

# IGBP

## Annual Report



# 2008

**GLOBAL** International  
**I G B P** Geosphere-Biosphere  
**CHANGE** Programme

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### Cover photographs courtesy of:

(left to right from back cover) IGAC project office, Arne Körtzinger, Dan Costa, Cheryl Rankin, Chris Sabine, iLEAPS project office, Kevin Connors.

### Earth System Illustration

The Earth system illustration appearing on the first page and elsewhere in this Annual Report was commissioned by IGBP from the English artist Glynn Gorick. The structure of the illustration mirrors the programme structure of IGBP, which is built around the Earth system compartments of land, atmosphere and ocean, the interfaces between these compartments, and system-wide integration.

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# International Geosphere-Biosphere Programme

IGBP is an international scientific research programme of the International Council for Science (ICSU) that networks scientists around the world to conduct interdisciplinary Earth system science and global change research.

## Vision

To provide scientific knowledge to improve the sustainability of the living Earth.

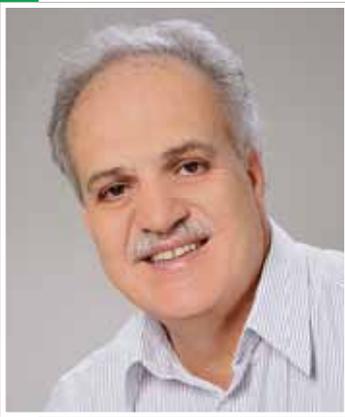
## Objective

IGBP studies the interactions between biological, chemical and physical processes, and human systems. IGBP collaborates with other programmes to develop and impart the understanding necessary to respond to global change.



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Carlos Nobre  
IGBP Chair  
São José dos Campos, Brazil

## The year in review

Our most significant event in 2008 was, of course, the IGBP congress in Cape Town, South Africa. IGBP congresses allow participants in our projects to discuss cutting-edge science and strengthen forward-looking scientific interaction on cross-cutting themes. The working group sessions reported new insights related to almost all of the “tipping elements” in the global climate – a sign the IGBP community is making progress on important systemic problems facing the planet.

The African venue was, in part, to call attention to the region’s special sustainability challenges. We want to make better links between development issues in the developing world and our community and scientific agenda. The congress’s focus – *Sustainability livelihoods in a changing Earth system* – made clear both the promise and challenges of such connections. These connections require synergies between fundamental and applied science agendas. Such synergies may be strengthened, in part, by encouraging more scientists from developing countries to become involved in our work. So I am delighted to see a new research network, the African Network for Earth System Science (AfricanNESS), take shape and gain strength. It is important for IGBP to nurture this as well as other regional networks. In this regard, we are most pleased with the recent launch of a European Alliance of Global Change Committees, first discussed during the IGBP congress.

IGBP’s Brazilian regional office is also contributing to building regional networks. The office is collaborating with the Inter-American Institute to identify ways to strengthen global change research in the region. As part of this, in November, the office united a subset of IGBP and global-change science leaders from Latin America and the Caribbean to discuss how to strengthen the region’s National Committees and increase involvement with IGBP, in general. As a result of that meeting, IGBP may consider establishing a Latin American and Caribbean global environmental change committee. This will engage active global change and IGBP-involved scientists from the region.

Regional efforts must work with global efforts. IGBP, the World Climate Research Programme and the Earth System Science Partnership are working to enhance their input into the Intergovernmental Panel on Climate Change Fifth Assessment Report (AR5). The IGBP project AIMES (Analysis, Integration and Modelling of the Earth System) is making an important contribution towards the definition and use of the new IPCC emissions scenarios and coordination of impacts/adaptation/vulnerability research.

Careful coordination and integration of the global change programmes is especially necessary in the challenging global economic situation to avoid redundancy and enhance societal benefits resulting from research.



Sybil P. Seitzinger  
IGBP Executive Director  
Stockholm, Sweden

## The way ahead

Society relies on the global-change research community to provide leadership, information and solutions on our most pressing environmental challenges. This is a significant responsibility for the thousands of scientists that make up the International Geosphere-Biosphere Programme and provides immediacy to our work.

In 2008, our achievements over the last 20 years were recognised. A review of IGBP by the International Council for Science and the International Group of Funding Agencies for Global Change Research stated that the programme can take considerable credit for the success and recognition of the Intergovernmental Panel on Climate Change (IPCC) and the Millennium Ecosystem Assessment (MA). Indeed, the International Council for Science has said IGBP and our three sister programmes have a far larger influence on the worldwide investment in global environmental change research than our budgets indicate.

But there is a renewed urgency to do more. IGBP intends to continue its brand of policy-relevant Earth system science. Climate change, ocean acidification, fisheries, environmental impacts of megacities, nutrient enrichment, and land-use change remain integral parts of our research portfolio. We are refining our programme to build closer links with funders of global change research, and better meet the needs of governments, other policy-makers and, ultimately, people in every nation.

Beyond that, we are now putting in place a strategy to produce syntheses on key policy-relevant global-change topics.

The goals are to bring together recent findings in key areas to advance fundamental understanding of the Earth system. We aim for these syntheses to underpin key international assessments and policy decisions. Products from these syntheses will include a series of scientific publications as well as communication products for policy-makers, published in the next three-to-five years. We will work with a wide range of stakeholders including scientists, policy-makers, and the public to ensure they are targeted at their needs.

None of our advances would be possible without the funding agencies and governments who must share credit for our achievements. First, we thank Sweden: the Royal Swedish Academy of Sciences in Stockholm has been our home for the past 20 years. Other countries support us according to their abilities (see the financial report). Our work would not be possible either without the generous hosting of our IGBP core project offices in Denmark, Finland, France, Germany, Switzerland, the United Kingdom and the USA.

This support allows us to sharpen our strategic vision, prioritise our science and reach out to more people. We have a full research and outreach agenda over the coming years that focuses on policy-relevant research priorities. We invite all members of our community – from scientists, to policy-makers, to the general public – to help us achieve our goals. For it is only through the full participation of all of our stakeholders that we will be able to address effectively the challenges of global change.



## IGBP science highlights

Glance at a map of the world showing the major cities and you'll be struck by how many sit on the coast. This makes accurate prediction of sea-level rise one of the most important questions global-change researchers must answer. Indeed, the Intergovernmental Panel on Climate Change has identified it as a major uncertainty needing urgent attention.

Much of the uncertainty lies in how the world's two great ice sheets, Greenland and Antarctica, are responding to rising levels of greenhouse gases. In 2008, IGBP scientists made significant advances in this area.

Marine researchers have recently discovered that rising carbon dioxide levels are having another significant effect on the geosphere and biosphere: it is making the oceans more acidic. If trends continue, by the end of the century the oceans may be more acidic than they have been for over 20 million years. The IGBP co-sponsored symposium on ocean acidification, held in Monaco, led to the Monaco declaration, which calls for international efforts to focus on this new challenge.

## Past climates inform future projections

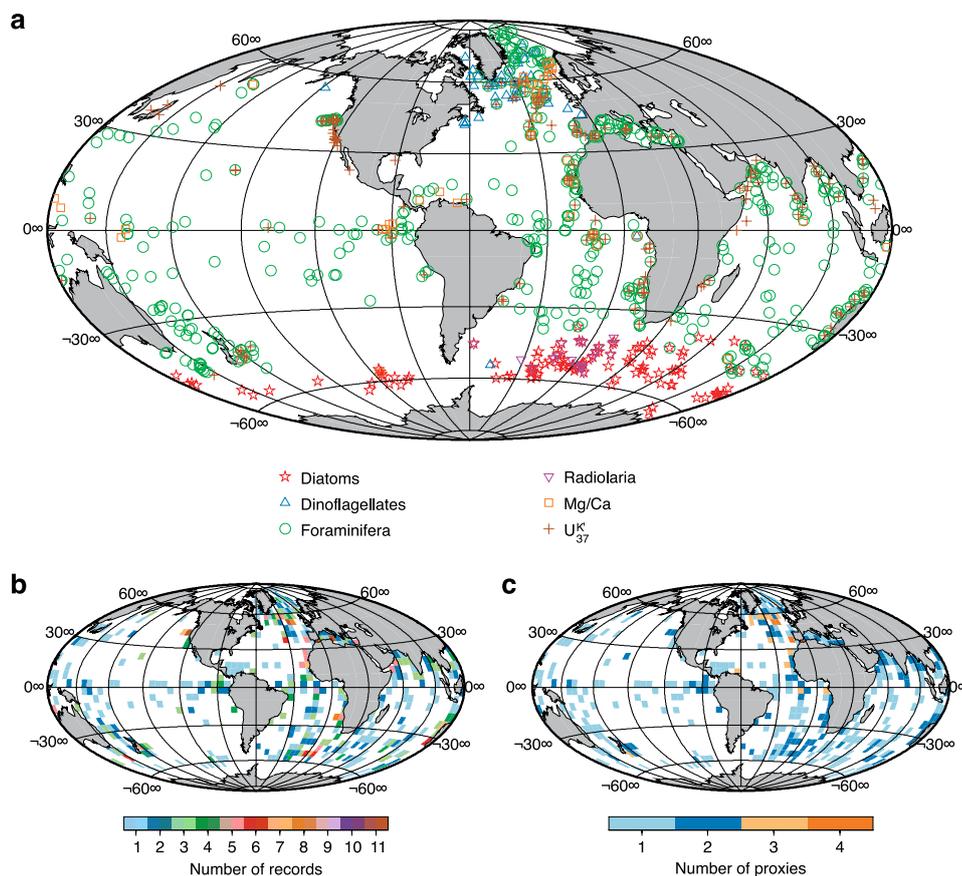
### Nordic seas ice free during glaciation

New maps showing the temperature of the sea surface at the height of the last ice age 23,000 to 19,000 years ago are helping scientists improve climate models' ability to predict future climate change [Fig. 1]. The results – part of IGBP's Past Global Changes project – show that even at the coldest point of the last ice age, Nordic seas remained ice-free during the summer. The research, which appeared in the journal *Nature Geoscience*, provides new insight into the sensitivity of the Earth's climate system, and will help improve existing climate models.

The project, called the Multiproxy Approach for the Reconstruction of the Glacial Ocean Surface, or MARGO, pulled together the work of around 50 specialists in the ancient climate. These experts combined 696 estimates of sea surface temperature from different methods in different areas into a single map. [1]

#### Reference:

1. MARGO Project Members (2009) Constraints on the magnitude and patterns of ocean cooling at the Last Glacial Maximum. *Nature Geoscience* 2: 127 – 132. copyright 2009.


**Figure 1.**

Study of sea-surface temperatures over time.

A map of the world was divided into grids, within which cells were identified. The cells were given a specific temperature resulting from the weighted average of data collected in the different paleothermometers analyses. Data was collected mainly in the North Atlantic, Antarctic and tropical regions, considered key to the understanding of climate systems.

Reprinted with permission from Macmillan Publishers Ltd, *Nature Geoscience* 2: 127 – 132. copyright 2009.

## Ice-sheet research places constraints on sea-level rise

Sea-level rise during the 21<sup>st</sup> century is perhaps the greatest threat from climate change, but the rate and magnitude have been disputed. New insights into the response of ice sheets to climate forcing have placed empirical constraints on future sea-level rise. Sea-level reconstructions and modelling of the last Interglacial Period (around 126,000 years ago) suggest the Greenland and West Antarctic ice sheets will become increasingly unstable. Sea-level rise related to current warming may be rapid at first and slow with time. [1]

Loose limits on how rapidly sea-level rise might occur over the next century have been developed using palaeo data and direct observations. For example, we may expect sea-level rise over the next century to fall between the lower limit of 20<sup>th</sup> century sea-level rise (0.12 metres per century) and the sea-level rise at the conclusion of the last glacial termination (one metre per century). Extreme upper bounds of two metres per century have been estimated by extrapolating the fastest observed ice-stream responses to all of the Greenland and West Antarctica ice streams. Significant improvements in ice-sheet models used to predict future sea-level rise are required. Their ability to capture the dynamics revealed by the palaeo sea-level record are crucial to increasing confidence in the model predictions.

### Reference:

1. Siddall M, Clark P, Thompson B, Waelbroeck C, Gregory J, and Stocker T (2009), The sea level conundrum: insights from paleo studies, *Eos Trans. AGU*, 90(9), doi:10.1029/2009EO090007.

## Climate change and water resources in South America

Researchers piecing together the climate over the last 2000 years have focused on the Northern Hemisphere. Details of climate in the Southern Hemisphere during this time are sketchy. New information from South America on temperature, precipitation and glaciation is showing changes in all these factors. Glaciers, which provide important water resources for people and ecosystems downstream, are retreating at an unprecedented rate. Increased rates of melting can cause short-term flooding and long-term water shortages and associated stresses for people and habitats downstream [1].

### Reference:

1. Villalba R, Grosjean M & Kiefer T, (2009) Long-term multi-proxy climate reconstructions and dynamics in South America (LOTRED-SA): state of the art and perspectives. *Palaeogeography, Palaeoclimatology, Palaeoecology* (editorial to special issue, in press).

## Scientists warn ocean acidification is accelerating

Ocean acidification may render most regions of the ocean inhospitable to coral reefs by 2050 if atmospheric CO<sub>2</sub> levels continue to increase. The fishing industry, too, is set to suffer. These are the conclusions from the international symposium on *The Ocean in a High-CO<sub>2</sub> World*, co-sponsored by IGBP.

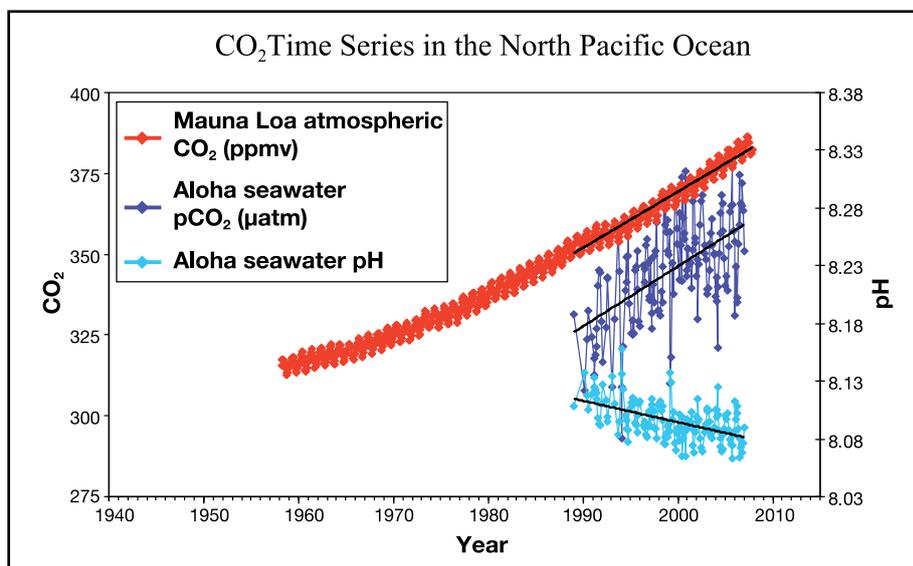
The symposium, the second of its kind, attracted over 200 of the world's leading marine experts and received widespread media attention.

Symposium participants signed a declaration on ocean acidification, supported by one of the symposium sponsors, H.S.H. Prince Albert of Monaco, urging policymakers around the world to develop ambitious and urgent plans to cut CO<sub>2</sub> emissions drastically.

The ocean absorbs a quarter of the carbon dioxide emitted into the atmosphere from human activities. When carbon dioxide dissolves in seawater it forms carbonic acid. Observations from the last 25 years show increasing acidity in surface seawater following trends in increasing atmospheric CO<sub>2</sub> levels [Fig.2]. Indeed, ocean acidity has risen 30% since the beginning of the industrial revolution. This increase is 100 times faster than any change in acidity experienced by marine organisms for at least 20 million years.

Ocean acidification causes seawater to corrode the shells and skeletons of numerous marine organisms and affects reproduction and physiology of some marine life. These effects have now been detected in living organisms in several regions of the world. Within decades, large parts of the polar oceans will become corrosive to calcareous marine organisms. These far-reaching changes will affect food webs and biodiversity. For people and the global economy, it could lead to substantial changes in commercial fish stocks, threatening food security for millions as well as harming the multi-billion dollar fishing industry.

Researchers identified new priorities for laboratory and *in situ* experiments and discussed the challenges of scaling up results. They stressed the importance of improving international coordination to develop agreed protocols, methods and data sharing to optimise the efficiency of limited research resources. Signatories recommended international cooperation to establish a worldwide observation network. This would monitor changes to ocean chemistry and ecosystems providing a timely assessment of ocean acidification impacts.



**Figure 2**

Time series of atmospheric CO<sub>2</sub> at Mauna Loa and surface ocean pH and pCO<sub>2</sub> at Ocean Station Aloha in the subtropical North Pacific Ocean. Figure credit: Richard A. Feely, Pacific Marine Environmental Laboratory, National Oceanic and Atmospheric Administration, USA, with atmospheric data from Pieter Tans and seawater data from David Karl. Adapted from Feely (2008) in Levinson and Lawrimore (eds), *Bull. Am. Meteorol. Soc.*, 89(7): S58.

One day of the symposium was dedicated to social-economic aspects of ocean acidification and the implications for policy. Coral reefs generate billions of dollars through tourism each year and serve as a habitat for one-fourth of the world's fish species during at least part of their lifetime.

The impacts of ocean acidification are just beginning to be estimated. According to Dr Hermann Held from the Potsdam Institute for Climate Impact Research, Germany, and co-author of the declaration, the current ocean uptake of CO<sub>2</sub> represents an annual subsidy to the global economy of 40–400 billion US dollars. The projected decrease in efficiency of the ocean carbon pump could cost billions of dollars annually.

