish to exploit these Themes in support of their Implementation Plan it will likely involve some change of scope and approach on both sides. Evolution of these Themes in support of the GEOSS will probably need to be undertaken incrementally as elements are identified as being suitable for adoption by GEO.



Global Carbon Cycle Theme

The realisation that human activities are already affecting climate, and that the emission of greenhouse gases is a primary cause, has focused attention on the global carbon cycle. Effective monitoring and management of the carbon cycle poses a major challenge to policy-makers and to the observation and research communities. The IGOS Partners have responded to this challenge by the development of an Integrated Global Carbon Observation (IGCO) Theme.

OBJECTIVES

The overall objective of the IGCO Theme is to develop a flexible and robust strategy for international global carbon observations over the next decade. The aim is to build integrated approaches that combine both remote and in-situ observations and bring together observational strategies in the terrestrial, oceanic, and atmospheric compartments; to build close collaboration with the international carbon cycle research community; and to be flexible enough to incorporate new observational requirements, as measurement technologies and science develop and as requirements evolve.

MEMBERSHIP

- Food and Agriculture Organization of the United Nations (FAO)
- Global Climate Observing System (GCOS)
- Global Ocean Observing System (GOOS)
- Global Terrestrial Observing System (GTOS)
- International Council for Science (ICSU)
- International Geosphere-Biosphere Programme (IGBP) (Lead)
- Japan Aerospace Exploration Agency (JAXA)
- National Aeronautics and Space Administration (NASA)
- United Nations Educational, Scientific and Cultural Organization (UNESCO)

APPROACH

The IGCO Theme Team has adopted some common approaches among the three components in developing the carbon observation strategy, which aim to:

- build upon existing efforts to identify priority observational requirements in terrestrial, oceanic and atmospheric components of the carbon cycle;
- ensure that in situ networks are able to provide validation information for remote sensing;
- identify 'multiple constraint techniques' that assimilate observations from a wide variety of sources;
- Interact with IGOS Themes, and the WMO/GAW global greenhouse gas monitoring program.

BENEFITS AND APPLICATIONS

The IGCO Theme is aimed at delivering the following benefits:

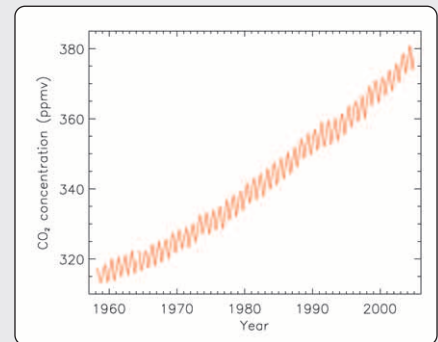
- Enhanced scientific understanding of the global carbon cycle and the current patterns of carbon stocks and flows and prediction of their changes in the future.
- Improved knowledge base for better policy-making, e.g. using improved understanding of natural sources and sinks of carbon in international agreements aimed at reducing carbon emissions.
- Advanced Earth System observation capability with the development of new observation technologies and remote sensing and in situ data handling systems within the context of Earth System observations.

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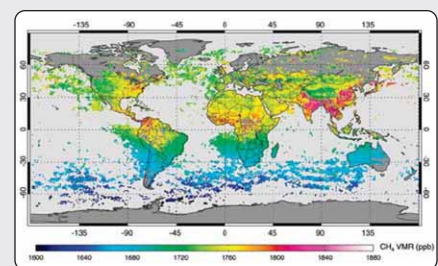
The IGCO report was approved by IGOS-P in November 2003 and published in mid 2004. As of late 2005, the Implementation Plan, based on the IGCO report, is being drafted.

FURTHER INFORMATION

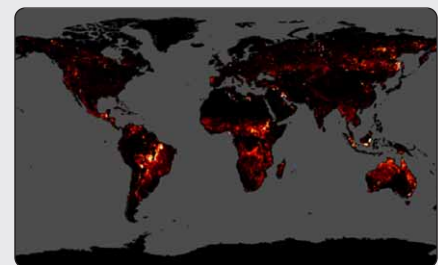
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In situ atmospheric CO₂ record from Mauna Loa, Hawaii. Data prior to 1974 from SCRIPPS Institute of Oceanography, and from NOAA/CMDL from 1974 onwards.



