



IGBP **2** Annual
Report
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GLOBAL
I G B P
CHANGE

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IGBP Annual Report 2004

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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Report from the Executive Director



Kevin Noone
Executive Director

There are different ways one can forge ahead in a new direction. You can close your eyes, spin around a few times, open your eyes and start off in the direction you happen to be facing. This provides opportunities to deal with unexpected situations, and can often provide novel views of new parts of the journey. However, it is seldom the best way to discover and learn about new territory. Another difficulty with this approach is that once more than one individual starts spinning, choosing a single direction becomes challenging. Anyone who has coordinated a large field cam-

campaign, a model intercomparison or another complex activity, knows that careful planning pays off in the end.

2004 was a year of careful planning and construction for IGBP, building on the previous year's culmination of the comprehensive synthesis of the first decade of IGBP research. Several realisations emerged from the synthesis to guide the scientific planning for the second decade of IGBP research: the Earth is a complex system that life itself helps to control; the dynamics of the Earth System are characterised by thresholds and abrupt changes; the human enterprise drives multiple, interacting effects that cascade through the system in complex ways; global environmental change is much more than climate change and is happening now; and our planet is, in many respects, in a state far different from anything seen in the last half million years.

Guided by the synthesis of the first decade of research, most IGBP projects have developed science plans for the coming decade, the majority of which will be formally published in 2005. Taking the time necessary to properly deliberate on the scientific questions to be considered in the next ten years, and carefully planning strategies for addressing them, are viewed as critical to the success of the projects. Equally important is the effort being taken to make sure that the scientific development of the projects happens in a synergistic fashion. This has been fostered by the development, in parallel with the project science plans, of the overarching IGBP Science Plan, which was significantly advanced during 2004 and sent for external review at the end of the year.

During 2004 the Integrated Land Ecosystem–Atmosphere Processes Study (iLEAPS) had its “official” beginnings, with the establishment of its International Project Office (IPO) at the University of Helsinki, and the approval of its Scientific Steering Committee (SSC). The integration project Analysis, Integration and Modelling of the Earth System (AIMES) began to take shape (as successor to the Global Analysis, Integration and Modelling (GAIM) task force), with the securing of funding for an IPO in the USA. Funding was also secured for an IPO for the Integrated Marine Biogeochemistry and Ecosystem Research (IMBER) project in France (to open in 2005), and the first IMBER SSC was approved. Regional project offices were established for LOICZ in Germany and Sri Lanka.

Another important of 2004 was the initiation of IGBP “Fast-Track Initiatives” (FTIs): “scouting” efforts in new or rapidly-progressing areas aimed to foster integration and synthesis (see pg. 27). Initial FTIs included investigations of the global iron cycle, the global nitrogen cycle, and the role of fire in the Earth system. FTIs are an exciting new approach to system-level analysis across IGBP scientific activities.

2004 not only bedded down the new scientific structure of IGBP, but saw a change in Executive Director. Will Steffen, Executive Director since 1998, stepped down in the summer of 2004, and I had the good fortune to succeed him. I come to IGBP as an outsider, although had previously contributed to IGAC and iLEAPS projects. I hope my relative inexperience with IGBP will provide fresh eyes and ears to help understand and guide the network. For the past 15 years I have worked in academia – research and education, thinking about aerosols, clouds, climate and health issues. This has given me a good feel for the challenges, frustrations and joys of interdisciplinary research, which I trust will be useful in my journey with IGBP.

My view is that, first and foremost, science must remain the heart and soul of IGBP; not just good science, but world-class science. The issues of global change are so profound, and so important to society, that we cannot afford to settle for just good science. We must be willing to work in an interdisciplinary fashion. A focused, reductionist approach is necessary for some global change studies, but is insufficient to fully understand the Earth System. We need both disciplinary and integrative science to achieve real progress.