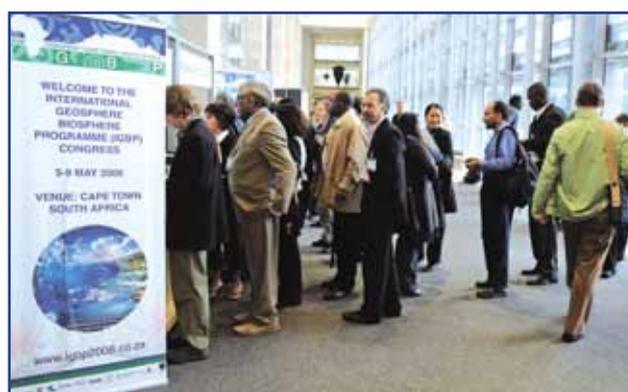
Products from the symposium include the report *Research Priorities for Ocean Acidification*, a special issue of *Biogeosciences*, a summary article in *Oceanography Magazine*, the *Monaco Declaration* and a *Summary for Policymakers* and fact sheets in French and English. All are available from [www.ocean-acidification.net](http://www.ocean-acidification.net).

The symposium, which involved experts from SOLAS, IMBER and PAGES, was jointly organised by IGBP, UNESCO's Intergovernmental Oceanographic Commission, the Scientific Committee on Oceanic Research (SCOR) and the International Atomic Energy Agency (IAEA).

## Global change researchers focus on Africa

### Cape Town Congress, 5–9 May 2008

Every three to four years, IGBP holds a congress made up of members of the IGBP scientific committees, the national committees and other relevant global change research programmes. It includes a scientific advisory committee to assess the programme and indicate new directions.



**Figure 3**

About 65 countries took part in the Cape Town congress.

The fourth such congress, entitled *Sustainable livelihoods in a changing Earth system* was held in Cape Town, South Africa. Around 380 people from 65 countries took part, including many from Africa. Its main outputs were to share research and knowledge of global environmental-change science, and help develop IGBP's scientific agenda for the period 2008–2013.

The congress's success was due to the financial support from all the sponsors and the help of the local organising committee and the South African Global Change Committee.

### **Building a lasting network in Africa**

The issues raised at the South African congress were directly relevant to society and policy. They helped identify where IGBP work can make larger contributions to developing sustainable pathways for mitigation, innovation and adaptation to global change.

The African Network for Earth System Science (AfricanNESS) presented its science plan and implementation strategy at the congress. The plan focuses on four top-level issues: food and nutritional security, water resources, health, and ecosystem integrity.

### **The Cape Town Declaration on science for environmental sustainability**

Congress participants issued a statement of commitment:

- To build upon the successes we have had of constructing a scientific infrastructure that brings together scientists from many nations, disciplines and backgrounds, from across the natural and social sciences;
- That we use this human and intellectual capital to build the next level of scientific infrastructure that is necessary to understand and predict the behaviour of coupled human-environmental systems;
- That the framework for this scientific infrastructure be built around the ideas of sustainability and ethical global stewardship of the Earth system;
- That we challenge ourselves with using the understanding that we develop about these coupled systems as the scientific basis for assessments and communication of the options, risks, vulnerabilities and possibilities for future sustainable development of our planet.

## **World Summit for Climate Prediction**

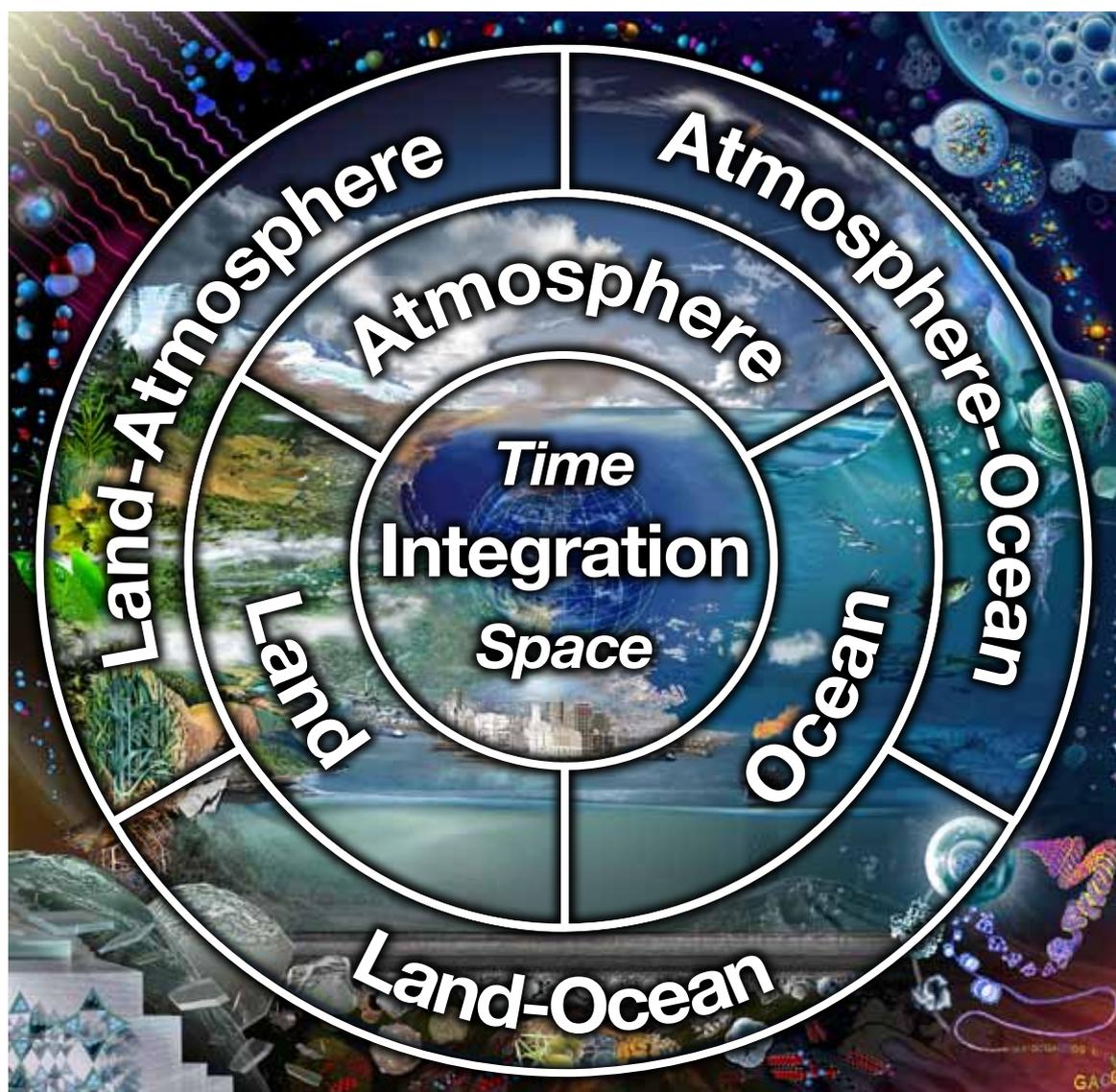
The World Modelling Summit for Climate Prediction, held at the European Centre for Medium-Range Weather Forecasts in Reading, UK, in May 2008, concluded with a 12-point statement entitled, *Revolutionising Global Climate Prediction for Regional Adaptation and Decision-Making in the 21st Century*.

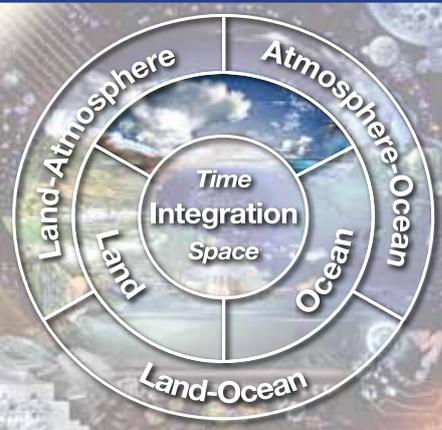
The summit, co-sponsored by the World Climate Research Programme, IGBP and the World Weather Research Programme brought together leading scientists from around the world to rigorously assess and discuss the capabilities of current model systems. The aim was to develop a visionary strategy to accelerate progress in the modelling and prediction of regional climate change and variations from days to decades

The summit strongly endorsed the initiation of a Climate Prediction Project coordinated by the World Climate Research Programme, in collaboration with the World Weather Research Programme and IGBP, and involving the national weather and climate centres, as well as the wider research community. The goal of the project would be to provide improved global climate information to underpin global mitigation negotiations and for regional adaptation and decision-making in the 21st century.

## IGBP science

IGBP research comprises a suite of nine research projects focused on the major Earth system components (land, ocean and atmosphere), the interfaces between them (land-ocean, land-atmosphere and ocean-atmosphere) and system-wide integration (Earth system modelling and palaeo-environmental studies).





## International Global Atmospheric Chemistry (IGAC)

Earth's atmosphere is both a part of, and a product of, the biosphere. Without plants the Earth's atmosphere would have evolved to have at least a thousand times less oxygen, and a hundred times more carbon dioxide. Currently, anthropogenic activities are significantly altering not only atmospheric carbon dioxide levels but also the concentrations of chemically active species that affect both air quality and climate. Atmospheric chemistry studies therefore require understanding of how both the biosphere and mankind – and the interactions between them – influence the distribution of these species.

IGAC examines the atmospheric chemistry issues facing society to understand the role of atmospheric chemistry in the Earth system and to determine the effects of changing regional emissions and depositions, long-range transport and chemical transformations on air quality and climate.



## Highlights

### Air-ice chemical interactions

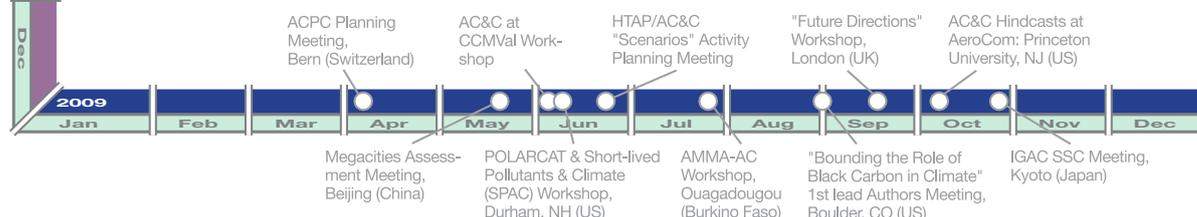
Publication of a special issue of *Atmospheric Chemistry and Physics* (8, 2008) through the Air-Ice Chemical Interactions Task, synthesising newly understood chemistry at the air-ice interface in polar regions (e.g. bromine explosions, which lead to near-surface ozone depletion events).

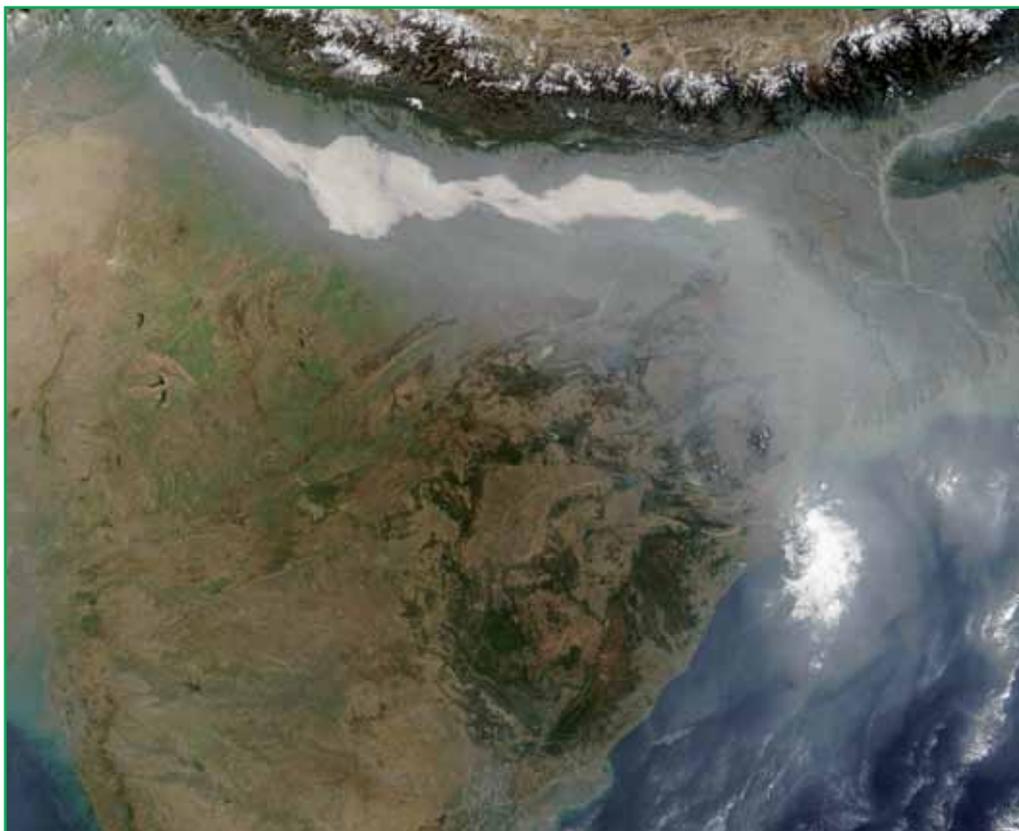
### Halogens and ice-atmosphere interactions

A joint IGAC/SPARC workshop on lab studies focusing on areas of common interest around, for example, halogens and ice-atmosphere interactions. The need for high quality laboratory experiments to provide quantitative data for the interpretation of field data and as input for atmospheric models was stressed. The workshop outcomes included a set of recommendations for future laboratory studies and has resulted in the pursuit of a new communal facility for carrying out experiments at and over ice surfaces.

### Atmospheric chemistry in north Africa and the Arctic

Completion of two major field campaigns: POLARCAT provided new insights into the transport pathways and sources of pollutants to the Arctic, and the African Monsoon Multidisciplinary Analysis campaign included measurements and analyses that improved understanding of atmospheric chemistry in north Africa, which is influenced by both heavy biomass burning and some of the world's largest desert dust storms.





In this image, a thick band of haze is trapped against the foothills of the Himalayan mountains in northern India, with outflow spreading over eastern India, Bangladesh and the Bay of Bengal. This event affected human health and transport throughout the region. The haze layer overlays surface fog against the foothills, whereas a cloudy area over the Bay of Bengal appears to be above the haze layer. (Note the difference in colour of the two.) Understanding these interactions is important for determining the climate impact of such events.

Photo credit:  
NASA image courtesy Jeff Schmaltz, MODIS Rapid Response Team, Goddard Space Flight Center.

## Trace species across Africa

The programme published 5 research papers on unified studies of the deposition of biogeochemically important trace species across the African continent.

## Megacities

Continued studies on atmospheric chemistry in Asian megacities, including the CARE-BEIJING study during the 2008 Summer Olympics, which provided important insights as to the sources of pollution in summertime Beijing.

Results from IGAC's Atmospheric Chemistry and Climate Initiative model runs will comprise a critical, objective assessment of the ability of a suite of chemistry-climate models to reproduce observed trends in chemically active short-lived trace species, as well as produce a set of future scenarios using emissions that have been coordinated with trends for the long-lived greenhouse gases. These studies will contribute directly to the 5th IPCC assessment report.

IGAC has completed the first phase of its studies on megacities covering Asia, and is working to combine this with studies on atmospheric chemistry in other parts of the world in a mega-cities assessment report, which is expected to assist decision-making around both air quality and climate issues.

## Co-sponsor:



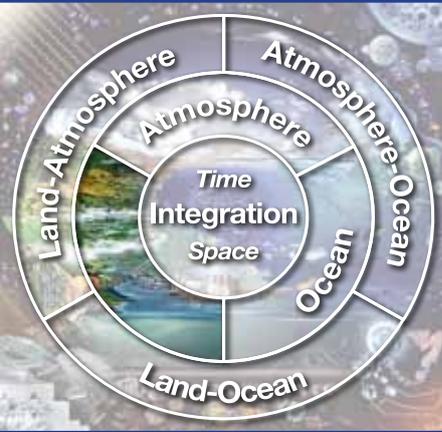
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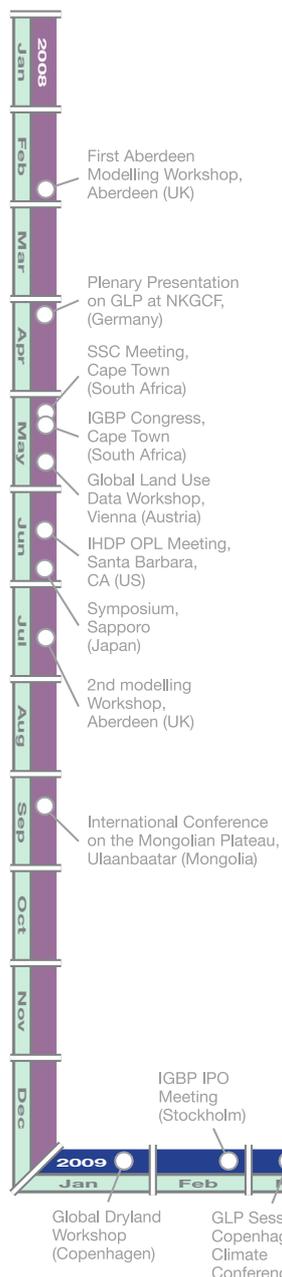
Website:  
www.igac.noaa.gov



## Global Land Project (GLP)

The development of civilisation during the past 10,000 years has been accompanied by radical changes in the terrestrial environment. Mankind now harvests plant-derived materials from over 35% of the total land surface, at considerable environmental cost. Additional impacts are likely in the future. These arise from global changes in atmospheric composition (with CO<sub>2</sub> and ozone of particular importance) and their likely consequences (increasing temperatures, changes in precipitation, and other climate changes), and increased UV radiation.