Atmospheric concentrations of CH₄ from the SCIAMACHY instrument on board the ENVISAT satellite



Forest and grassland fire detections from the ATSR sensor for the period 1997 to 2003

Ocean Theme

The Ocean Theme strategy builds on the long-term observational legacies of past efforts such as the Tropical Ocean Global Atmospheres (TOGA) Project and the World Ocean Circulation Experiments (WOCE) and incorporates ongoing present day efforts such as the worldwide network of Argo profiling floats and oceanic components of the Global Earth Observing System of Systems (GEOSS). It is dynamic and evolving, helping to drive future developments both on technological and scientific frontiers, for example integrating biological and biogeochemical observations for improved understanding of the role of the ocean in the dynamics of the integrated Earth system. The overall goal is to design, evolve and promote an observational strategy to serve the research and operational oceanographic communities and a wide range of users from science, policy, port and coastal zone management, marine hazard warning, tourism, fisheries and aquaculture, shipping, offshore mining and the general public.

MEMBERSHIP

The following agencies generously support the Ocean Theme through provision of experts on the ocean theme team and/or financial contributions:

- European Space Agency (ESA)
- Global Ocean Observing System (GOOS)/ Intergovernmental Oceanographic Commission [Lead]
- Japan Aerospace Exploration Agency (JAXA)
- Ocean Observations Panel for Climate (OOPC)
- National Aeronautics and Space Administration (NASA/JPL) [Lead]
- National Oceanic and Atmospheric Administration (NOAA)
- Scientific Committee on Oceanic Research (SCOR)

BENEFITS AND APPLICATIONS

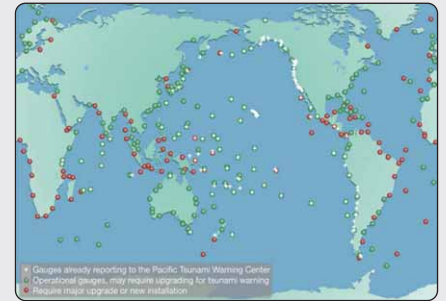
- Operational forecasting and analyses
- Seasonal to interannual climate prediction
- Improved and extended weather prediction
- Data products for climate research
- Monitoring of biodiversity, habitat and living marine resources
- Monitoring of marine environment and coastal zone for fisheries management
- Hazard warnings including pollution, toxic algal blooms, flooding, storm surges, tsunami

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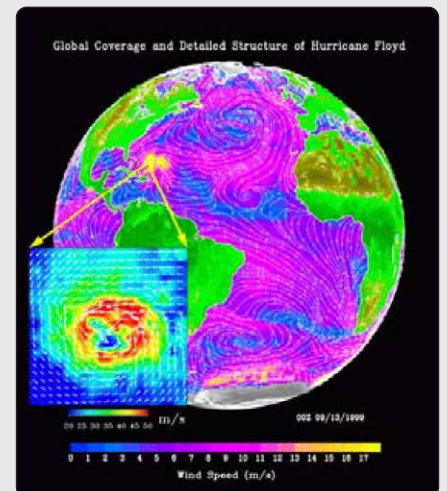
The Joint WMO/IOC Technical Commission for Oceanography and Marine Meteorology (JCOMM) is implementing the in-situ component of the Ocean Theme strategy (see figure). The Ocean Theme Team is working with other IGOS Themes to ensure synergies are developed. These include the Carbon Theme for ocean's role in the global carbon cycle, the Geohazards Theme for tsunami warnings and the Coastal Theme for coastal ocean observations. The Team is also working to ensure seamless integration in the Global Observing System of Systems (GEOSS) in order to best target ocean observations for societal benefits. Finally, the Team is actively engaged in a rolling review of the first Ocean Theme Report, published in January 2001.

FURTHER INFORMATION

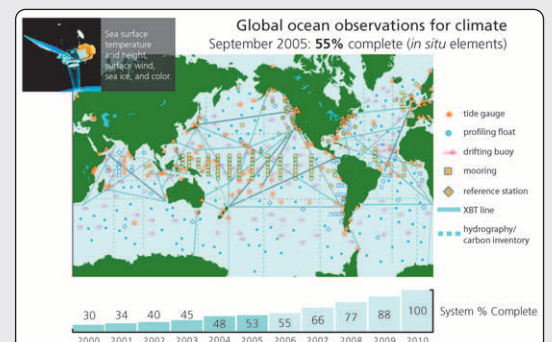
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Tide gauges contributing to the Global Sea Level Observing System (GLOSS). Extensive upgrading of components of gauges in the Indian Ocean to real-time data delivery is simultaneously contributing to the development of a regional tsunami warning system while continuing to provide information for coastal zone and port management, in-situ calibration of satellite altimeters and global change research



The distribution of ocean surface winds over the Atlantic Ocean, based on September 1999 data from NASA's SeaWinds instrument on the QuikSCAT satellite, shows wind direction (white streamlines) at a resolution of 25 kilometers (15.5 miles), superimposed on the color image indicating wind speed. The inset shows detailed structure of Hurricane Floyd. Credit: NASA/JPL; Source: <http://visibleearth.nasa.gov/>.