We also need to find new ways of communicating what we do – not only amongst ourselves, but also to politicians, civil servants, educators, the media and the public. We need to communicate the scientific findings and the excitement we feel about our work. The next generation of Earth System scientists cannot be taken for granted: we must engage and enthuse them now. Nor can continued financial support be taken for granted; ultimately funding will depend on the public's belief that what we do is important. It will not be considered important if politicians and the public are not aware of what we do. Promoting "outward" communication will be an important part of the strategic development of IGBP.

Several steps in this direction were taken in 2004. Further development of the visual profile of IGBP was embarked upon, with the commissioning of an Earth System illustration by UK artist Glynn Gorick. This illustration will be used as a unifying theme in presenting and promoting IGBP and its science. A new IGBP brochure and poster were produced using this image, as the centrepieces of a display booth at the American Geophysical Union (AGU) Fall Meeting in San Francisco. Other outreach included Earth System science sessions at two major conferences: firstly, the over-subscribed session at the inaugural EuroScience Open Forum in Stockholm (August): "Beyond Global Warming: Where on Earth are we going?"; and secondly, a session at the AGU Conference on the interactions and feedbacks between climate, humans and biogeochemistry.

I started this report by spinning; as a new Executive Director my head sometimes still seems to spin, however, the IGBP network as a whole is now firmly set in its scientific directions for the next decade. The hard work of 2004 in completing the careful planning for the next decade is already paying off in many new and exciting activities.

Kevin Noone
Executive Director
Stockholm, Sweden
June 2005

Highlights of 2004

The science of global change is a truly “big picture” enterprise. It cannot be done without focused, disciplinary investigations of the different Earth System components, and yet the integrative activities necessary to assemble and the big picture are themselves very challenging and necessary scientific endeavours.

Different analogies can be used to describe this process. Peter Liss (chair of SOLAS and IGBP Chair, 1993–1997) describes a cathedral whose pillars represent disciplinary research activities, and whose roof represents over-arching integrative science. Without the pillars the roof would collapse; without the roof, the cathedral would be incomplete. In a jigsaw puzzle analogy the pieces of the puzzle represent the disciplinary efforts, but the big picture does not emerge until the puzzle is assembled. Correctly positioning the pillars or the puzzle pieces requires careful thought and is critical to the success of the whole.

These analogies highlight one of the most important value-adding aspects of IGBP: to provide the Earth System science framework within which the outcomes of projects and activities can be integrated. IGBP provides a structure that allows projects to develop their own scientific profile, while simultaneously fostering systemic, integrative Earth System analyses. IGBP projects also add value by coordinating major international activities, such as regional and global observation campaigns. Some highlights from IGBP activities in 2004 are described below.

Science Highlights

Global Iron Connections

Iron is an essential nutrient for all organisms. For marine phytoplankton, separated from iron-rich sediments by considerable water depths, iron must be sourced from the water column. Iron is generally sparse in the marine water column and hence iron availability limits phytoplankton growth over vast areas of the ocean. Iron reaches the oceans mainly as suspended sediment from rivers, however, as this supply is mostly trapped in near-coastal areas, aeolian dust transport is the dominant input of iron to the open ocean.

Globally, dust is largely produced by short dust-storm events in the great deserts of the world, with total production estimated to be approximately 1700 Tg yr⁻¹. North Africa is the biggest single source region (Figure 1) with dried-out lake systems being particularly important dust production sites.

Only a small fraction of the iron in transported dust dissolves in surface ocean waters, but this fraction is sufficient to enhance phytoplankton growth in regions – such as the high latitude oceans – where iron availability is sufficiently low to limit productivity. In nitrogen-poor tropical waters, dust can stimulate nitrogen fixation which requires large amounts of iron for the relevant enzyme systems. In these regions therefore, iron supply stimulates nitrogen fixation and hence relieves nitrogen limitation of phytoplankton growth. The marine impacts of dust deposition on phytoplankton ecosystems are therefore spatially heterogeneous and depend upon nutrient availability.