Since 2006, the Global Land Project has been promoting the research framework for land systems in the coming decade. The GLP agenda is to better integrate research on the coupled human-environment system while recognising first, how human activities on land are affecting feedbacks to the Earth system, and second, the response of the human-environment system to global change.



## Highlights

### Events and publications

Scientists from the core project and scientific committee attended conferences, workshops, symposia and courses. These events led to publications like *Landscape Ecology* (Aberdeen Workshop), contributions to journals such as *Global Environmental Change* (from the Globalisation workshop) and a special issue in *Journal for Land-Use Science* (from the LaSys conference).

### Taking sessions at the Cape Town congress

The project held three GLP sessions at the IGBP Cape Town congress in May 2008. The sessions focused on: the grand challenges for land systems and sustainability science; land-system change: competing for food, energy and environmental services; and modelling in coupled human-environmental systems.

### New integrated models being built

Integrative models for land-change science and market-based instruments for integrated modelling were developed by GLP researchers.

### State of arid and semi-arid regions under investigation

GLP scientists are researching the status and trend for observed vegetation dynamics in the world's arid and semi-arid environments using global time series.



Harvest in Mato Grosso, Brazil.

Photo credit:  
Gillian Galford

## Researchers develop historical land-use datasets

Scientists are developing tools such as datasets to better understand global land use from historical land use to human appropriation of biomass.

## Linking ecosystem services to human well-being

GLP is working on research into the effects of changes in ecosystem structure and functioning on ecosystem service delivery and links to human well-being.

The GLP international office and its regional nodes (Aberdeen, Beijing and Sapporo) have worked to make better links with other research efforts and related communities, including the NASA-funded Land Cover and Land-use Change programme; the International Alliance of Research Universities, the Northern Eurasia Earth Science Partnership Initiative; the Land Use Study Center at Beijing University and others.

### Co-sponsor:



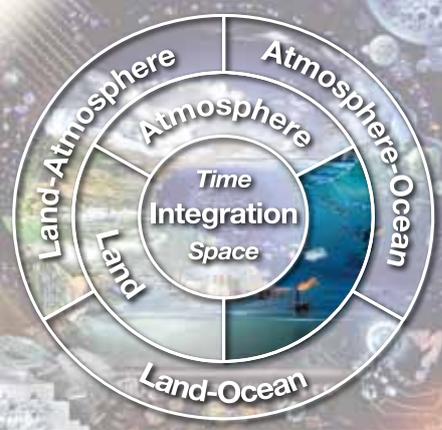
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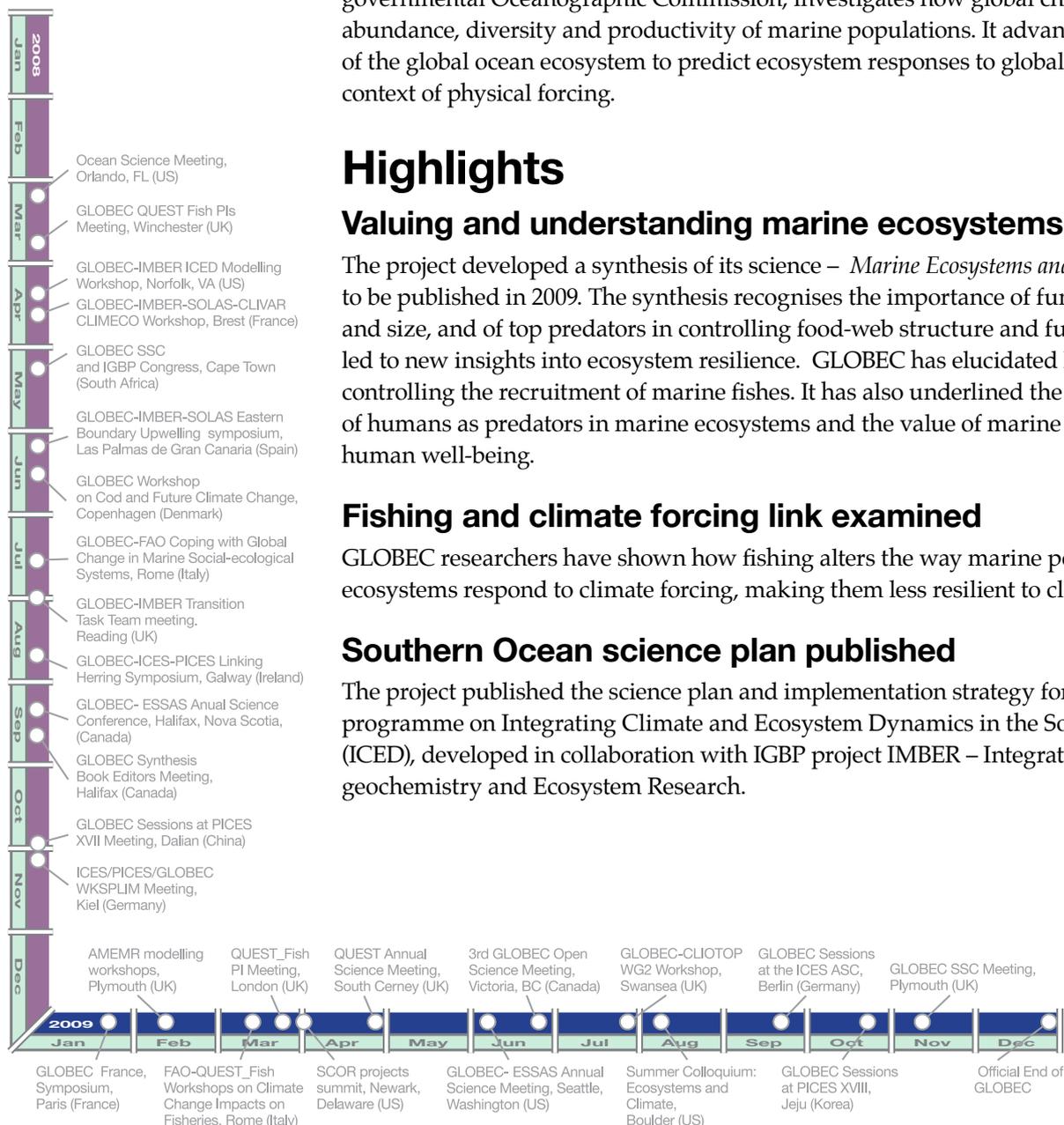
Website:  
www.globallandproject.org



## Global Ocean Ecosystem Dynamics (GLOBEC)

The ocean is a vital component of the Earth's metabolism and plays a key role in global change. Marine ecosystems are inextricably involved in the physical, chemical, biological and societal processes of global change. It is impossible to describe and understand the Earth system without understanding the ocean, the special characteristics of the environment that it provides for life, the changes that it is undergoing and the manner in which these changes interact with the total Earth system. Understanding the functioning of marine ecosystems and how they respond to global change is essential for managing marine living resources, like fisheries, effectively.

GLOBEC, co-sponsored by the Scientific Committee on Ocean Research and the Intergovernmental Oceanographic Commission, investigates how global change will affect abundance, diversity and productivity of marine populations. It advances knowledge of the global ocean ecosystem to predict ecosystem responses to global change in the context of physical forcing.



## Highlights

### Valuing and understanding marine ecosystems

The project developed a synthesis of its science – *Marine Ecosystems and Global Change* – to be published in 2009. The synthesis recognises the importance of functional diversity and size, and of top predators in controlling food-web structure and function. This has led to new insights into ecosystem resilience. GLOBEC has elucidated key processes controlling the recruitment of marine fishes. It has also underlined the importance of humans as predators in marine ecosystems and the value of marine ecosystems to human well-being.

### Fishing and climate forcing link examined

GLOBEC researchers have shown how fishing alters the way marine populations and ecosystems respond to climate forcing, making them less resilient to climate change.

### Southern Ocean science plan published

The project published the science plan and implementation strategy for a new regional programme on Integrating Climate and Ecosystem Dynamics in the Southern Ocean (ICED), developed in collaboration with IGBP project IMBER – Integrated Marine Biogeochemistry and Ecosystem Research.



Fishermen land their catch in the port of Mindelo on the island of São Vicente, Cape Verde.

Photo credit:  
Arne Körzinger

## Predictability of marine regime shifts highlighted

An analysis of regime shifts in marine ecosystems shows that some may be predictable and manageable and others not, depending on the scales, drivers and characteristics.

## Seals become oceanographers

Scientists are using seals to gather data on the physical properties of Antarctic waters. Researchers have harmlessly equipped the seals with light-weight oceanographic equipment.

## Cause of coastal zooplankton decline explained

Long-term decreases in coastal zooplankton off the Gulf of Guinea are likely to be due to a combination of warming of surface waters and predation by *Sardinella* fish, according to GLOBEC scientists.

## Glacial melt provides the favourable conditions needed for Antarctic blooms

Nutrient-rich, glacial melt water dominates over sea-ice melt water in a bay in Antarctica, providing favourable conditions for phytoplankton blooms. This contradicts the assumption that sea-ice processes dominate the seasonal evolution of the physical ocean in Antarctica.

## Networking drives research outputs

GLOBEC held more than ten symposia or workshops to bring together scientists from all over the world. These workshops have helped bump the number of research articles in the GLOBEC database to over 3000.

Note: GLOBEC will complete its work at the end of 2009 and integrated ecosystem and biogeochemical research will continue within IMBER from 2010 (see page 17 - IMBER section).

### Co-sponsors:



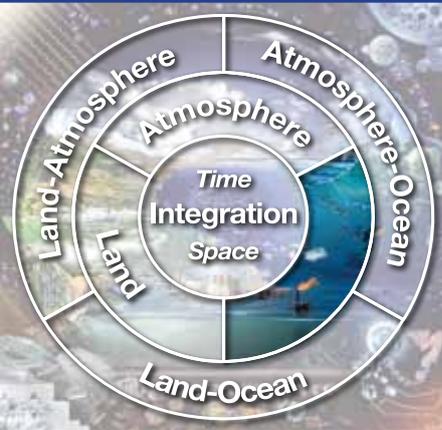
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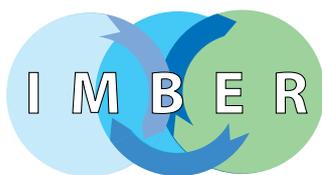
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## Integrated Marine Biogeochemistry and Ecosystem Research (IMBER)

The ocean is a vital component of the Earth's metabolism and plays a key role in global change. The Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project studies the sensitivity of marine biogeochemical cycles and ecosystems to global change, on timescales ranging from years to decades. The project, co-sponsored by the Scientific Committee on Oceanic Research, aims to understand and predict how the ocean responds to accelerating global change, as well as the consequent effects on the Earth system and human society. This research will fill the knowledge gap between short-term climate events (seasonal scale) and anthropogenic global change (century scale) that is critical for Earth system modelling.



### Highlights

#### Reducing uncertainties of oceans' CO<sub>2</sub> uptake

Scientists produced a climatological mean distribution of surface-ocean CO<sub>2</sub> concentrations and air-sea CO<sub>2</sub> fluxes over the global ocean based on three million measurements. This study has enormous value in reducing uncertainties in the magnitude of anthropogenic CO<sub>2</sub> uptake by the oceans. It also provides accurate estimates of both the global and regional increases in surface water CO<sub>2</sub> over the period 1970 to 2000.

#### Deep-sea synthesis completed

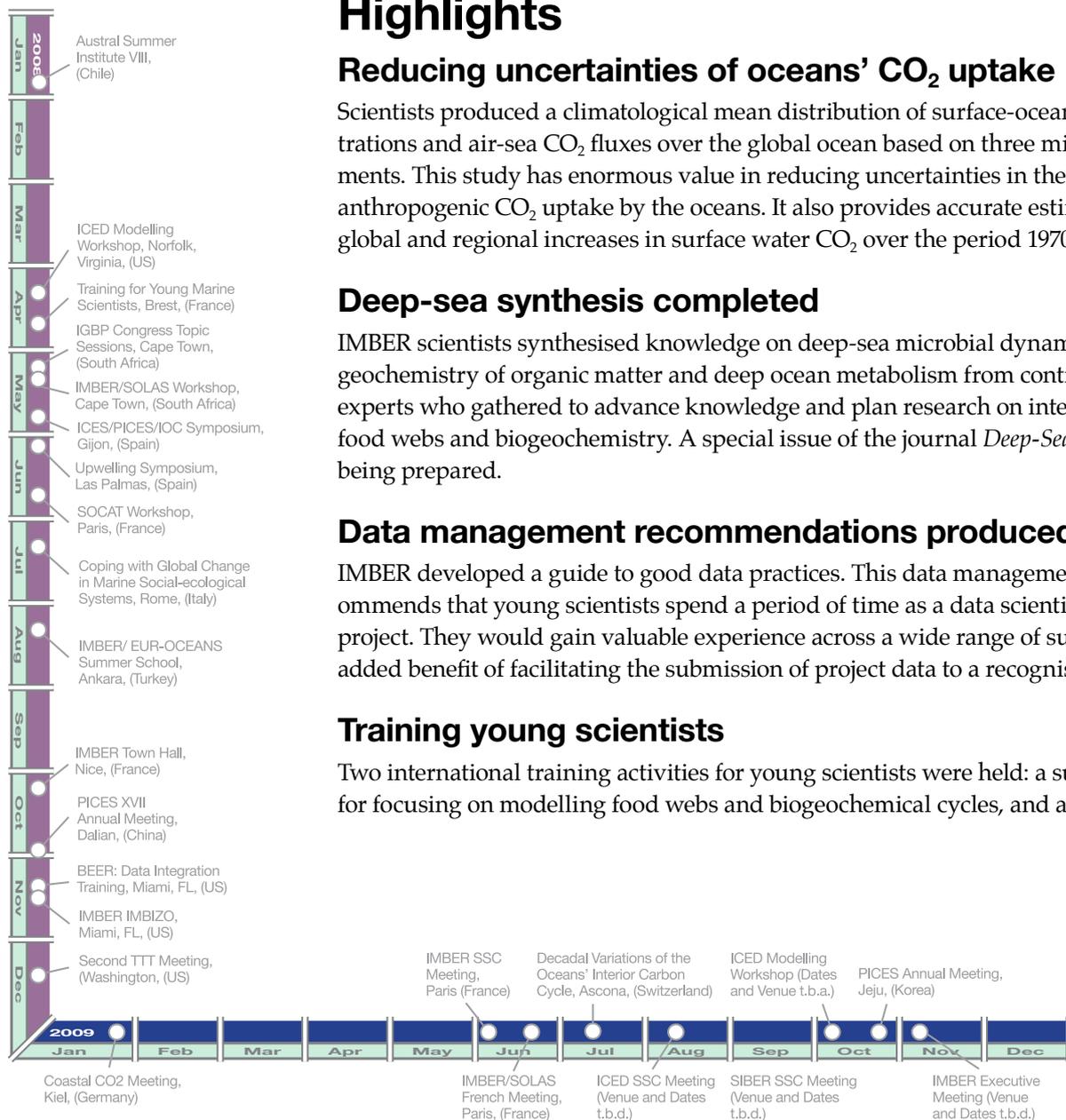
IMBER scientists synthesised knowledge on deep-sea microbial dynamics, the biogeochemistry of organic matter and deep ocean metabolism from contributions of 110 experts who gathered to advance knowledge and plan research on integrated marine food webs and biogeochemistry. A special issue of the journal *Deep-Sea Research* is also being prepared.

#### Data management recommendations produced

IMBER developed a guide to good data practices. This data management strategy recommends that young scientists spend a period of time as a data scientist for a particular project. They would gain valuable experience across a wide range of subjects, with the added benefit of facilitating the submission of project data to a recognised database.

#### Training young scientists

Two international training activities for young scientists were held: a summer school for focusing on modelling food webs and biogeochemical cycles, and a training work-





Acoustic current meter being recovered from a long-term mooring at the Cape Verde Observatory in the eastern tropical North Atlantic.

Photo credit:  
Arne Körzinger

shop on climate-driven ecosystem changes. Participation in the latter workshop was expanded by live interactive Internet broadcasts.

## Launch of major programme

The project launched a major regional programme, Integrating Climate and Ecosystem Dynamics, in collaboration with GLOBEC. The science plan was approved and published and a steering committee established.

## South Pacific research yields results

Researchers published the results of a major study of biological and biogeochemical cycles in contrasting ocean provinces in the South Pacific.

## Pressure-simulation device put to test

Scientists used a new experimental device which simulates pressure increases that particles experience when sinking to explain why fast-sinking particles like fecal pellets can fall through the water column with minimum degradation.

## IMBER expands

At the end of 2009, upon the conclusion of GLOBEC, which has conducted the research on the higher trophic levels of the ocean ecosystem (see page 15), IMBER will be expanded to cover the full ocean ecosystem. The scope of that expansion will be defined in a supplement to the IMBER Science Plan, being written by an independent team of experts appointed by IGBP and SCOR.