Remote sensing based and in-situ open ocean components of GOOS already implemented under the auspices of the Joint IOC-WMO Technical Commission for Oceanography and Marine Meteorology (JCOMM) and the planned timeline for completion of the system.

Global Water Cycle Theme

Water cycle observations at various scales are needed for weather, climate and water prediction and monitoring to support the sustainable development of water resources. Since the Integrated Global Water Cycle Observations (IGWCO) theme was approved in November 2003, it has implemented an organizational and programmatic structure and launched a number of activities. The IGWCO theme also is making a major contribution to the 'Water Resources' Societal Benefit Area of the Global Earth Observation System of Systems (GEOSS).

OBJECTIVES

The overall objective of the IGWCO is to provide a framework and strategy for coordinating the diverse observations from the atmosphere, land surface, subsurface, and the ocean that are available through space agencies, resource agencies and weather services and to facilitate the use of diverse data elements in an inter-operational system of data processing, assimilation, prediction and decision support systems. Specific objectives include:

- 1) Guiding decisions on water cycle observations and
- 2) Promoting strategies for the acquisition, processing and distribution of data products needed for effective management of the world's water resources.

MEMBERSHIP

IGWCO is managed by an Executive committee that reports on progress to IGOS-P, the Committee on Earth Observation Satellites (CEOS) Strategic Implementation Team and other relevant committees. It includes the World Climate Research Programme, World Meteorological Organization and Japan Aerospace Exploration Administration (JAXA) representatives. The Science Advisory Group includes representatives

from North America, South America, Europe, China, India, Japan and Africa. IGWCO secretariat services are supported mainly by JAXA for CEOS.

APPROACH

The IGWCO Theme is being addressed through a number of new initiatives that are being carried out in support of the developing IGWCO Implementation Plan. They include projects that deal with:

- improving data products for specific variables by combining satellite data, in-situ measurements and data assimilation capabilities. Currently projects involving precipitation and soil moisture are in progress while a project on water quality and bioindicators is being planned and another on integrated runoff products is being discussed.
- Developing integrated data systems and observing networks through the Coordinated Enhanced Observing Period (CEOP) that will provide prototype infrastructure for the Global Earth Observing System of Systems.
- Coordinating with bodies that can use global water cycle observational products and expertise to identify their applications to the Global Water System Project (GWSP), the World Water Forum (IV) and the goals of the World Summit on Sustainable Development as well as local applications in many countries.
- Capacity Building activities whereby new products and approaches developed in IGWCO can be transferred to information providers and water managers in developing countries.

BENEFITS

IGWCO will bring a number of benefits to the broad user community, including:

- 1) Better forecast services;
- 2) Improved information for sustainable development of the Earth's water resources;
- 3) Enhanced monitoring and understanding of changes in the global water cycle; and

- 4) Reduction of risk due to improved flood and drought warning.

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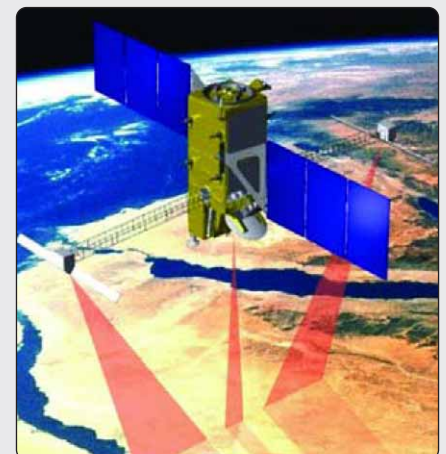
Since its approval in November 2003, IGWCO has launched a number of initiatives to address the priorities outlined in the theme report. A number of these actions also contribute directly to GEOSS targets. Currently, the pace of implementation is determined by the "best effort" nature of IGOS-P activities.