Stimulation of plankton growth in the oceans can affect the atmosphere by changing ocean uptake and release of climatically active gases like carbon dioxide, dimethylsulphide and nitrous oxide. These changes in gas exchange have the potential to affect the global climate and hence dust production itself, creating the potential for large-scale, multiple and complex climate feedbacks. Dust in the atmosphere also directly affects climate by absorbing and scattering light.

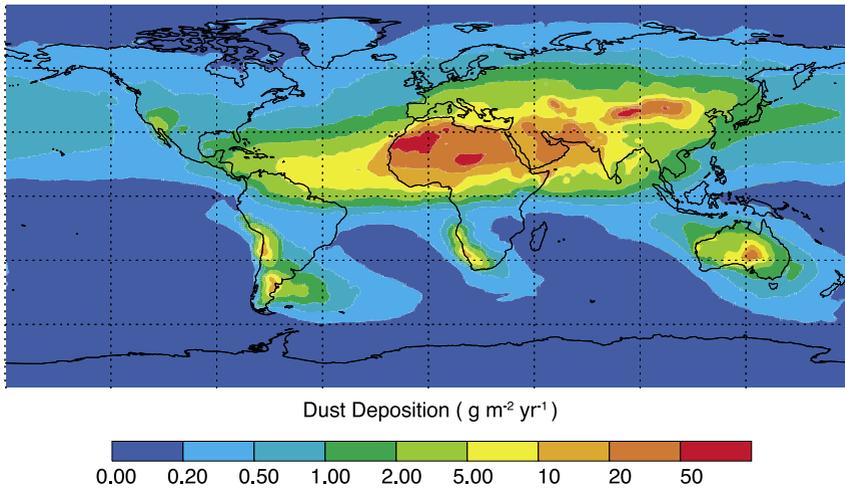


Figure 1: Estimates of global dust deposition fluxes. From [1]; reprinted with permission from AAAS.

As dust production rates are strongly linked to climatic variables such as rainfall and wind, the potential for global change pressures to modify dust production is substantial. There is therefore an urgent need to quantitatively understand the complex linkages of the global iron cycle and to develop predictive models of the potential feedbacks to climate change. This is a major challenge requiring integrative Earth System science.

The above summary is based on the “Iron Fast-Track Initiative” [1]: an IGBP initiative which was undertaken in collaboration with SCOR. Several IGBP projects will further advance our understanding of components of the global iron cycle, especially the ocean-atmosphere research of SOLAS. AIMES will contribute to the incorporation of the global iron cycle into Earth System models.

Acknowledgement: Tim Jickells is thanked for assisting with this article.

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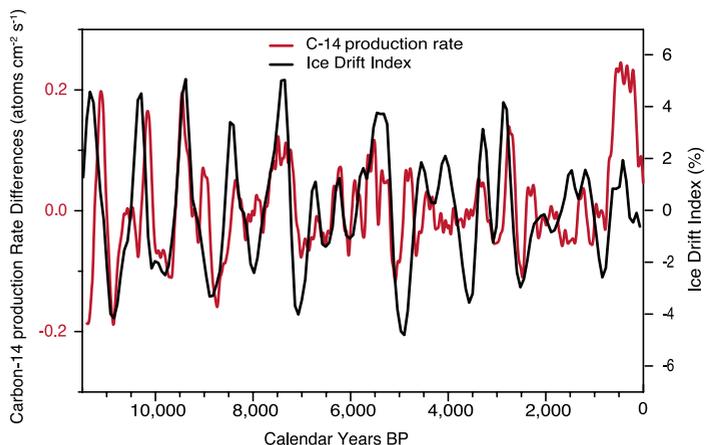
Solar Variability and Holocene Climate

Solar forcing of the climate is an unresolved issue. A link between widespread cooling and the low level of solar activity that was suggested by the absence of sunspots in the 17th century (the Maunder minimum) was first postulated in the 1970s [1]. Cosmogenic isotopes preserved in well-dated archives provide the only proxy information for times prior to visual observations of solar activity. Cosmogenic isotope production rates depend on the shielding of the Earth by its magnetic field and the solar wind.