### Co-sponsor:



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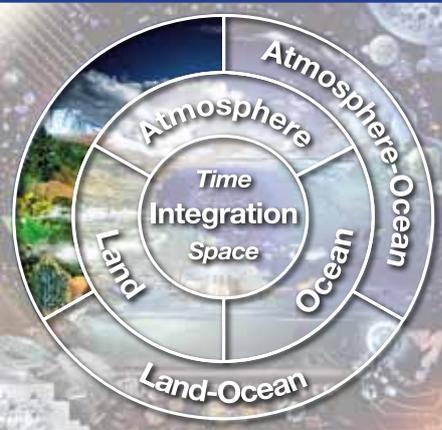
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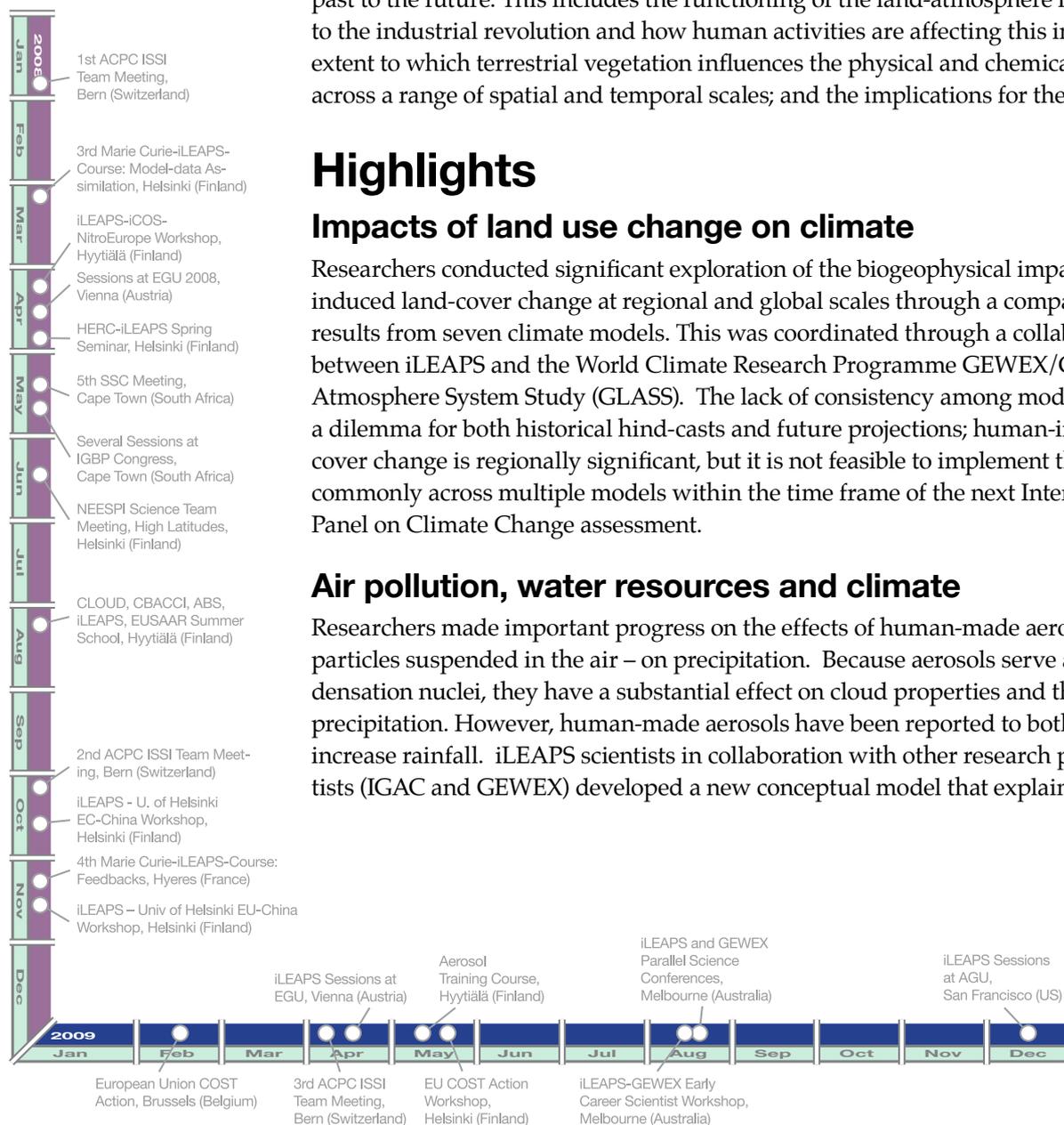
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## Integrated Land Ecosystem-Atmosphere Processes Study (iLEAPS)

Where the land and atmosphere meet – the land-surface interface – plays a vital role in the functioning of the Earth system. The transfer of energy, gases and small particles between the land and atmosphere are important in regulating climate. Terrestrial vegetation plays a key role in determining the physical and chemical environment of the Earth system. Land use affects, and is affected by, the water cycle and climate. Emission of pollutants to the atmosphere influences weather, water resources and climate.

The iLEAPS project examines the interacting physical, chemical and biological processes that transport and transform energy and matter through the land-atmosphere interface, looking at interactions and feedbacks from local-to-global scales, and from the past to the future. This includes the functioning of the land-atmosphere interface prior to the industrial revolution and how human activities are affecting this interface; the extent to which terrestrial vegetation influences the physical and chemical environment across a range of spatial and temporal scales; and the implications for the Earth system.



## Highlights

### Impacts of land use change on climate

Researchers conducted significant exploration of the biogeophysical impacts of human-induced land-cover change at regional and global scales through a comparison of results from seven climate models. This was coordinated through a collaboration between iLEAPS and the World Climate Research Programme GEWEX/Global Land Atmosphere System Study (GLASS). The lack of consistency among models highlights a dilemma for both historical hind-casts and future projections; human-induced land-cover change is regionally significant, but it is not feasible to implement this change commonly across multiple models within the time frame of the next Intergovernmental Panel on Climate Change assessment.

### Air pollution, water resources and climate

Researchers made important progress on the effects of human-made aerosols – tiny particles suspended in the air – on precipitation. Because aerosols serve as cloud condensation nuclei, they have a substantial effect on cloud properties and the initiation of precipitation. However, human-made aerosols have been reported to both decrease and increase rainfall. iLEAPS scientists in collaboration with other research projects' scientists (IGAC and GEWEX) developed a new conceptual model that explains this appar-



Haboob (dusty convective outflow) in Hombori, Mali, 23 August 2005. Photo taken during the AMMA (African Monsoon Multidisciplinary Analyses) field campaign.

Photo credits:  
Françoise Guichard  
and Laurent Kergoat,  
CNRS copyright

ent dichotomy. This improved understanding has significant consequences in an era of climate change and specifically in areas suffering from pollution and water shortages.

## Fire and climate

Fire is the most ubiquitous form of landscape disturbance, and has important effects on climate through the global carbon cycle, changing atmospheric chemistry and increased atmospheric aerosol particles. IGBP Cross-Project Initiative on Fire, hosted by iLEAPS, published an important study on the connection of fires and climate in the past.

There has been a significant increase in large-scale wildfires in all regions of the world during the past decade. This has triggered an interest in knowing how fire has changed in the past, and particularly how fire regimes respond to periods of major warming. The end of the Younger Dryas, about 11,700 years ago, was an interval when the temperature of Greenland warmed by over 5°C in less than a few decades. In the study, clear changes in biomass burning and fire frequency were found in North America whenever climate changed abruptly, but most particularly when temperatures increased at the end of the Younger Dryas cold phase.

## Evaluation of flux measurements in difficult conditions

Researchers reviewed and analysed techniques widely used to continuously measure the biosphere-atmosphere exchange of carbon and energy. They identified problems when applying standard analysis routines to data from single towers in complex flows. The causes, mechanisms, magnitudes, and possible solutions were presented in a set of papers published from a workshop on flux measurements in difficult conditions.

## Training young scientists

The iLEAPS project organised a training course for 91 young scientists on model-data assimilation: 'Physics and chemistry of air pollution and their effects'. A Marie Curie-iLEAPS training course.

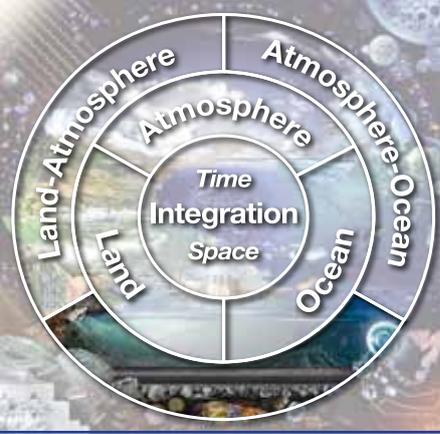
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## Land-Ocean Interactions in the Coastal Zone (LOICZ)

LOICZ examines global-change issues along the world's coastal zones. Its goal is to provide the knowledge, understanding and prediction needed to allow coastal communities to assess, anticipate and respond to the interaction of global change and local pressures which determine coastal changes.

LOICZ focuses on:

- Socio-ecological-system analysis of coastal zone systems, processes and thresholds;
- A system-approach framework for coastal sustainability and development;
- Mitigation of global change impacts in the coastal zone;
- Modelling multi-stressors at different scales in the coastal zone;
- Multi-indicator assessment of the state and governance of the coastal zone.



## Highlights

### Scientists confirm Europe's seas in serious decline

The LOICZ-affiliated project, European Lifestyles and Marine Ecosystems (ELME), has confirmed the serious state of decline of Europe's regional seas. The project hit new ground by exploring the effects of lifestyles on coastal system functions. It also provided simulations of ecosystem health and goods and services under different principles of governance and globalisation.

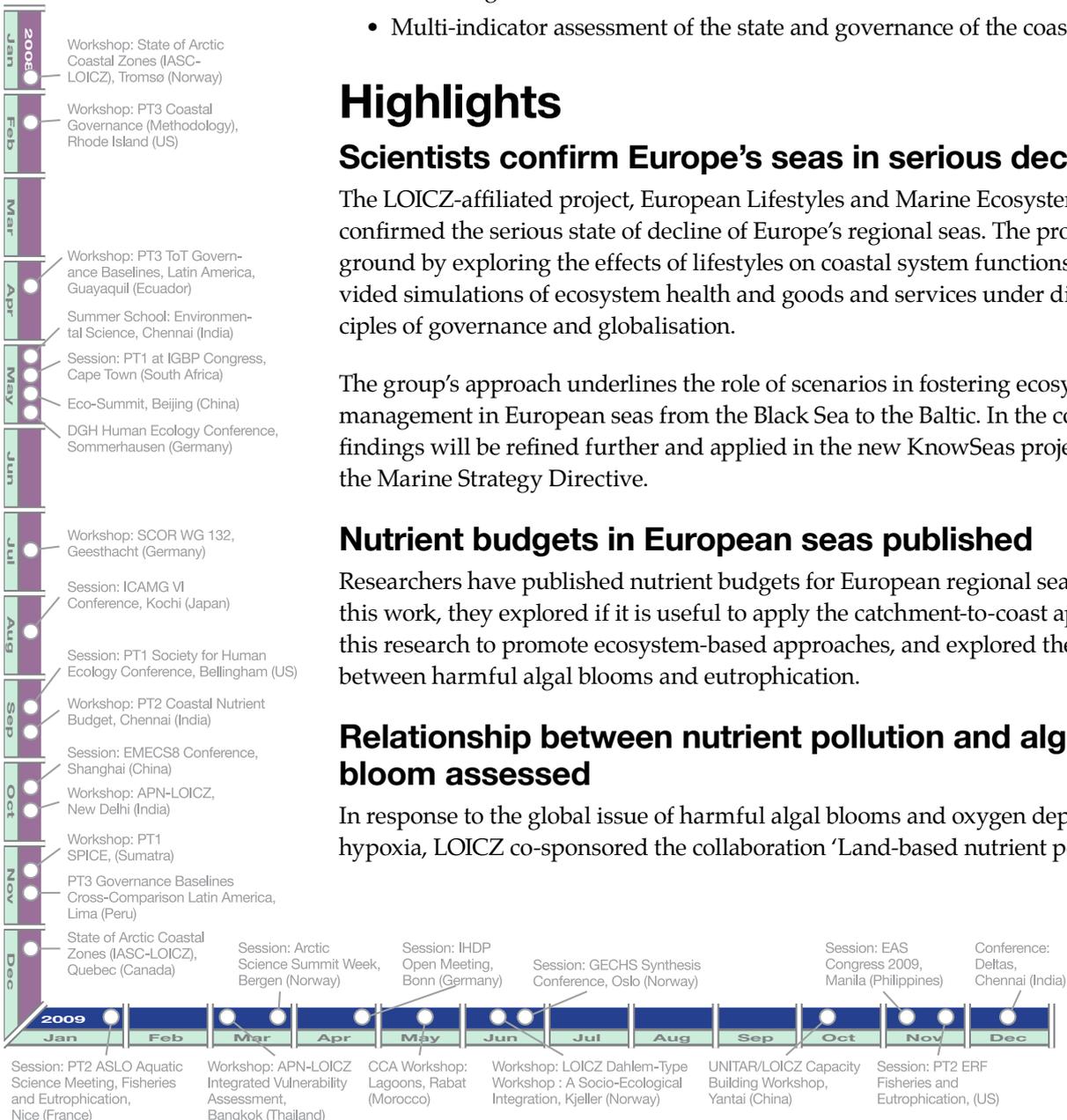
The group's approach underlines the role of scenarios in fostering ecosystem-based management in European seas from the Black Sea to the Baltic. In the coming year the findings will be refined further and applied in the new KnowSeas project addressing the Marine Strategy Directive.

### Nutrient budgets in European seas published

Researchers have published nutrient budgets for European regional seas. As part of this work, they explored if it is useful to apply the catchment-to-coast approach to this research to promote ecosystem-based approaches, and explored the relationship between harmful algal blooms and eutrophication.

### Relationship between nutrient pollution and algal bloom assessed

In response to the global issue of harmful algal blooms and oxygen deprivation, or hypoxia, LOICZ co-sponsored the collaboration 'Land-based nutrient pollution and the





Fishermen in Yantai, China. Coastal goods and services are a vital part of many economies. Ensuring their sustainability requires effective governance to mitigate and adapt to global environmental change – one of the LOICZ Priority Topics.

Photo credit:  
Juergen Weichselgartner

relationship to harmful algal blooms in coastal marine systems'. The collaboration, led by the Scientific Commission on Oceanic Research and the Intergovernmental Oceanographic Commission, was a contribution to the Global Ecology and Oceanography of Harmful Algal Blooms (GEOHAB) international programme.

### **New model on trophic status of estuaries adopted internationally**

The LOICZ-endorsed ASSETS model (Assessment of Estuarine Trophic Status) is now widely used internationally. Around 200 estuary systems throughout the USA, China, the European Union, Latin America and Africa are using the system plus an online tool also provided. See [www.eutro.org](http://www.eutro.org)

### **Nutrient and carbon cycle report handed to UN Environment Programme**

A policy digest of LOICZ biogeochemical assessments culminated in a report to the UN Environment Programme: *The Role of the Coastal Ocean in the Disturbed and Undisturbed Nutrient and Carbon Cycles – A Management Perspective*.

### **Carbon budgets in Arctic coastal waters published**

Field campaigns to Arctic coastal waters and boreal seas led to several papers on coastal carbon budgets that looked at the role of the coastal sea as a sink or source of CO<sub>2</sub>.

### **Linking governance and science**

A sequence of conceptual workshops supported by LOICZ resulted in a first draft of a guideline on "the Analysis of Governance Responses to Ecosystem Change" – publishing is foreseen in early 2009. The approach is a bottom-up issue-driven approach in direct interaction with relevant stakeholders.

#### **Co-sponsor:**



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## Surface Ocean–Lower Atmosphere Study (SOLAS)

The connections between sea and sky are crucial to climate and help determine the global distributions of heat, freshwater and greenhouse gases. SOLAS, co-sponsored by the Scientific Commission on Oceanic Research and others, studies how the key biogeochemical-physical interactions and feedbacks between the ocean and the atmosphere affect and are affected by climate and environmental change. Data sets produced by SOLAS help to build comprehensive Earth system models with predictive capabilities.



### Highlights

#### One third of nitrogen entering oceans from humans

Researchers have shown a third of the nitrogen entering the ocean comes from increasing anthropogenic sources transported via the atmosphere. This nitrogen is in a form that acts as a fertiliser for plankton growth, which draws down CO<sub>2</sub> from the atmosphere. The reduced greenhouse warming of the planet estimated to be caused by this process is significantly offset by the marine production of another greenhouse gas, nitrous oxide.