FURTHER INFORMATION

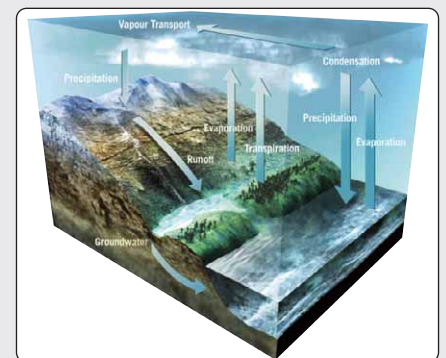
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The Water Satellite Mission (Water Elevation Recovery)



The Earth's water cycle (ESA)



Geohazards Theme

The societal impact of geological and geophysical hazards is enormous. Every year volcanoes, earthquakes, landslides and subsidence claim thousands of lives and injure many thousands more. As the human population increases and more people live in hazardous areas, this impact grows.

Geohazards are complex phenomena that can be understood through the integration of data acquired by different systems – in-situ, airborne and satellite-based. Associated geologic mapping and historical data archives, coupled with the use of Geographic Information Systems (GIS) and other modelling tools are of great importance if these hazards are to be understood and managed.

OBJECTIVES

The goal of the Geohazards Theme in the long-term is to improve the mitigation of Geohazards world-wide. There must be a shift between the current culture of repair to a culture of preparation and mitigation of geohazards. The current strategy developed within the Geohazards Theme is defined in the IGOS Geohazards report published in April 2004 and identifies five focal themes as key to reaching this objective:

1. Support for long-term fundamental **science** with potential application to Geohazards;
2. Co-ordinate **observations** – a systems approach to the measurement of geophysical/geological parameters that allow the monitoring and study of Geohazards;
3. Work towards harmonised **infrastructure** – the structures and techniques used for the storage and dissemination of data and information required in the mitigation of Geohazards;
4. Improve the **integration** of different data sources for the provision of better and more timely information on Geohazards to decision makers;
5. Facilitate the transfer of knowledge through **Capacity Building**.

MEMBERSHIP

The Geohazard Theme is steered by the GARS-IGOS Geohazard Joint Committee,

Chaired by UNESCO and including the British, French and United States Geological Surveys and the European and Japanese Space Agencies. This body reports progress to the IGOS Partnership and the CEOS Strategic Implementation Team.

APPROACH

Implementation of the current strategy defined in the Theme report published in April 2004, will be monitored and coordinated by the IGOS Geohazards Bureau set up jointly by ESA and the French Geological Survey (BRGM). The bureau will be responsible for coordinating the international community brought together by this initiative within working groups. A second key partner in the development of the IGOS Geohazards Theme is the IUGS-UNESCO Geological Applications of Remote Sensing (GARS) programme – it provides the home for the Theme within the IGOS Partnership.

During the IGOS Geohazards Workshop of June 2005, five working groups were established and defined a number of actions:

1. Define Observational Requirements (sampling strategy in time / space / resolution / accuracy) across Geohazards and for in-situ/airborne/spaceborne data.
2. Identify existing regional/global archives of data and historical events.
3. Develop a cross-disciplinary approach to the integration of different data sources for the generation of hazard-specific and multi-hazard information products.
4. Identify geographical zones and disciplines where capacity building activities are insufficient.

BENEFITS

The strategy is aimed primarily at the international geohazards user community, especially scientists working in monitoring and advisory who provide information to support decision makers. Other groups are an integral part of the Theme: end users in responsible authorities managing geohazards on a daily basis; the research scientists developing the underpinning

knowledge base; and finally to the IGOS partners and others who are responsible for making the observations.

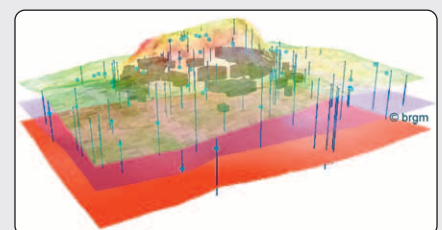
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The Geohazards Theme was initiated and scoped in 2001. A Theme Team and ESA-supported Secretariat was set up in summer 2002 and generated a report that, following international review was issued as the IGOS Geohazards Theme report in April 2004. The second phase of IGOS Geohazards initiative began with the creation of the IGOS Geohazards Bureau hosted by BRGM and co-funded by ESA. An International Workshop, hosted by the BRGM in June 2005, established a set of working groups around which the ongoing work of the IGOS Geohazards Initiative will be structured.

FURTHER INFORMATION

The IGOS Geohazards Website (<http://www.igosgeohazards.org>) provides further information about the Geohazards Theme, including the complete theme report.

Enquiries can be sent to the IGOS Geohazards Bureau (igosg@brgm.fr).