Within PAGES, a DEKLIM-funded project focuses on (i) reconstructing patterns of solar activity over the past 12,000 years using fluctuations in atmospheric carbon-14 levels, and (ii) investigating tree-ring climate proxies during periods of high and low solar activity. Past carbon-14 levels are obtained from high-precision analyses of decadal tree-ring sections.

Comparisons of ice-drift indices and carbon-14 production-rate variations (Figure 1) have provided strong evidence for solar forcing of cooling events in the North Atlantic, as Holocene cooling events are coincident with intervals of low solar activity (high carbon-14 production). To test the solar forcing hypothesis suggested by these correlations, a time series of solar irradiance (scaled with respect to the carbon-14 production rate changes, [2–3]) was created for the full Holocene, and used as input to a climate system model of intermediate complexity.

Figure 1. Calculated variations in carbon-14 production rate (difference from long term trend) and an ice drift index (percentage of hematite stained grains in North Atlantic cores); from [4]).



Because the climate system model shows no free decadal and centennial variability, the model results clearly show the response of the climate system to changes in solar forcing. The model results show a linear, positive response of surface air temperatures over Greenland to irradiance changes (Figure 2a), and a negative response of Atlantic overturning to irradiance changes (Figure 2b), since overturning is enhanced during cooling events. The model shows some larger temperature excursions in response to solar variability, for example in the 3rd and 5th millennium BP, which may have been as large as the climate changes in the Maunder and other minima of the last millennium.

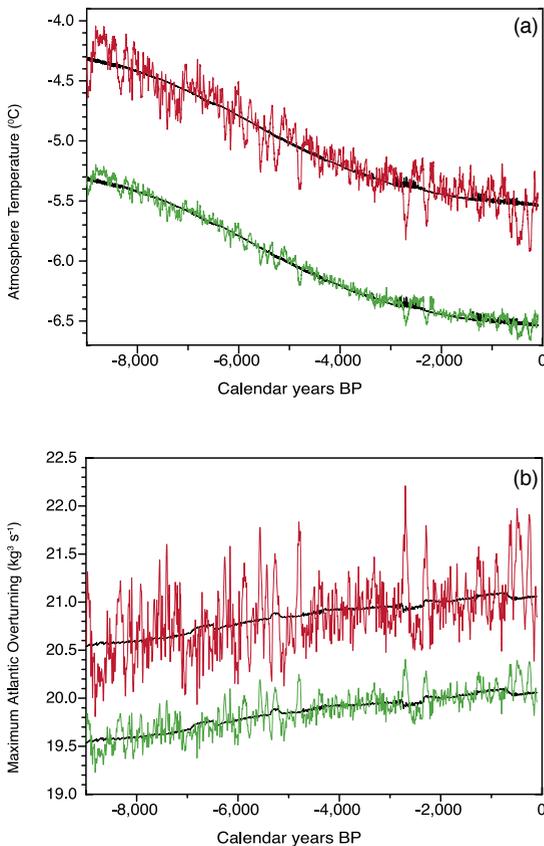


Figure 2.

(a) Modelled surface air temperatures over Greenland during the past 9,000 years, comparing control runs (black lines) to runs with solar irradiance changes based on the carbon-14 production rate changes shown in Figure 1 (red curve). The green curve represents a change in irradiance of 0.24% between the Maunder minimum and the present; this curve and the associated control are offset from the lower curves by 1°C. The red curve represents a change in irradiance of 0.65% between the Maunder minimum and the present.

(b) Modelled maximum of the North Atlantic overturning for the past 9,000 years comparing control runs (black lines) to runs with solar irradiance changes based on the carbon-14 production rate changes shown in Figure 1 (red curve). The green curve represents a change in irradiance of 0.24% between the Maunder minimum and the present; this curve and the associated control are offset from the lower curves by 1 km³ s⁻¹. The red curve represents a change in irradiance of 0.65% between the Maunder minimum and the present.