#### Launch of the Surface Ocean CO<sub>2</sub> Atlas

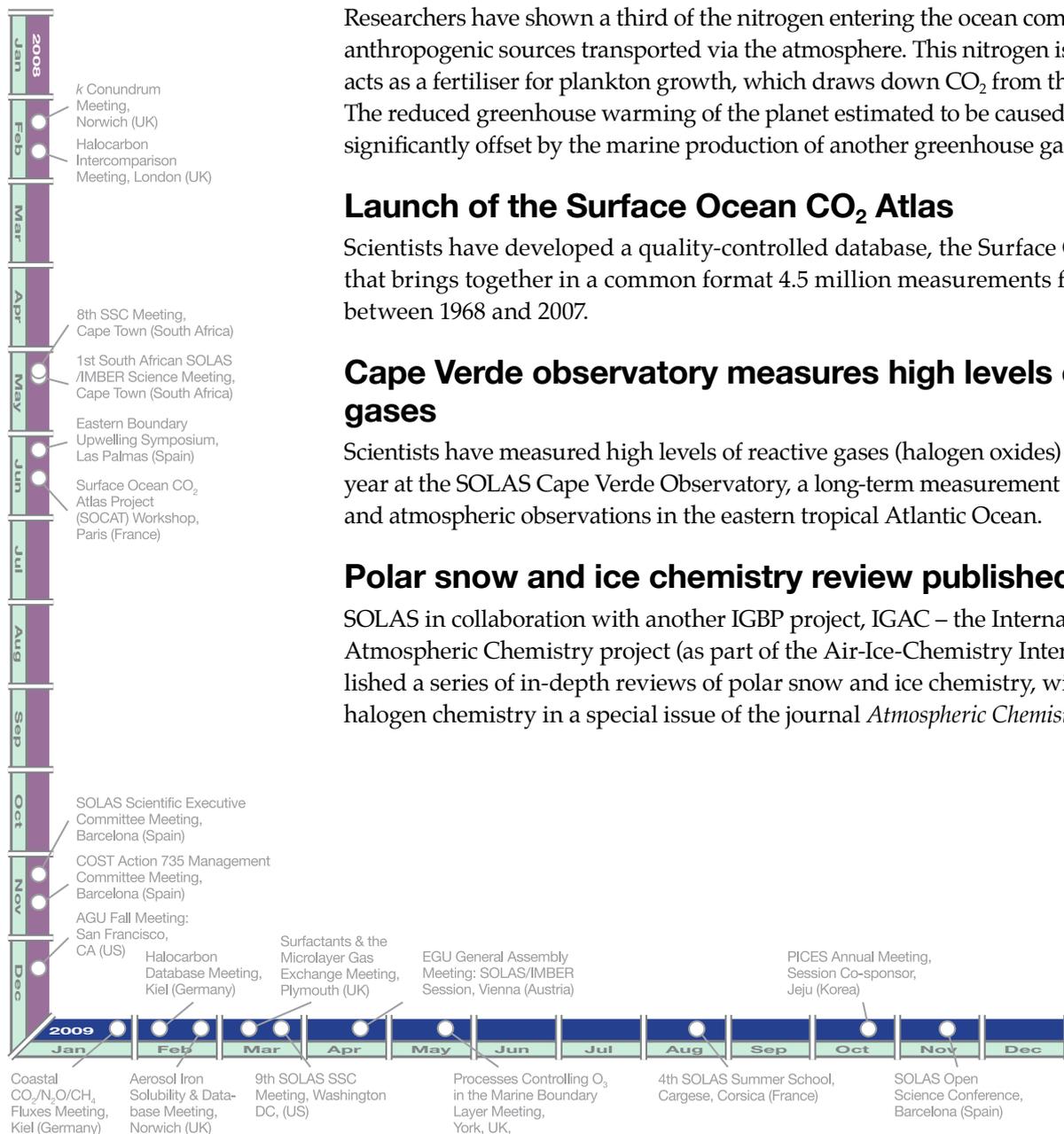
Scientists have developed a quality-controlled database, the Surface Ocean CO<sub>2</sub> Atlas, that brings together in a common format 4.5 million measurements from 1250 cruises between 1968 and 2007.

#### Cape Verde observatory measures high levels of reactive gases

Scientists have measured high levels of reactive gases (halogen oxides) throughout the year at the SOLAS Cape Verde Observatory, a long-term measurement station for oceanic and atmospheric observations in the eastern tropical Atlantic Ocean.

#### Polar snow and ice chemistry review published

SOLAS in collaboration with another IGBP project, IGAC – the International Global Atmospheric Chemistry project (as part of the Air-Ice-Chemistry Interactions) – published a series of in-depth reviews of polar snow and ice chemistry, with a focus on halogen chemistry in a special issue of the journal *Atmospheric Chemistry and Physics*.





Off-shore mesocosms developed as part of the German SOLAS programme SOPRAN (Surface Ocean Processes in the Anthropocene) are deployed in the Baltic Sea to study effects of ocean acidification.

Photo credit:  
Ulf Riebesell

## Synthesis of movements of important climate gases between the air and sea

Scientists conducted a synthesis of air-sea gas flux transfer velocity parameterisations and constructed climatologies for the transfer velocity of climatically important gases.

## Contributing to the geoengineering debate

SOLAS continued to contribute to the debate on ocean iron fertilisation as a carbon mitigation strategy. SOLAS scientists caution against such an approach unless there is better demonstration that it effectively removes CO<sub>2</sub> from the atmosphere, retains that carbon in the ocean for a quantifiable time and has predictable and acceptable environmental impacts.

## Methane in the North-West Pacific

Scientists determined, through carbon isotopic characterisation, that the major source of sub-surface excess methane in the North-West Pacific is sinking particles.

## Dust and aerosol sampling

Researchers initiated a new-terrestrial time-series dust sampling platform, and continued the routine sample programme for aerosol ion chemistry at New Zealand's National Institute for Water and Atmospheric Research (NIWA) sampling site at Baring Head on the south coast of the North Island.

### Co-sponsors:



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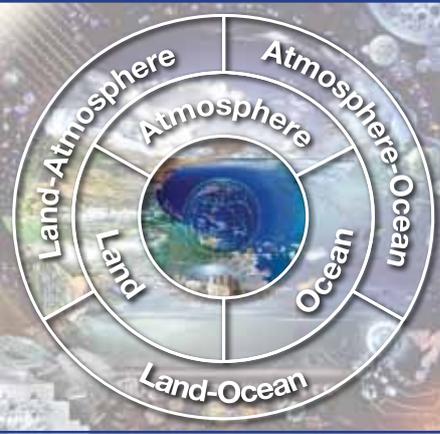
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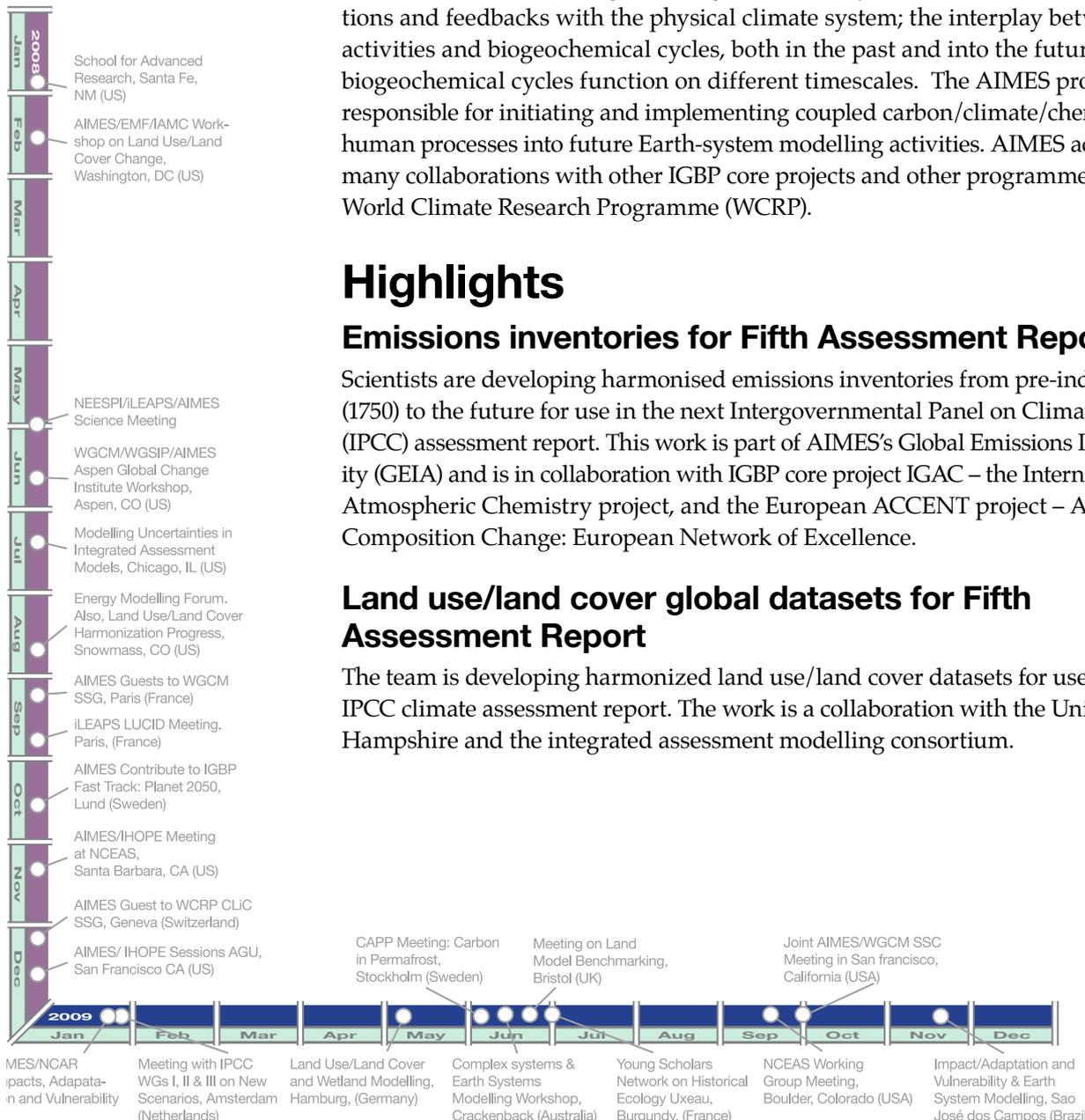


## Analysis, Integration and Modelling of the Earth System (AIMES)

Models, observations and measurements contribute to understanding and quantifying Earth-system dynamics. Their scientific integration and synthesis are fundamentally important activities for IGBP. The ultimate goal of these activities is to provide policy and resource-management communities with useful global-change and Earth-system information.

The AIMES project seeks to achieve a deeper and more quantitative understanding of the role of human perturbations in the Earth's biogeochemical cycles and their interactions with the coupled physical climate system.

AIMES's focus is on how global biogeochemical cycles function, including interactions and feedbacks with the physical climate system; the interplay between human activities and biogeochemical cycles, both in the past and into the future; and how biogeochemical cycles function on different timescales. The AIMES project office is responsible for initiating and implementing coupled carbon/climate/chemistry and human processes into future Earth-system modelling activities. AIMES activities involve many collaborations with other IGBP core projects and other programmes include the World Climate Research Programme (WCRP).



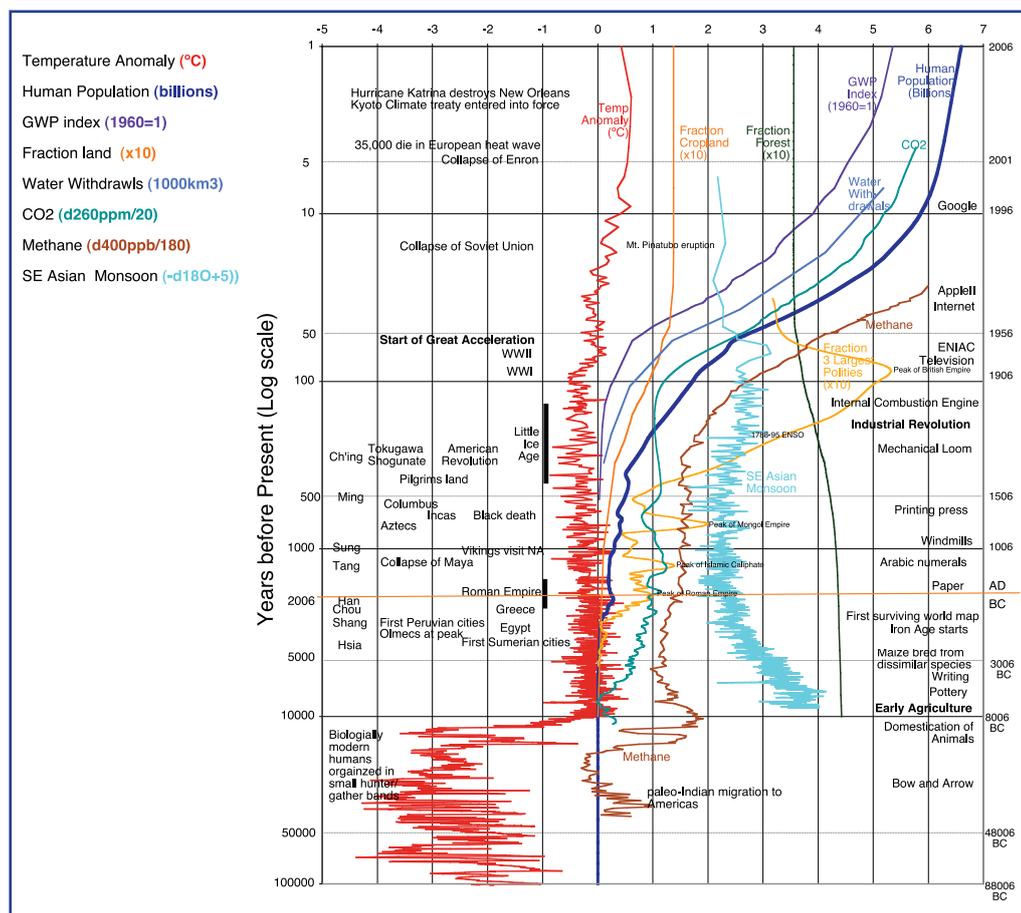
## Highlights

### Emissions inventories for Fifth Assessment Report

Scientists are developing harmonised emissions inventories from pre-industrial times (1750) to the future for use in the next Intergovernmental Panel on Climate Change (IPCC) assessment report. This work is part of AIMES's Global Emissions Inventory Activity (GEIA) and is in collaboration with IGBP core project IGAC – the International Global Atmospheric Chemistry project, and the European ACCENT project – Atmospheric Composition Change: European Network of Excellence.

### Land use/land cover global datasets for Fifth Assessment Report

The team is developing harmonized land use/land cover datasets for use in the next IPCC climate assessment report. The work is a collaboration with the University of New Hampshire and the integrated assessment modelling consortium.



Selected indicators of environmental and human history from 100kyr BP to present.

Reprinted from: Developing an Integrated History and Future of People on Earth, (IHOPE): Research Prospectus, in press.

## Progress made on an Integrated History of People on Earth

Earth-system scientists, archaeologists and historians came together to study the Integrated History and Future of People on Earth (IHOPE). At a recent work group meeting, the collaboration made progress on a strategy for developing a data system that can be used in this highly interdisciplinary study. An international group of Mayan archaeologists agreed to collaborate across six Mayan focal regions to develop a systems understanding of Mayan social, environmental, archaeological and historical interactions. The IHOPE activity is a partnership with AIMES, PAGES and the International Human Dimensions Programme (IHDP).

## Addressing major uncertainties in the carbon/permafrost system

The dynamics and possible futures of the carbon cycle and permafrost in northern high latitudes is the topic of a new activity between AIMES and the WCRP's Climate and Cryosphere project. The group proposes a coordinated modelling framework for the northern high latitudes to address major uncertainties in the permafrost-carbon-climate system.

## Young scholars

The cultural uses and impacts of fire was the topic of the fourth AIMES Young Scholars Network (YSN) workshop. More than 40 young scholars from Africa, Asia, Australia, Europe, South America, and North America participated. Through the YSN workshops, an international network of young scholars for Earth-system science is developing to foster collaborations among them on integrative research on the role of humans in perturbing biogeochemistry and climate.

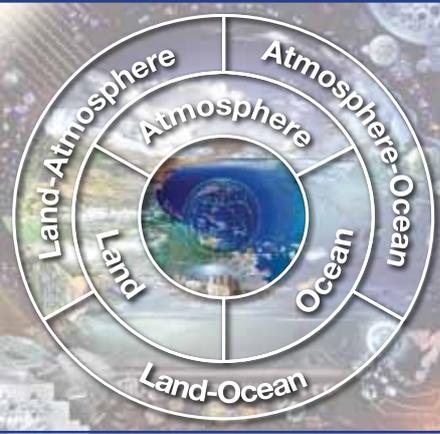
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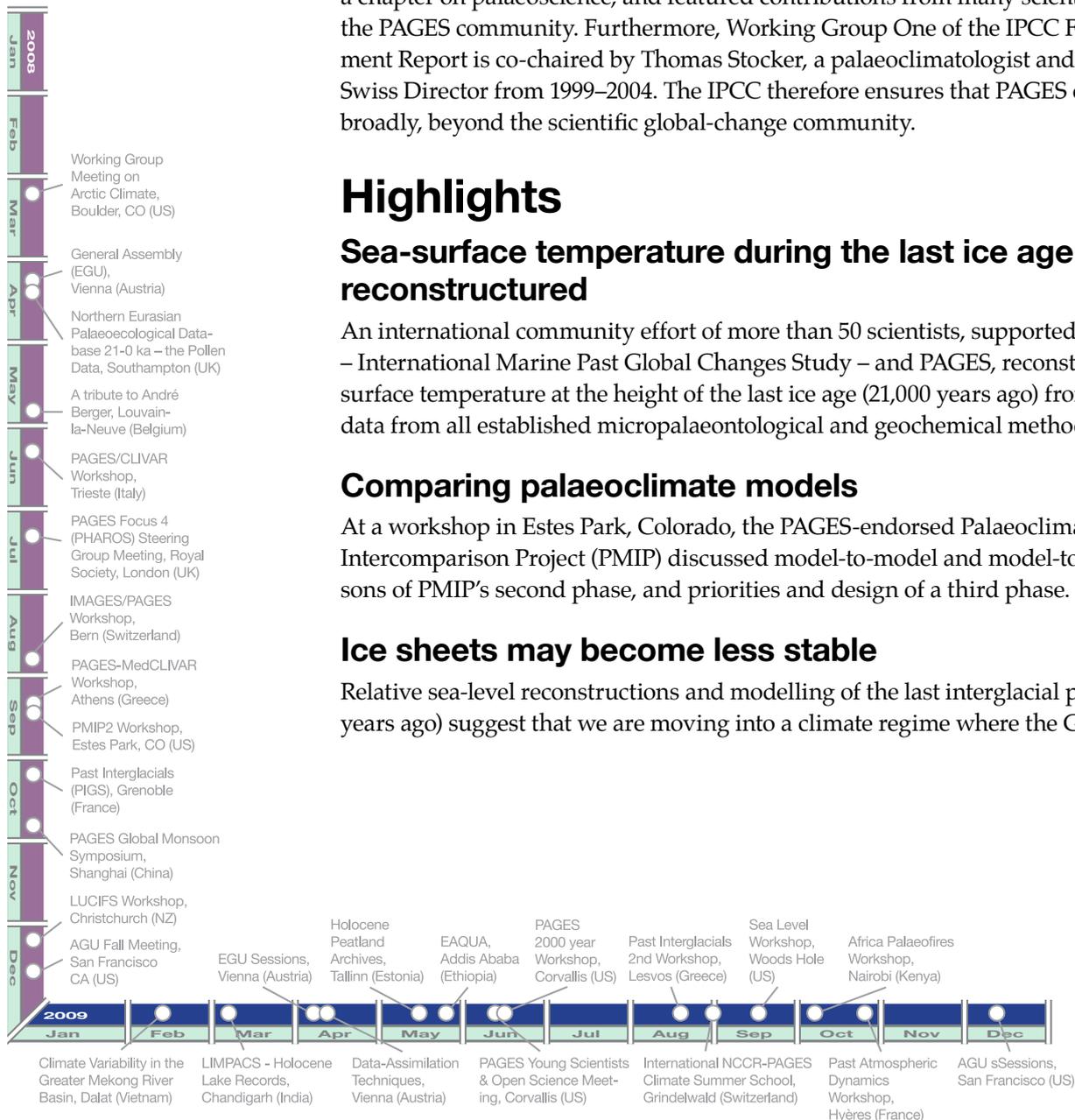
Website:  
www.aimes.ucar.edu



## Past Global Changes (PAGES)

The PAGES project's main emphasis is on regional and global synthesis of past climatic and environmental changes. These syntheses allow assessment of natural variability and anthropogenic impact, which can be used with model simulations to make sound estimates of future global change and its consequences.