View of a 3D geological model of the Montmartre area of Paris showing ground deformation measured by InSAR draped over an DTM. Former quarries (grey blocks), known boreholes (blue lines) and boundaries of two geological formations are shown under the surface.



Atmospheric Chemistry Theme

The Integrated Global Atmospheric Chemistry Observations (IGACO) strategy focusing on ozone depletion, greenhouse gases, aerosols and substances important to air quality and human/ecosystem health was accepted by IGOS-P in May 2004. It will lead to better understanding of climate, weather and the long range transport/deposition of air pollutants. The World Meteorological Organization (WMO) leads implementation through its Global Atmosphere Watch (GAW) programme working with other WMO programmes, space agencies and the research community. The products of IGACO are directly linked to the Vienna Convention for the Protection of the Ozone Layer, the United Nations Framework Convention on Climate Change and the UN-ECE Convention on Long Range Transboundary Air Pollution.

OBJECTIVES

- ensure long-term continuity and spatial comprehensiveness of atmospheric composition observations, and
- optimally integrate surface-based (in situ, balloon and remote sensing), aircraft and space-borne measurements using “smart interpolation” models with data assimilation, and
- make the integrated data easily accessible to a wide range of users.

IGACO will support the acquisition and analysis of atmospheric observations in relation to changing atmospheric composition, chemistry and climate; ozone depletion and its impact on UV-B irradiation; air quality on local, regional and global scales; the changing oxidising capacity of the atmosphere.

MEMBERSHIP

Managed by an implementation team co-chaired by WMO/GAW and the European Space Agency (ESA) that links to other WMO programmes (WWW, Space), co-

sponsored programmes (GCOS, WCRP), other IGOS/Themes, GEOSS, ICSU groups (International Ozone Commission, Commission for Atmospheric Chemistry and Global Air Pollution), to the International Global Atmospheric Chemistry (IGAC) project of IGBP as well as national/regional research projects and space agencies. Four secretariats hosted by recognized research institutions for each of the IGACO foci (ozone, greenhouse gases, aerosols and LRTAP/Air Quality) will be responsible for implementation and represented on the IGACO Implementation Team.

APPROACH

Each focus of IGACO will be supported by a secretariat and a scientific advisory panel responsible for development of an implementation plan. The WMO/GAW programme will provide a foundation for calibration and quality assurance as well as providing a mechanism that continues to develop surface-based observations. The implementation plan for each focus will contain a common vision and a description of priority actions needed to meet the objectives.

BENEFITS

- The availability of regular global IGACO products will contribute to
- enhanced scientific understanding of biogeochemical cycles that govern atmospheric composition, of chemistry-climate interactions, and of anthropogenic perturbations to air composition, chemistry, clouds, rain and climate;
 - more precise assessment of the effects of climate change and air pollution on ecosystems, human health and society;
 - improved knowledge base for policy-making, i.e. for the design and assessment of effectiveness of emission reduction strategies;
 - enforcement of environmental laws and international conventions;
 - improved weather forecasting and

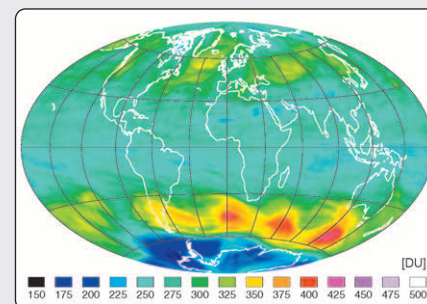
environmental predictions (e.g. air quality, fire smoke, dust storms).

STATUS

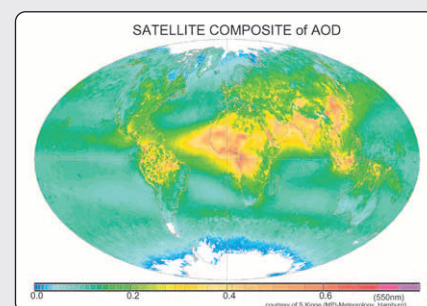
WMO/GAW and ESA co-chair the Implementation Team. The Finnish Meteorological Institute hosts the IGACO-Ozone Secretariat and with the partnership of GAW and the International Ozone Commission (a member of GEOSS) will develop an implementation plan at a workshop in 2006 co-sponsored with GCOS and GEOSS. IGACO for greenhouse gases is being implemented in collaboration with the IGOS Carbon Cycle theme.