Carbon and oxygen isotopes from tree rings were analysed for periods of strong solar activity variation (e.g. 11,310–10,880 BP – German pine chronology, and 4,900–4,700 BP and 2,930–2,570 BP – German oak chronology). The information from carbon-14 and oxygen-18 is complex, with strong contributions from physiological processes within the tree, not directly related to external climate forcing. However, the early Holocene record is striking because of dramatic declines and subsequent recoveries in carbon isotopes: smooth sections alternate with strong variations of up to almost 4‰. Similar behaviour was observed for the oxygen isotopes, though the variations do not correlate with those of the carbon isotopes.

Although many questions remain unanswered, these analyses and modelling investigations are providing increasingly strong support for solar forcing of decadal to multi-centennial aspects of the global climate.

Acknowledgement: Bernd Kromer is thanked for assisting with this article.

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IGBP Value-Adding Activities

The ACE-Asia Field Campaign

Coordinating complex, multi-national field campaigns is one of the important value-adding activities of IGBP. Such campaigns are important because many Earth System processes do not operate within national boundaries, and specialised expensive equipment or instrumentation is often required that is limited in number or availability. The IGAC Aerosol Characterisation Experiments (ACE) have integrated *in-situ* measurements, satellite observations and models

to reduce the uncertainty in calculations of the climate forcing due to aerosol particles. A coordinated approach to measurements was used, with deployment of a large number of individual measurement capabilities by research teams from many countries operating across national boundaries, but within an international framework.

ACE-Asia – the fourth ACE campaign – consisted of two focused components. Firstly, an intensive field study quantified the spatial and vertical distribution of aerosol concentrations and properties, the processes controlling their formation, evolution and fate, and the column-integrated radiative effect of the aerosols. Secondly, a network of ground stations used *in-situ* and column-integrated measurements to quantify the chemical, physical and optical aerosol properties, and to assess their spatial and temporal (seasonal and inter-annual) variability.



Photograph. Steve Howell (University of Hawaii) and Lynn Russell (Princeton University) with instrumentation aboard the NSF/NCAR C-130Q Hercules aircraft.

Simultaneous measurements of aerosol chemical, physical and optical properties and their radiative impacts were made in a variety of air masses using three aircraft, two ships, a network of LiDARs and many surface sites – often coordinated with satellite overpasses. Chemical transport models (CTMs) were used in forecast mode during the intensive observation period to identify promising areas for airborne and ship observations, and subsequently as tools for integrating observations. The testing and improvement of a wide