The results generated by PAGES activities immediately serve the research and other user communities working on present and future aspects of global change, complementing observational and modelling research. Palaeoscience results are regularly used to provide a context for observed changes. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (2007) was the first assessment to include a chapter on palaeoscience, and featured contributions from many scientists active in the PAGES community. Furthermore, Working Group One of the IPCC Fifth Assessment Report is co-chaired by Thomas Stocker, a palaeoclimatologist and former PAGES Swiss Director from 1999–2004. The IPCC therefore ensures that PAGES output is used broadly, beyond the scientific global-change community.



## Highlights

### Sea-surface temperature during the last ice age reconstructed

An international community effort of more than 50 scientists, supported by IMAGES – International Marine Past Global Changes Study – and PAGES, reconstructed the sea-surface temperature at the height of the last ice age (21,000 years ago) from a synthesis of data from all established micropalaeontological and geochemical methods.

### Comparing palaeoclimate models

At a workshop in Estes Park, Colorado, the PAGES-endorsed Palaeoclimate Modelling Intercomparison Project (PMIP) discussed model-to-model and model-to-data comparisons of PMIP's second phase, and priorities and design of a third phase.

### Ice sheets may become less stable

Relative sea-level reconstructions and modelling of the last interglacial period (126,000 years ago) suggest that we are moving into a climate regime where the Greenland and



Drilling for ice cores in Greenland with the ITASE coring system.

Photo credit: P. Mayewski

West Antarctic ice sheets will become increasingly unstable. Furthermore, the response model revealed by the palaeo sea-level data suggests that sea-level rise related to current warming may be rapid at first and slow with time.

## Scientists unravel regional climate effects due to changes in Earth's orbit in last 6000 years

A synthesis paper of Wanner et al. (2008), based on PAGES workshops and special sessions, provides an overview of climate change over the last 6000 years. What makes this period particularly interesting is that boundary conditions of the climate system were largely comparable to today, while the forcings changed over time. Proxy and model evidence reveal that the gradual redistribution of solar energy due to orbital forcing resulted in a progressive southward shift of the Intertropical Convergence Zone during the northern hemisphere summer, a weakening of the African and Asian monsoon systems and increasing dryness on both continents.

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## Fast Track Initiatives (FTI)

The IGBP Scientific Committee initiates FTIs to advance our knowledge of Earth-system functioning. These initiatives cut across the programme's research and provide a means for the IGBP community to contribute to synthesis.

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### **The Planet in 2050**

What defines a desirable future? The answer to this question differs widely amongst individuals, societies and cultures. Even if consensus could be reached, there are multiple pathways for getting there. There is growing consensus that a 'business as usual' approach will not produce a desirable – or even viable – future for *Homo sapiens* as well as other forms of life on Earth. These were the issues at the focus of a meeting of 50 world-class scientists and representatives from the business world in Lund, Sweden, in October 2008.

Participants concluded that human society is moving dangerously beyond the carrying capacity of the planet, in a striking parallel to the current financial crisis. Yet researchers predict that the consequences of the breakdown of the ecological system will be far worse, on just a slightly longer timeframe.

The meeting consisted of four parallel and interacting workshops and covered issues from climate change, water quality and health to land-use, urban development, technology and the economy.

A book is in preparation, 'The Planet in 2050, the Lund Disclosure on the Future' and a summary will be published in the electronic journal *Solutions*.



## Plant Functional Classifications

Large-scale vegetation models – needed for Earth-system models, and to understand the role of ecosystems and biodiversity in global environmental change – require detailed information about plants, classified according to their responses to environmental drivers and effects on ecosystem processes. Recent advances in modelling recognise the need to accommodate more detailed plant traits than the ones included in previous modelling initiatives. This FTI focuses on bridging a traditional gap between experimental scientists and modellers.

Together, data contributors and modellers are constructing a global-scale database of vascular plant traits. It currently consists of more than two million entries and is composed of about 50 databases from more than 50 contributors.

A new generation of dynamic vegetation models are being constructed which take into account the greater biological complexity held in the database. These models provide a more robust representation of the ecosystem response to and feed back onto global change.

A major challenge in constructing such a database is in convincing contributors to provide their data for modelling purposes. Intellectual property guidelines have therefore been developed to facilitate data sharing and recognition of contributions.

A third workshop is planned in 2009 in collaboration with the Global Land Project's initiative on decreasing uncertainty in predicting biome boundary shifts. This will focus on improving regional and global models of vegetation dynamics in response to disturbance and migration and on developing applications for the global plant functional trait database so that it can be used in other areas of ecology and biogeography.

This initiative is shared with, and is an increasingly important component of, the Diversitas BioDiscovery project.

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# IGBP networking activities

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Established by IGBP chair Carlos Nobre, the IGBP regional office in Brazil started operating in July 2006. In 2008, the office assisted the IGBP secretariat with the planning, fundraising, and organisation of the fourth IGBP congress in Cape Town. In addition, its two science officers supported the secretariat staff by serving as liaisons between IGBP and the Global Land Project and the Global Carbon and Global Water System Projects of the Earth System Science Partnership. The office also coordinated and edited the seventieth issue of the IGBP *Global Change Newsletter*.

On top of the financial support for the activities listed above, the regional office secured financial support from the Brazilian National Institute for Space Research (INPE), to print and mail three issues of the IGBP newsletter to each of 2200 institutions in less developed countries around the world.

## Highlights

### Making connections

The office helped the Global Land Project connect with the Inter-American Institute for Global Change Research (IAI) so the project could benefit from the institute's established networks in the Americas.

### Developing a bioenergy and Earth sustainability initiative

In July 2008, the office held an Earth System Science Partnership Biofuels Workshop in Brazil. Conceptualised, funded, and organised jointly with the Global Carbon Project, the workshop yielded a proposal for a new research initiative on bioenergy and Earth sustainability which sets a new benchmark for cooperation among a broad range of research projects, UN agencies, and the policymaking community.

### Carbon and water projects

The office hosted and organised steering committee meetings for the Global Carbon Project and the Global Water System Project at the University of São Paulo and the National Institute for Space Research, with the participation of the Inter-American Institute for Global Change in the latter case. Local researchers and students attended open scientific discussions.

### Latin America and Caribbean strengthen links to IGBP

The office organised, hosted and funded a meeting at the National Institute for Space Research in São José dos Campos, Brazil, uniting IGBP and global-change science leaders from Latin America and the Caribbean to discuss how to strengthen the

region's involvement with IGBP. In light of discussions at the fourth IGBP congress in South Africa in May 2008 and the conclusions of the ICSU review of IGBP, a central focus was on how to render the IGBP national committees more active and effective in improving scientific capacity and understanding of global environmental change in the region, as well as become better equipped to make the science respond to, and bear on, decision-making processes.

As part of a broader effort to build scientific capacity and sustainability worldwide, the regional office participated in the science-policy dialogue meeting of the International Human Dimensions Programme which focused on Energy, Sustainability and Societal Change. It also collaborated with the Inter-American Institute to conceptualise and organise a working group session at the fourth IGBP congress on "Regional knowledge systems for sustainable development". The session brought together natural and social scientists from Brazil, the US and Africa, with central conceptual involvement and financial sponsorship from the Inter-American Institute for Global Change Research (IAI). This working group session is now being used to disseminate lessons learned on regional network creation, and fostering global change scientific capacity in less-developed regions.

## IGBP: an Earth System Research Network

IGBP was founded over 20 years ago to launch broad interdisciplinary Earth-system science research on a global scale. The programme brings together researchers to address scientific questions where an international, integrated approach is the best or the only way to provide answers to the issues addressed by national or regional programmes. National science communities can participate in IGBP's complex, multi-national field campaigns and experiments, model and data intercomparisons, regional and global upscaling activities, data exchange, and the synthesis of research results. Through the IGBP network scientists have an opportunity to shape international research strategies.

The core project offices, directing the scientific research plans, are located in, and largely funded by, institutions in Denmark, Finland, France, Germany, Sweden (the IGBP Secretariat), Switzerland, the UK, and USA, with scientific steering committees composed of members from all the continents. All of the core projects have national scientific networks in relevant regions that further the research.

To facilitate dialogue between national and international global-change research, IGBP has 74 national committees representing every continent, which play an essential role in IGBP's scientific planning and implementation, and in turn benefit from the research and studies in their region. The national IGBP committees are often the national committees for global-change research, and carry out extensive activities on their own or in collaboration with regional clusters, such as in the case of Europe. Building on these networks, the IGBP core projects have created a wealth of multinational studies, and an even greater corpus of international and regional programmes.

## Highlights from each continent

### Africa

IGBP and the Egyptian Academy of Scientific Research and Technology co-sponsored a workshop on "Sustainable Water and Land Management in Semi-Arid Regions". The

workshop, held in Cairo, Egypt, 20–21 November 2008, was attended by 85 participants representing 17 countries, including young Egyptian scholars. It provided a forum aimed at refining IGBP's scientific agenda for applied Earth-system science and sustainability in the Middle East – North Africa (MENA) region. Top on the research agendas are:

- Land degradation, over-irrigation and desertification;
- Changes in land use as well as related stresses to their water;
- Support for the African Network for Earth System Science (AfricanNESS – an IGBP initiative) to develop a network for global environmental change in Africa.

The workshop identified where IGBP and MENA researchers can better contribute to addressing mitigation, innovation and adaptation, large-scale pilot projects and institutional networking.

### **Botswana**

The committee helped draft the Ministry of Environment Wildlife and Tourism chapter of the National Development Plan No.10. The committee proposed establishing a dedicated centre to promote research on Botswana's dry lands. The Kalahari and Arid Lands Research Center (KALAREC) will focus on the Kalahari sands, which cover 80% of the country. The committee is speaking directly to the business community about climate mitigation and adaptation through the Botswana Confederation of Commerce Industry and Manpower.

### **Cameroon**

Committee chair, Maurice Tsefelac, presented the AfricanNESS research plan at the "Africa – EC Dialogue" workshop in Brussels. This workshop helped ensure African research priorities are included in the next Framework Programme 7 of the Environment Work Programme.

### **Congo, Democratic Republic**

The committee starting a soil sampling study in Ituri Forest with scientists from the Congo, France and the US.

### **Egypt**

In 2008, prior to hosting the Middle-East and North African workshop, the Egyptian Academy of Scientific Research and Technology hosted the IGBP Officers' Meeting.

### **Kenya**

The committee has worked on projects investigating early man in the East Africa Rift Valley and the links with environmental and climate changes. Projects were also prepared with UNEP, WMO and NOAA, to build an Equatorial African atmospheric deposition network, and with UNEP and START to assess Africa's vulnerability to water stress and other environmental changes.

### **Morocco**

Committee members published research articles on drought, desertification, precipitation, water and risk management. In addition, they produced press releases on climate change and vulnerability and organised climate change-related events.

### **South Africa**

The South African national committee organised the fourth IGBP congress, and helped organise the Fifth EGU Alexander von Humboldt International Conference in Cape Town in January 2009.

## Americas

Global Change Science in Latin America: The Role of IGBP and National Committees was the theme of a meeting organised by the Brazil Regional Office that united a subset of Latin American leaders in global-change science and IGBP national committee members in November at INPE in São Jose dos Campos, Brazil, to discuss how to strengthen global-change science and its impacts in Latin America and, in particular, how IGBP might help in that process.

### United States

The US hosts the AIMES international project office in Boulder, Colorado and the IGAC international project office in Seattle, Washington. A consortium of US funding agencies generously contributes to the running of the IGBP Secretariat.

### Venezuela

During 2008, scientists pursued ongoing collaborative research projects on oceanographic timescales, atmosphere-biosphere interactions, ecology and global change research, hydrology, hydrometeorology and heodesy, and social and ecological vulnerability and risk management.

## Asia

### Bangladesh

With regional support the committee participated in two research projects: Socio-economic and Physical Perspectives of Water-related Vulnerability and Carbon Dioxide Enhancement Rice Research Experiment Using Open Top Chamber. Bangladeshi activities aim at combating sea-level rise and advising farmers to shift cropping patterns from summer flooding time to winter dry season.

### China

The committee has been involved in a crucial step in China's bid to strengthen its capacity to cope with climate change. Following an expert meeting in Beijing on the feasibility study *Evolution of Climate and Environment in China: 2012* the first research symposium began compiling China's basic work on climate change. The Chinese Academy of Sciences, the Ministry of Science and Technology, and the China Meteorological Administration contributed to the work. The work follows the Intergovernmental Panel on Climate Change working group structure.

China geared up for its *Second National Assessment Report on Climate Change* with a ceremony in December 2008.

### Pakistan

The Global Change Impact Studies Centre continued to develop climate extreme indices and indicators for monitoring trends in climate extremes and their social and economic effects in South Asia.

### Philippines

Through the National Academy of Science and Technology, the members held a discussion on climate change and the Clean Defense Mechanism in Manila.

### Singapore

Committee members and their institutes advanced research projects on climate change impacts on Singapore, integrated vulnerability assessment of coastal areas, and changes in biogeochemical cycling as an estuary is converted to a freshwater reservoir in a tropical urban catchment.

## Taiwan

Taiwan hosts the IGAC Taipei core project office. The national committee promotes three areas of study: data collection, impact and vulnerability of global change on Taiwan's ecological system, and hazard mitigation and adaptation, as well as leading two science-policy projects.

## Vietnam

During 2008, scientists contributed to a project on adaptation to climate change and air pollution in Vietnam, and an international project on reducing environment degradation in the South China Sea.

## Europe

The European Alliance of Global Change Research was founded at the fourth IGBP Congress in Cape Town where a charter was drawn up defining its purpose to promote and support supranational European Global Change science. Its approach is inclusive, covering all aspects from basic to applied research. It will aim to improve the dialogue with decision makers and stakeholders, to support the Global Change Programmes, to facilitate young scientists' participation at the European level, and to ensure communication between the global-change research communities in Europe and collaboration with African colleagues. The first meeting was in Lisbon in November 2008, with the second meeting in Bonn in April 2009.

## Austria

Published research projects in 2008 focused on alpine permafrost, land-use change in mountain areas, and global change effects in high-mountain and Arctic areas.

## Czech Republic

As part of IMBER, contributed to papers published on the carbon cycle functioning in an aquatic environment.

## Denmark

Denmark hosts the international project office for the Global Land Project at the University of Copenhagen.

## Finland

Finland continued to host the International Project Office for iLEAPS at Helsinki University.

## France

France continued to host the international project office for IMBER at the Institut Universitaire Européen, Brest.

## Germany

Germany continues to host the international project office for LOICZ at the Institute for Coastal Research, Geesthacht, and helped found the Alliance of European Global Change Research Committees.

## Greece

The committee has organised an international conference in collaboration with the International and Greek GEO Office (June 2008) on the best management of the coastal Mediterranean zones and a workshop on how global change will affect the Mediterranean.

## Hungary

The research centre initiated under the former IGBP core project Global Change and Terrestrial Ecosystems (GCTE) continues work on the impacts of elevated CO<sub>2</sub> concentrations on plant ecological processes.

## Ireland

The national committee has become the Irish Committee for Climate Change of the Royal Irish Academy. In addition to ongoing research projects, it sponsored a series of public lectures in 2008 on climate change, which were broadcast on TV.

## Italy

Italy hosts the IGAC Bologna core project office.

## Portugal

The committee hosted the first meeting of the European Alliance of Global Change Research Committees. In 2008, a pilot study on the use of water by tourists in the coastal area of the Algarve, Portugal, was made for LOICZ. The results of the study will be used for a larger-scale study of water use by tourism in the Mediterranean region, seasonal migration, environmental change, water scarcity, governance and human security.

## Romania

The Romanian committee organised the Seventh National Conference on Global Environmental Change – Impact of Global Climate Change on Society and Environment in Bucharest.

## Russian Federation

The committee held an international conference in Siberia, focusing on a research project, the Development of the Siberia Integrated Regional Study (SIRS). This is a mega-project which includes research on boreal forests and wetlands, greenhouse gases and aerosol exchange between biota and atmosphere, regional climate-change impact monitoring and modelling, developing information-computational infrastructure; and the regional social-economical consequences of global change.

## Sweden

The Royal Swedish Academy of Sciences hosts the IGBP secretariat, which is generously sponsored by the Swedish government.