FURTHER INFORMATION

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Joerg Langen (Joerg.Langeng@esa.int)



Total column ozone derived from satellite using KNMI models for 29 August 2005 and evaluated with ground-based observations (KNMI - ESA ENVISAT)



A best estimate of the global distribution of annual average tropospheric aerosol optical depth (AOD) compiled by combining data from six satellites (1979-2004) with global ground-based AOD sunphotometer observations (S. Kinne MPI, Hamburg, Germany)

Coastal Theme

The Coastal Theme was established by the IGOS Partners in 2003 to focus on observing requirements (both space-based and in situ) across the land-sea boundary and the information products that users require to support discovery and decision-making. Marine effects on land of particular interest include coastal flooding, erosion, and sea level change. Similarly, land influences on marine ecosystems include changes in surface runoff and ground water discharge of fresh water and associated inputs of sediments, nutrients and contaminants. In this context, the following priority issues have been identified for the IGOS Coastal Theme: Coastal Populations at risk, including coastal hazards and coastal development and urbanization; and, Coastal Ecosystems, including hydrological and biogeochemical cycles, and ecosystem health & productivity.

OBJECTIVES

- 1) Specify requirements for in situ and remote observations (as an integrated package) needed to provide timely coastal data and information to satisfy user needs.
- 2) Evaluate current and projected observation capabilities in terms of the extent to which they meet these requirements, identifying gaps, redundancies, and activities that need to be strengthened;
- 3) Establish a framework to integrate observations (in situ and remote), particularly across boundaries, as time-space scales of variability differ dramatically between the terrestrial side and the marine side of the coastal zone;
- 4) In the process of addressing 1-3, stimulate coordination and collaboration among the diverse institutions, bodies, and organizations that have coastal interests.

MEMBERSHIP

- GOOS (Global Ocean Observing System)
- GTOS (Global Terrestrial Observing System)
- IGBP (LOICZ, IMBER)
- CEOS (NASA, NOAA, ESA, JAXA, DLR, CSA, ISRO)

APPROACH

This effort builds on and complements the design and implementation plans of the coastal modules of GOOS (<http://ioc.unesco.org/goos/coop.htm>) and GTOS (<http://www.fao.org/gtos/C-GTOS.html>). In so doing, it was recognized that the occurrence of, or changes in, coastal terrestrial and marine phenomena are often related and that interactions among them must be addressed explicitly. It was also recognized that coral reefs are of special interest, and thus, the IGOS Coral Reef Sub-Theme has been incorporated into the Coastal Theme. Focusing on the priority issues discussed above, the Coastal Theme has identified priority observing needs with recommendations for space agencies and other data providers, as well as prototype activities to address user needs, including the development of a Coastal Data Assimilation System (CODAS) and an Integrated Coastal Decision Support System (ICoDSS).

BENEFITS

The IGOS Coastal Theme will:

- identify gaps in observations and reduce unnecessary duplication;
- strengthen the linkage between in situ and space-based observations, integrated with watershed-ocean models, for coastal research and management applications;
- stimulate building of long-term and climate quality coastal data sets;
- assist in the design and implementation of the coastal components of GOOS and GTOS;
- establish priorities for research &

- development projects to improve the operational elements of observing systems and other programmes;
- support user needs through improved tools, products and services;
- establish cross-cutting links with other IGOS Themes and the emerging GEO effort.

STATUS

The Coastal Theme is presently being implemented, and efforts are underway for it to lead development of a GEO 'Community of Practice' in support of coastal user needs. A number of workshops are planned for 2006-2007 and beyond that will bring together coastal data providers and users to address high priority needs.

FURTHER INFORMATION

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True-color image of the Mississippi River sediment plume, acquired from the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Terra satellite. Image credit: NASA. Image courtesy: Liam Gumley, Space Science and Engineering Center, University of Wisconsin-Madison and the MODIS science team. Image source: <http://visibleearth.nasa.gov/>.



Landsat 7 ETM+ false color image of the Ganges River Delta. Image credit: USGS EROS Data Center



Land Theme

The impact of human activities around the globe is most readily seen in terrestrial environments. It is now recognised that this human activity has caused severe degradation of many terrestrial ecosystems, and that there have been consequential losses in productive capacity, in the availability of potable water supplies, and in biodiversity.

To manage the human impacts, there is a need for sound, up-to-date information about the state of the ecosystems and the processes that sustain them, the pressures that are affecting the ecosystems and responses to those pressures. This information needs to be readily available so that the management of terrestrial environments will be consistent with sustainable development.