## Switzerland

Switzerland hosts the international project office of Past Global Changes (PAGES). The IGBP national committee is a programme of ProClim, itself a forum of the Swiss Academy of Sciences, which acts as the governmental advisory body for climate change.

## United Kingdom

The UK hosts the GLOBEC and SOLAS international project offices. The committee held a series of one-day meetings at the Royal Society in London, showcasing particular aspects of IGBP core projects in the UK.

## Oceania

### Australia

The committee is part of the National Committee for Earth System Science, hosted by the Australian Academy of Sciences. In 2008, the synthesis and recommendations document "Vegetation dynamics and global climate change: research priorities for the next decade" was signed by the Executive Committee of the academy. The document affected the decision to establish the Terrestrial Ecosystem Research Network.



## Earth System Science Partnership

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# Earth System Science Partnership (ESSP)

ESSP is a science partnership for the integrated study of the Earth system, the ways that it is changing, and the implications for global and regional sustainability. It is made up of the International Council for Science's (ICSU) four global environmental change research programmes: DIVERSITAS (an international biodiversity programme) the International Human Dimensions Programme on Global Environmental Change (IHDP), the World Climate Research Programme (WCRP) and IGBP.

In 2008, ICSU and the International Group of Funding Agencies for Global Change Research (IGFA) published a review of ESSP. The review panel, chaired by Professor Louise Fresco, took a consultative and evidence-based approach to assist the development of ESSP.

### Key findings:

- The Amsterdam Declaration that created ESSP is even more relevant today than in 2001 when the ESSP was established;
- There is a need for a strengthened ESSP;
- The review panel recommends that ESSP formulate as soon as possible a long-term vision of where it wants to be in ten years' time.

In response to the recommendations, a retreat was organised in May 2008 to take stock of the review findings and begin preparation for the drafting of the ESSP strategic plan. The ESSP scientific committee convened in Oxford in July 2008 to follow up actions from the retreat and further develop the strategic plan. Out of this meeting and subsequent *ad hoc* meetings, ESSP is developing a vision and mission and set of new activities to carry it forward.

# ESSP Joint Projects

## Global Water System Project (GWSP)

The central research questions of GWSP are, how are humans changing the global water cycle, the associated biogeochemical cycles, and the biological components of the global water system? And what are the social feedbacks arising from these changes?

To address these questions, GWSP launched three global initiatives:

1. Global scale initiative: ranking of threats to the global water system.
2. Global catchment initiative: bringing the global perspective to river basin research and management.
3. Global water needs: humans and nature.

The initiatives are targeted towards the production of scientifically cutting-edge and highly policy-relevant results.

GWSP results have already been successfully represented in assessments such as the IPCC Fourth Assessment Report and Technical Paper on Water as well as the *Brazilian National Plan and Strategy for Climate Change* (GWSP endorsed project).



Global Water  
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## Global Environmental Change and Human Health (GECHH)

The main research objectives of the project are to:

1. Identify and quantify health risks posed by global environmental change, now and in the reasonably foreseeable (scenario) future.
2. Describe spatial (geographic, inter-population) and temporal differences in health risks, to understand vulnerabilities better and, therefore, intervention priorities.
3. Develop adaptation strategies to reduce health risks, assess their cost-effectiveness, and communicate results.
4. Foster research training to boost networked international research capacity in global environmental change and human health.

The project's inaugural scientific steering committee meeting convened in Merida, Mexico, December 2008, in conjunction with the EcoHealth Forum ([www.ecohealth2008.org](http://www.ecohealth2008.org)). Proposed Fast Track activities range from policy briefs, training courses, research collaboration with existing projects and research groups and papers at major conferences and in peer-reviewed journals

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## Global Carbon Project (GCP)

The scientific goal of the Global Carbon Project is to develop a complete picture of the global carbon cycle, including both its biophysical and human dimensions together with the interactions and feedbacks between them.

Two major scientific findings resulted from the new analyses of recent trends in the global carbon cycle:

- For the first time, we showed that the efficiency of the natural sinks to remove carbon dioxide is declining.
- The current fossil fuel emission trajectory is tracking if not surpassing the most carbon intense IPCC scenarios, and this is due, in part, to the fact that after decades of improvements, the carbon intensity of the global economy, the carbon emitted per unit of Gross Domestic Product (GDP), stalled during the period 2003–2005 due to the increased emissions from China.

In 2008, GCP posted the most recent figures for the world's carbon budget, a key to understanding the balance of carbon added to the atmosphere, the underpinning of human-induced climate change. Experience with the carbon budgets has shown integrative/synthetic science products that are released and updated regularly, and have a direct connection with the policy process, can generate a lot of visibility and excitement. See more on: [www.globalcarbonproject.org/carbontrends/index.htm](http://www.globalcarbonproject.org/carbontrends/index.htm).

The Global Carbon Project is taking the lead in an ESSP-wide bioenergy activity that will take an Earth system view of bioenergy, its opportunities and constraints in contributing to stabilising atmospheric CO<sub>2</sub>. An initial workshop took place in Piracicaba, Brazil, hosted by the IGBP regional office.

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## Global Environmental Change and Food Systems (GECAFS)

The goal of GECAFS is to determine strategies to cope with the impacts of global environmental change on food systems and to assess the environmental and socio-economic consequences of adaptive responses aimed at improving food security.

In April 2008, Oxford University, United Kingdom, GECAFS convened an international conference on Food Security and Environmental Change. Major conclusions from the conference included: technological fixes alone will not solve the food security challenge and the major environmental changes bringing additional threats to food security need a whole food system approach, not just a focus on agricultural practices. The conference highlighted the importance of global food trade in reducing vulnerability to environmental change. It also highlighted the non-production aspects of the food system – road and rail networks – can also be vulnerable to environmental change.

In 2008, GECAFS successfully led, on behalf of ESSP, a major proposal "Climate Change, Agriculture and Food Security". The project aims to find ways to overcome the additional threats posed by climate change to achieve food security, enhance livelihoods and improve environmental management in the developing world. The proposal involves 15 centres supported by the Consultative Group on International Agricultural Research (CGIAR). This will be a major collaborative endeavour between the group on agricultural research and their partners, and ESSP. It is chaired by Professor Thomas Rosswall, IGBP's first director. For more information see [www.essp.org](http://www.essp.org)

## Monsoon Asia Integrated Regional Study (MAIRS)

ESSP's first integrated regional study, MAIRS, addresses coupled human and natural processes in Asia's monsoon region.

The vision of MAIRS is to support strategies for sustainable development by advancing knowledge of the interactions between the human and natural components of the overall environment in Asia's monsoon region and their implications on the Earth system. MAIRS's research activities focus on integrated studies of four vulnerable geographic zones: high mountain, urban, coastal and semi-arid zones. In 2008, MAIRS mainly worked to develop joint activities in these four zones, especially concerning linking observations and research.



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## Global Change System for Analysis, Research, and Training (START)

START is responding to the challenge of global environmental change by building human and institutional capacity and generating knowledge to support decisions that enable sustainable development in developing regions.

### Collaborative regional research

START supported several regional research projects on the following themes: land use change and its impacts on terrestrial ecosystems; regional climate variability and change; regional changes in atmosphere; coastal zones; global change and water resources; and assessments of impacts of and adaptations to climate change.

### Advancing Capacity for Climate Change Adaptation (ACCCA)

ACCCA, in collaboration with United Nations Institute For Training and Research and the Stockholm Environment Institute, brings together scientific communities and parties that have a direct interest in adaption to climate change to:

- reduce climate change vulnerability by supporting and enabling effective adaptation decisions;
- identify and set priorities on climate risks and the recommendations for adaptation; and
- identify critical knowledge gaps and design gap-filling strategies.

### South-East Asia Regional Water and Carbon Cycle

This effort is a contribution to ESSP's Global Carbon Project. Over the past four years young scientists from south-east Asian countries have been trained through advanced institute sessions. Small research grants have been provided to them to make measurements in various rivers of the region to derive a comprehensive knowledge of water fluxes and related carbon dynamics in South-East Asia.

### Cities at risk: Developing Adaptive Capacity for Climate Change in Asia's Coastal Megacities

The project Cities at Risk: Developing Adaptive Capacity for Climate Change in Asia's Coastal Megacities was launched in 2008, with a workshop planned for February 2009. The IGBP-IHDP project on Land-Ocean Interactions in the Coastal Zone (LOICZ) will also be involved in this activity.



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## Other collaborations

### Funding agencies and international assessment panels

Three major overarching organisations are part of a vital chain: the International Council for Science (ICSU) that founded IGBP over 20 years ago, the International Group of Funding Agencies (IGFA) providing a link to funders, and the Intergovernmental Panel on Climate Change (IPCC), which conveys our research results to the world community.

### The observing community

Global-change research needs more *in situ* and satellite measurements. Developing and financing these global observations systems requires international collaboration. IGBP participates in the Group on Earth Observations (GEO) and continues to collaborate with the European Space Agency (ESA) to facilitate these systems and measurements. IGBP also participates in the Integrated Global Observing Strategy (IGOS) and the Committee on Earth Observation Satellites (CEOS).

### Partners in marine research

IGBP continues close collaborations with the Scientific Committee on Oceanic Research (SCOR). The committee co-sponsors GLOBEC, IMBER and SOLAS with IGBP. The second symposium on *the Ocean in a High-CO<sub>2</sub> World* was organised with SCOR, the Intergovernmental Oceanographic Commission (IOC) and the International Atomic Energy Agency (IAEA) (see Science Highlights). IGBP additionally collaborates with the IOC through the co-sponsorship of GLOBEC.

### Atmospheric chemistry

The International Commission on Atmospheric Chemistry and Global Pollution (CACGP) is co-sponsor of both the Surface Ocean-Lower Atmosphere Study (SOLAS) and the International Global Atmosphere Chemistry (IGAC) project. CACGP supports atmospheric chemistry research that contributes to solving the basic societal issues of water supply, food production and human/ecosystem health.

### Land-use systems

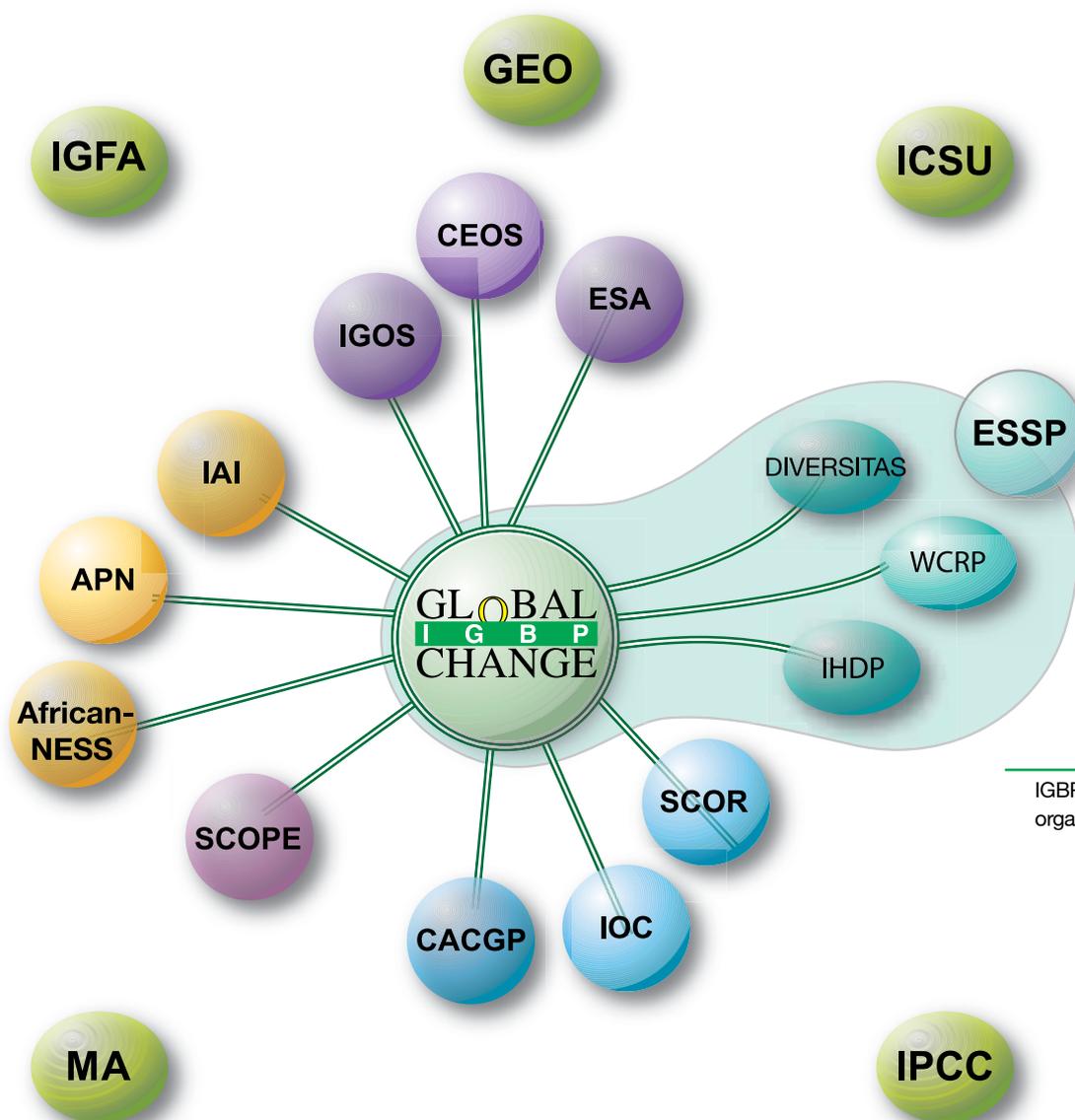
The International Human Dimensions Programme co-sponsors IGBP's youngest project, the Global Land Project, and the long-established project on Land-Ocean Interactions in the Coastal Zone.

## Climate prediction

The World Climate Research Programme co-sponsors SOLAS and is a collaborator in many enterprises, including the historical World Modelling Summit for Climate Prediction, held in Reading, UK, May 2008. The summit, organised by IGBP, the World Climate Research Programme (WCRP) and the World Weather Research Programme (WWRP) brought together, perhaps for the first time, a diverse set of experts from the weather, climate and environment community. The final report is available at [www.wcrp.wmo.int](http://www.wcrp.wmo.int).

## Regional collaborations

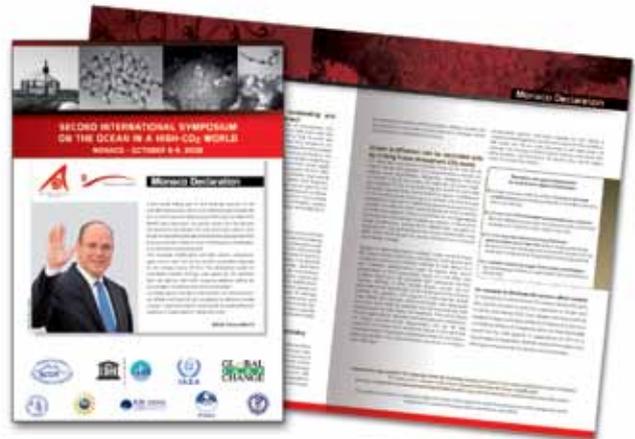
IGBP works closely with the Asia-Pacific Network for Global Change Research (APN) and the Inter-American Institute for Global Change Research (IAI), which support IGBP-related research and training activities. Collaboration with APN and IAI is important for helping develop the scientific agenda for research within IGBP in Asia, Oceania and the Americas, the latter especially through the IGBP regional support office in Brazil. The launches of similar networks in Africa, AfricanNESS, and in Europe, the European Alliance of Global Change Committees were other breakthroughs in 2008.



IGBP's connections with other organisations.

# Communications

During 2008, two major scientific events helped raise the profile of IGBP with policymakers, scientists and the general public: the IGBP fourth congress in Cape Town and the Second Symposium on the Ocean in a High-CO<sub>2</sub> World, which was co-sponsored by IGBP, SCOR, IOC and IAEA.



The communications team organised publicity through the media and produced two special issues of the Global Change newsletter to coincide with the Cape Town congress.

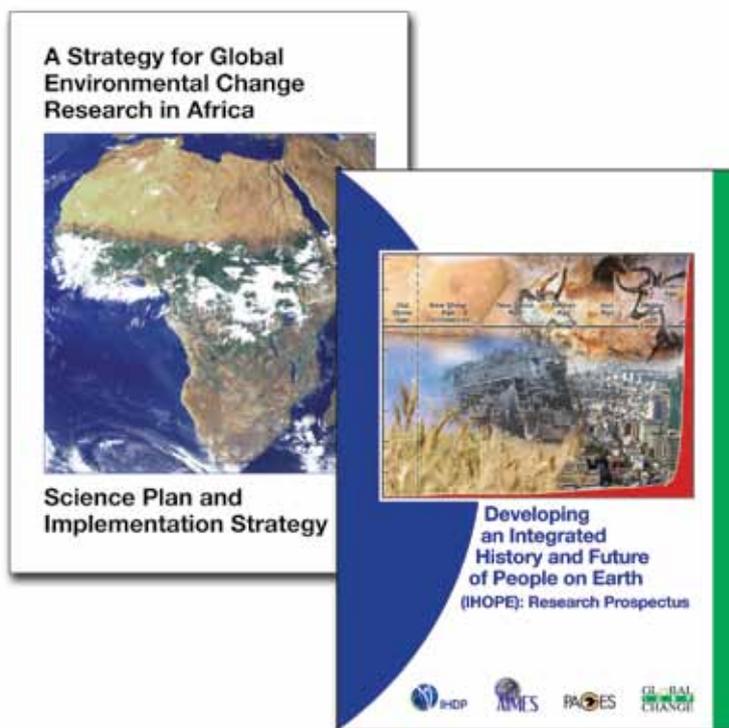
IGBP used the congress to launch its first factsheet, entitled “Global Environmental Change and Africa”. Part of the media efforts revolved around the “Cape Town Declaration” which was written by scientists at the congress and released on the final day.