OBJECTIVES

The established Land Theme Team has the responsibility to design a cohesive programme of activities which will provide a comprehensive picture of the present state of terrestrial ecosystems, and build capacity for long-term monitoring of those ecosystems. IGOL (Integrated Global Observations of the Land) will build on current assessments linked to relevant research programmes to provide access to best available science to support the monitoring activities and the interpretation of results.

MEMBERSHIP

- CIESIN (Center for International Earth Science Information Network)
- CRTS (Centre Royal de Teledetection Spatiale, Morocco)
- CAS (Chinese Academy of Sciences)
- FAO (Food and Agricultural Organization)
- Global Climate Observing System (GCOS)
- Global Observations of Forest and Land-cover Dynamics (GOFC-GOLD)

- GTOS (Global Terrestrial Observing System)
- IGBP (International Geosphere Biosphere Pro-gramme)
- JRC (Joint Research Center, Ispra)
- The Heinz Center
- UNEP (United Nations Environment Programme)
- CEOS (ESA, JAXA, NASA, NOAA, NRSCC, USGS)

APPROACH

It is essential that a selection process be adopted such that only those observations likely to benefit from the IGOS-P Theme process are included. Selection criteria include:

- Observations must be needed at a global scale or
- Observations needed locally which benefit from global scale observations.
- A case has been made for observations in the documents of the IGOS-Partners
- The observations contribute directly or indirectly to spatially explicit disaggregated data products

The proposed main components of IGOL will be observations pertaining to:

- land cover and land use change including fire and other major disturbances;
- human settlement and population;
- sustainable agriculture, pastoralism and forestry including water consumption and availability;
- extent and condition of ecosystems especially in relation to biodiversity and conservation;
- soils and land degradation;
- ecosystem services;
- elevation and drainage.

BENEFITS

At an international level improved information will help improve scientific assessments and in turn will help national governments make improved policy decisions.

The scientific community also is often limited in executing its research programs by the insufficient quality of terrestrial observations. Other stake-holders include natural resource managers, Environmental Conventions' secretariats, international development and aid agencies and NGOs.

STATUS

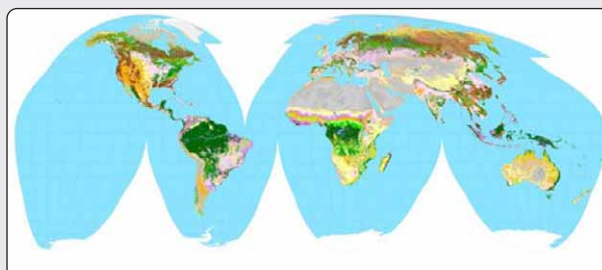
Currently the Theme is in its planning stage. Drafts of its report have been produced and a final report will be completed in late 2005 or early 2006.

FURTHER INFORMATION

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John Latham (john.latham@fao.org)
See also the IGOL web site
<http://www.fao.org/gtos/igol/>



Observation of night-time lights provide a global perspective on human populations and economic activity (Source: NOAA)



Global land cover classification derived from SPOT VEGETATION data (Source: JRC Ispra)

Cryosphere Theme

The cryosphere is an integral part of the global climate system, modulating surface energy and moisture fluxes, clouds, precipitation, hydrology, and atmospheric and oceanic circulation. Variability in the cryosphere has broad ranging socio-economic impacts, including land and sea transportation, water resources, sea level change, wildlife, and recreation. The Cryosphere Theme was established by the IGOS Partners in 2004.

OBJECTIVES

The Cryosphere Theme addresses observations of snow, solid precipitation, lake and river ice, sea ice, glaciers, ice caps, ice sheets, permafrost, and seasonally frozen ground. The Theme will create a framework for improved coordination of observations collected by research, long-term monitoring, and operational programmes. It's goals are to achieve better availability and accessibility of cryospheric information for operational services and research, strengthen national and international institutional structures responsible for cryospheric observations, and increase resources for ensuring the transition of research-based observing projects into sustained observations and practical applications. The grand challenge of the Cryosphere Theme is to determine how observations should be coordinated and developed, and to enhance the observation and monitoring of the cryosphere in support of process studies, model evaluation, and change detection.

APPROACH

The Cryosphere Theme approach involves three broad streams of observations and applications:

- A comprehensive system of validated remote sensing and in situ observations of the land-based cryosphere, capable of providing a complete picture of precipitation, snow reserves, river and lake ice, permafrost, and frozen soil characteristics.

- A system ensuring comprehensive observations of sea-ice characteristics, the efficient exchange of these data, their use in operational services, and subsequent processing for research applications and climate studies.
- A significantly enhanced ice-sheet, ice-cap, and glacier monitoring system, transforming research-based systems into a sustained, truly global system, producing data with the accuracy required for the prediction of sea level rise, water management, and disaster mitigation.

The Cryosphere Theme will provide economies of scale, and ensure that the cryosphere is adequately addressed by the observing systems that support climate, weather and environmental research and operations.

BENEFITS

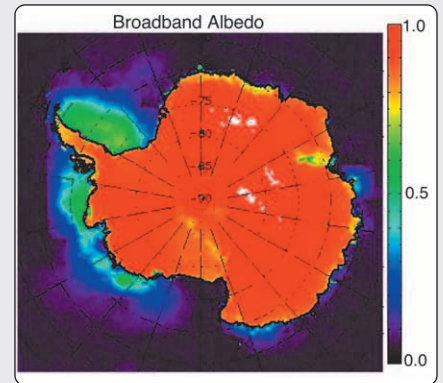
The Theme will contribute to assessments of the socio-economic and environmental impacts of changes in the cryosphere by providing scientific input to national and international policy makers.

STATUS

The Theme was initiated in early 2004 by the Climate and Cryosphere Project (CliC) of the WCRP and the Scientific Committee on Antarctic Research (SCAR) of ICSU. The first Cryosphere Theme workshop was held in March 2005 in Canada. The Cryosphere Theme Report is under development, and is expected to be completed in 2006.

FURTHER INFORMATION

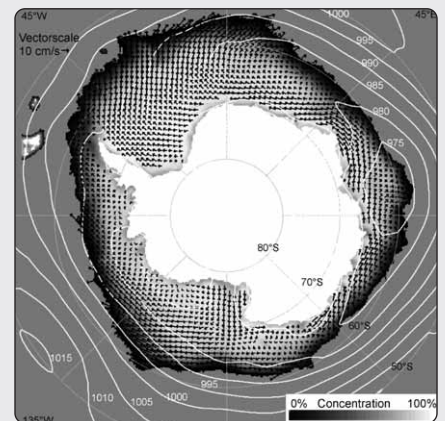
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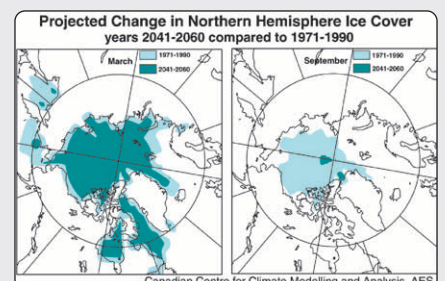
Satellite-derived surface albedo of Antarctica in January.



The Jakobshavn Glacier on the west coast of Greenland.



July 1979-1997 Mean Drift Vectors, Isobars and Sea Ice Concentration.



Arctic sea-ice extent change in March and September at the middle of the 21st century as projected by the Canadian Centre for Climate Modelling and Analysis global coupled model (CGCM2).

The IGOS Partners



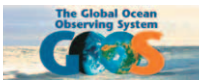
CEOS
Committee on Earth Observation Satellites
<http://www.ceos.org>



FAO
Food and Agriculture Organization of the United Nations
<http://www.fao.org>



GCOS
Global Climate Observing System
<http://www.wmo.int/web/gcos/gcoshome.html>



GOOS
Global Ocean Observing System
<http://ioc.unesco.org/goos/>



GOS/GAW
Global Observing System/
Global Atmosphere Watch of WMO
<http://www.wmo.int>



GTOS
Global Terrestrial Observing System
<http://www.fao.org/gtos/>



ICSU
International Council for Science
<http://www.icsu.org>



IGBP
International Geosphere-Biosphere Programme
<http://www.igbp.kva.se/>



IGFA
International Group of Funding Agencies
for Global Change Research
<http://www.igfagcr.org>



IOC-UNESCO
Intergovernmental Oceanographic
Commission of UNESCO
<http://ioc.unesco.org/iocweb/>



UNEP
United Nations Environment Programme
<http://www.unep.org>



UNESCO
United Nations Educational,
Scientific and Cultural Organization
<http://www.unesco.org>

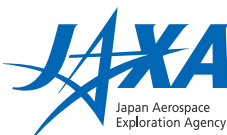


WCRP
World Climate Research Programme
<http://www.wmo.int/web/wcrp/wcrp-home.html>



WMO
World Meteorological Organization
<http://www.wmo.int>

Produced by
the Japan Aerospace Exploration Agency:



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<http://www.igospartners.org>