During 2008, the IGBP website attracted three million hits. These included downloads for IGBP reports, the Science Series, and the IGBP overview presentation, totalling close to sixty thousand downloads. We distributed six issues of the email bulletin in 2008 to keep our network of scientists informed of news and events.

IGBP issued six press releases in 2008, on topics ranging from aerosols to global sustainability to ocean acidification. The releases generated several news reports, particularly relating to the Second Symposium on the Ocean in a High-CO<sub>2</sub> World.

Other new communications products in 2008 included editing and producing the African-NESS and the IHOPE (Integrated History and Future of People on Earth) science plans.



## Scientific publications

Below is a selection of scientific publications resulting from IGBP research during 2008. We have chosen to list just 10–15 top articles or books in peer-reviewed publications for each core project, but there are many more. Newly established core projects may publish only a few for their first year, whereas well-established projects have several hundred peer-reviewed publications to their credit in 2008.

Additionally, the core projects, assisted by the IGBP Secretariat, publish science plans marking the path to state-of-the-art and integrative research, reports from workshops, white papers, and regular newsletters available from their websites. They produce datasets and models for use by the entire scientific community.

### Fast Track Initiatives

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<b>Suzanne Nash</b>	Interim Information Officer (from December 2008)
<b>Kevin Noone</b>	Executive Director (until August 2008)
<b>Sofia Roger</b>	Information Officer (until December 2008)
<b>Sri Sahlin</b>	Administrative Assistant
<b>Sybil Seitzinger</b>	Executive Director (from September 2008)
<b>Mary Ann Williams</b>	Science Communicator (until December 2008)
<b>Charlotte Wilson-Boss</b>	Office Manager

**Brazil Regional Office**

IGBP Regional Support Office in Brazil

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<b>Carlos Nobre</b>	IGBP Chair
<b>Myanna Lahsen</b>	Social Science Officer
<b>Jean Ometto</b>	Science Officer

# Financial report

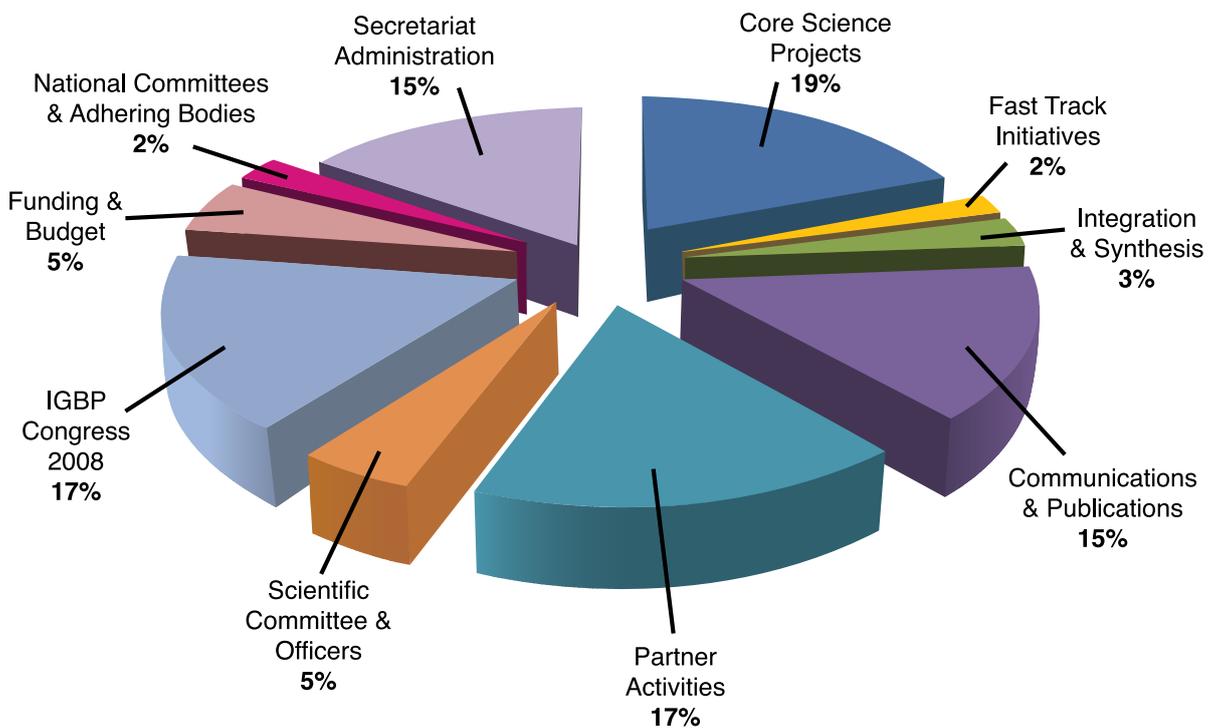
IGBP activities are predominantly funded by contributions from countries around the world. These national contributions support the operation of the IGBP Secretariat, the meetings of the Scientific Committee of IGBP and the Scientific Steering Committees of IGBP projects, IGBP contributions to the activities of the ESSP and other partner organisations, and communication and outreach activities (Tables 1, 2, 3 and 4 and Figure 1).

The IGBP national contribution scale is based on the United Nations Scale of Assessments (in percent). The IGBP scale is adjusted so that the total from all contributors will cover our central budget.

**Figure 1**

Percentage of budget used for core activities.

## Proportional Expenditures 2008



### National contributions 2008

1 USA	16 Austria	31 Singapore
2 Sweden	17 Denmark	32 Malaysia
3 Germany	18 Korea	33 Thailand
4 France	19 Poland	34 Pakistan
5 Japan	20 Finland	35 Jamaica
6 UK	21 South Africa	36 Benin
7 Russia	22 Czech Republic	37 Botswana
8 Spain	23 India	38 Cameroon
9 Netherlands	24 Brazil	39 Congo, Dem. Republic
10 Australia	25 New Zealand	40 Ivory Coast
11 Norway	26 Israel	41 Morocco
12 Switzerland	27 Ireland	42 Romania
13 China/Taipei	28 Portugal	43 Sri Lanka
14 Belgium	29 Hungary	44 Colombia
15 China/Beijing	30 Indonesia	

### National contributions received for previous and following years

Finland 2009

France 2007

**Table 1**

National contributions received for 2008 arranged by level of contribution.

Table 2

Income and expenditures  
for the year ended  
31 December 2008

<b>2008</b>		
<b>Income</b>		<b>Euro</b>
Total national contributions received in 2008		1,181,273
Other IGBP network income		17,422
Committed IGBP network assets from 2007		0
Operating IGBP network assets from 2007		100,808
<b>Subtotal IGBP network income</b>		<b>1,299,504</b>
<b>Administered grants including assets from 2007</b>		<b>213,661</b>
<b>TOTAL INCOME</b>		<b>1,513,165</b>
<b>Expenditures</b>		<b>Euro</b>
Total scientific and communication activities		578,234
	IGBP network budget assets	368,662
	Administered grants including assets from 2007	209,572
Publications and website		11,757
Secretariat salaries including social tax and pensions		580,378
	Scientific staff	371,038
	Administrative staff	209,340
Secretariat operating expenses		62,390
Loss due to exchange rate		11,489
Committed IGBP network assets to 2009		57,826
<b>TOTAL EXPENDITURE</b>		<b>1,302,073</b>
<b>OPERATING ASSETS TO 2009 *</b>		<b>211,092</b>
<b>Please note:</b> IGBP has a reserve fund at The Royal Academy of SEK 1,5 million that is not included in the financial report.		
* Carry over funds to support operating expenses during the first half of the year.		

**Table 3**Income and expenditures  
for the year ending  
31 December 2009

<b>2009 (Estimated)</b>		
<b>Income</b>		<b>Euro</b>
<b>National contributions received for previous and following years</b>		
Total expected national contributions in 2009		1,186,640
Committed IGBP network assets from 2008		57,826
Operating IGBP network assets from 2008		211,092
<b>Subtotal IGBP network income</b>		<b>1,455,557</b>
<b>Administered grants including assets from 2008</b>		<b>160,000</b>
<b>TOTAL INCOME</b>		<b>1,615,557</b>
<b>Expenditures</b>		<b>Euro</b>
Total scientific activities and communication activities		677,672
IGBP network budget assets	517,672	
Administered grants including assets from 2007	160,000	
Publications and website		26,452
Secretariat salaries including social tax and pensions		507,263
Scientific staff	319,576	
Administrative staff	187,687	
Secretariat operating expenses		81,527
<b>TOTAL EXPENDITURE</b>		<b>1,292,913</b>
<b>OPERATING ASSETS TO 2010 *</b>		<b>322,644</b>

\* Carry over funds to support operating expenses during the first half of the year.

Table 4

## International Project Offices

80% of IGBP's contribution to projects was allocated in the 2008 period, with the remainder allocated in 2009.

Exchange rate - 1 Jan 08:  
USD-EURO: 0.686

Funding for IGBP International Project Offices - 2008			
Project	Country/Organisation	USD	EUROS
AIMES	NSF International Programs (GEO)	250,000	171,500
	NCAR (in kind)	20,000	13,720
	IGBP	32,000	21,952
	<b>AIMES TOTAL INCOME</b>	<b>302,000</b>	<b>207,172</b>
GLOBEC	NSF-SCOR	85,000	58,310
	IOC UNESCO	10,000	6,860
	PML (in kind)	244,000	167,384
	NERC	282,659	193,904
	Other	29,500	20,237
	IGBP	16,000	10,976
	<b>GLOBEC TOTAL INCOME</b>	<b>667,159</b>	<b>457,671</b>
GLP	Univ. Of Copenhagen (1,435,000 DKK)	274,195	188,098
	IHDP	20,000	13,720
	IGBP	16,000	10,976
	<b>GLP TOTAL INCOME</b>	<b>310,195</b>	<b>212,794</b>
IGAC	U.S NASA	69,700	47,814
	NOAA	69,700	47,814
	NSF	69,700	47,814
	European ACCENT	43,000	29,498
	Academia Sinica, Taipei	10,000	6,860
	IGBP	32,000	21,952
	<b>IGAC TOTAL INCOME</b>	<b>294,100</b>	<b>201,753</b>
iLEAPS	Univ. of Helsinki, Faculty of Sciences	233,236	160,000
	Ministry of Education	29,155	20,000
	Finnish Met. Inst.	43,732	30,000
	IGBP	32,000	21,952
	<b>iLEAPS TOTAL INCOME</b>	<b>338,122</b>	<b>231,952</b>
IMBER	NSF-SCOR	50,000	34,300
	NSF-SCOR Carry-over from Previous Year	13,315	9,134
	CNRS/IRD/Brittany region	238,540	163,638
	CNRS funds	38,787	26,608
	Univ. of Western Brittany / IUEM -	23,570	16,169
	IGBP	17,135	11,755
	<b>IMBER TOTAL INCOME</b>	<b>381,347</b>	<b>261,604</b>
LOICZ	Institute for Coastal Research (430,000 Euro)	611,245	419,314
	IGBP	32,000	21,952
	<b>LOICZ TOTAL INCOME</b>	<b>643,245</b>	<b>441,266</b>
PAGES	Swiss NSF	265,000	181,790
	USA NSF	265,000	181,790
	IGBP	32,000	21,952
	<b>PAGES TOTAL INCOME</b>	<b>562,000</b>	<b>385,532</b>
SOLAS	UK-Natural Environment Research Council	279,401	191,669
	SCOR	25,000	17,150
	IGBP	16,000	10,976
	<b>SOLAS TOTAL INCOME</b>	<b>320,401</b>	<b>219,795</b>

# Acronyms

ACCCA	Advancing Capacity for Climate Change Adaptation
AC&C	Atmospheric Chemistry and Climate
ACCENT	Atmospheric Composition Change: European Network of Excellence
ACPC	Aerosols, Clouds, Precipitation, Climate
AfricanNESS	African Network of Earth System Science
AGU	American Geophysical Union
AIMES	Analysis, Integration and Modelling of the Earth System
AMEMR	Advances in Marine Ecosystem Modelling Research
AMMA	African Monsoon Multidisciplinary Analysis
APN	Asia-Pacific Network for Global Change Research
AR4	Fourth IPCC Assessment Report
AR5	Fifth IPCC Assessment Report
ASLO	American Society of Limnology and Oceanography
ASSETS	Assessment of Estuarine Trophic Status
CACGP	Commission on Atmospheric Chemistry and Global Pollution
CAREBEIJING	Campaigns of Air Quality Research in Beijing
CEOS	Committee on Earth Observing Satellites
CGIAR	Consultative Group on International Agriculture Research
CliC	Climate and Cryosphere
CLIMECO	Climate Driving of Marine Ecosystem Changes
CLIOTOP	Climate Impacts on Oceanic Top Predators
CLIVAR	Climate Variability and Predictability Study
CNRS	Centre National pour la Recherche Scientifique
CO <sub>2</sub>	Carbon dioxide
COP 15	Fifteenth Session of the United Nations Climate Conference

COST	European Cooperation in the Field of Scientific and Technical Research
DFG	Deutsche Forschungsgemeinschaft
DGH	German Society for Human Ecology
DIVERSITAS	An international programme of biodiversity science
EAS	Eastern Asian Seas
EGU	European Geophysical Union
ELME	European Lifestyles and Marine Ecosystems
ESA	European Space Agency
ESF	European Science Foundation
ESSP	Earth System Science Partnership
EU	European Union
FAO	Food and Agricultural Organization
FTI	Fast Track Initiative
GCOS	Global Climate Observing System
GCP	Global Carbon Project
GCTE	Global Change and Terrestrial Ecosystems
GEC	Global Environmental Change
GECAFS	Global Environmental Change and Food Systems
GECHH	Global Environmental Change and Human Health
GECHS	Global Environmental Change and Human Security
GEIA	Global Emissions Inventory Activity
GEO	Group on Earth Observations
GEWEX	Global Energy and Water Cycle Experiment
GLASS	Global Land-Atmosphere System Study
GLOBEC	Global Ocean Ecosystem Dynamics
GLP	Global Land Project
GO-SHIP	Global Ocean Ship-based Hydrographic Investigations Panel
GWSP	Global Water System Project
HTAP	Hemisphere Transport of Air Pollution
IAEA	International Atomic Energy Agency
IAI	Inter-American Institute for Global Change Research
IAMC	Integrated Assessment Modelling Consortium
IASC	International Arctic Science Committee
ICACGP	International Commission on Atmospheric Chemistry and Global Pollution

ICAMG	International Conference on Asian Marine Geology
ICED	Integrating Climate and Ecosystem Dynamics
ICES	International Council for the Exploration of the Sea
ICOS	Integrated Carbon Observation System
ICSU	International Council for Science
IGAC	International Global Atmospheric Chemistry
IGBP	International Geosphere-Biosphere Programme
IGFA	International Group of Funding Agencies for Global Change Research
IGOS	Integrated Global Observing Strategy
IHDP	International Human Dimensions Programme on Global Environmental Change
IHOPE	Integrated History and Future of People on Earth
iLEAPS	Integrated Land Ecosystem–Atmospheric Processes Study
IMAGES	International Marine Past Global Changes Study
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research
INPE	Brazilian Federal Institute for Space Research
INQUA	International Union for Quaternary Research
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IPCC	Intergovernmental Panel on Climate Change
IPO	International project office
IPY	International Polar Year
IRS	Integrated Regional Study
KALAREC	Kalahari Arid Lands Research Center
LaSyS	Land System Study
LOICZ	Land-Ocean Interactions in the Coastal Zone
LUCC	Land Use and Cover Change
LUCID	Land Use and Climate, Identification of Impacts
LUCIFS	Land Use and Climate Impacts on Fluvial Systems
MA	Millennium Ecosystem Assessment
MAIRS	Monsoon Asia Integrated Regional Study
MARGO	Multiproxy Approach for the Reconstruction of the Glacial Ocean Surface
NASA	US National Aeronautics and Space Administration
NCAR	US National Centre for Atmospheric Research
NCEAS	National Center for Ecological Analysis and Synthesis

NEESPI	Northern Eurasia Earth Science Partnership Initiative
NERC	Natural Environment Research Council
NIWA	National Institute for Water and Atmospheric Research
NOAA	National Oceanic and Atmospheric Administration
NRC	National Research Council
NSF	National Science Foundation
PAGES	Past Global Changes
PFT	Plant Functional Type
PHAROS	Past Human-Climate-Ecosystem Interactions
PICES	North Pacific Marine Science Organization
PMIP	Palaeoclimate Modelling Intercomparison Project
POLARCAT	Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, of Climate Chemistry, Aerosols and Transport
QUEST	Quantifying and Understanding the Earth System
RCP	Representative Concentration Pathways
SBSTA (UNFCCC)	Subsidiary Body for Scientific and Technological Advice
SCOR	Scientific Committee on Oceanic Research
SIBER	Sustained Indian Ocean Biogeochemical and Ecological Research
SIRS	Siberian Integrated Regional Study
SOCAT	Surface Ocean CO <sub>2</sub> Atlas
SOLAS	Surface Ocean–Lower Atmosphere Study
SPARC	Stratospheric Processes and their Role in Climate
SPICE	Seismic wave Propagation and Imaging in Complex media: a European network
SSC	Scientific Steering Committee
START	Global Change System for Analysis, Research and Training
UNEP	UN Environment Programme
UNESCO	UN Educational, Scientific and Cultural Organization
UNFCCC	UN Framework Convention on Climate Change
WCRP	World Climate Research Programme
WGCM	Working Group On Coupled Models
WMO	World Meteorological Organization
YSN	Young Scholars Network





# International Geosphere-Biosphere Programme