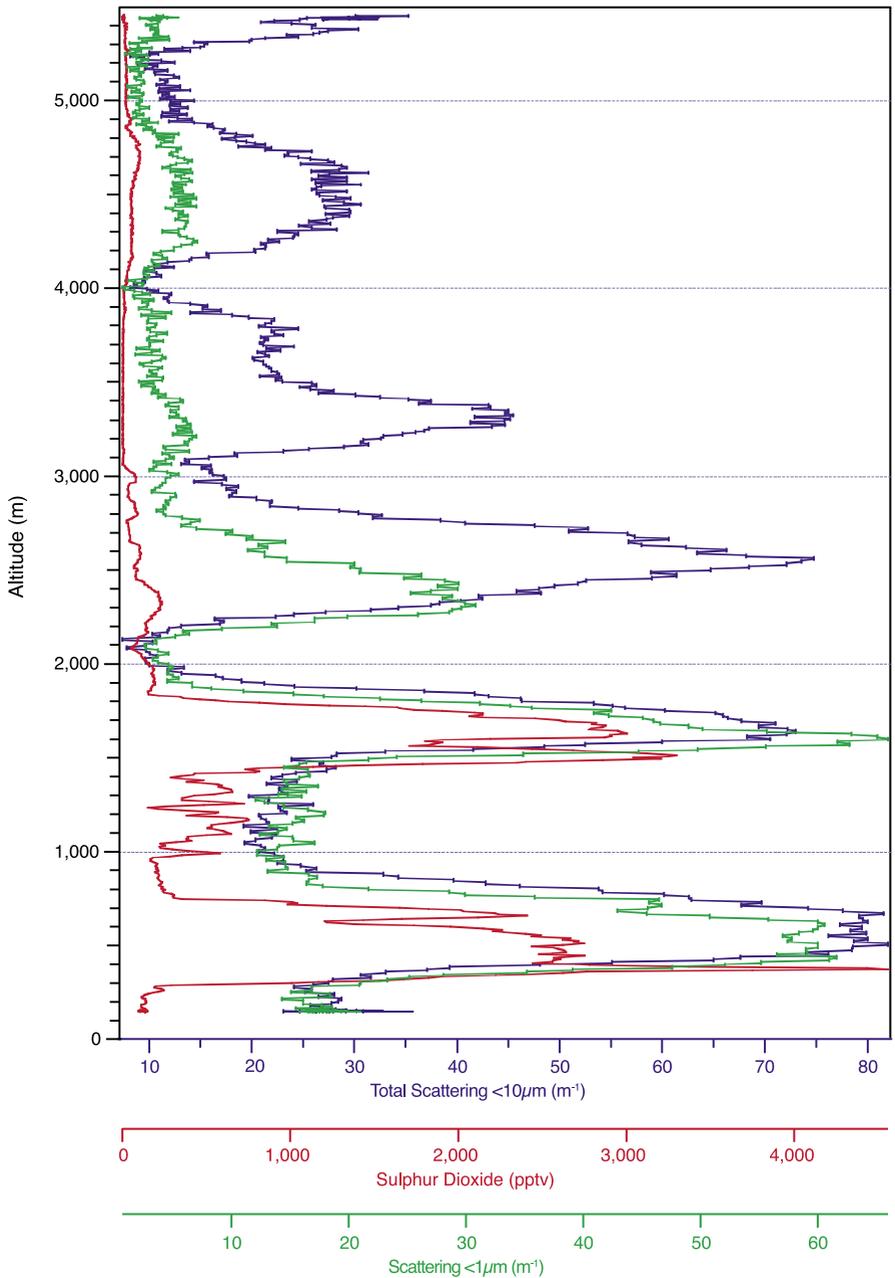


Figure 1. Vertical variations through an air mass near Pyongyang, Korea, of light scattering and sulphur dioxide concentrations. Source: B. Blomquist, A. Bandy, T. Anderson and S. Doherty

range of aerosol models (including microphysical, radiative transfer, CTM and global climate models) was an important means of assessing the understanding of the properties and controlling processes of Asian aerosols.

ACE-Asia has generated a huge new body of knowledge on aerosol properties and impacts in the Asia-Pacific region, and many of these have been published in two special issues of the *Journal of Geophysical Research*: one in 2004 and one in 2003. Some of the important general findings are:

- “dust” transport can be observed around the globe by satellite: aerosols and their impacts on air quality and climate are global.
- dust is mixed with pollution and adsorbs nitric acid and sulphur dioxide [1], reducing the amount of these substances in the more optically-active submicron size ranges and making dust more hygroscopic. Unpolluted Asian dust is less absorbing (less coloured) than Saharan dust [2], but becomes coated with black carbon particles after encountering urban areas.
- dust and pollution aerosols have different properties and climatic impacts in different regions [3]. Air masses with different histories can contain particles with dramatically different optical properties, and the frequent layering of air masses means surface measurements are seldom representative of the entire air mass (Figure 1).
- the regional net surface aerosol cooling effect downwind of Asia in the spring of 2001 [4] was ten times higher than the top-of-atmosphere warming by greenhouse gases [5]. Such strong negative aerosol forcings are responsible for the long-term cooling of some parts of the globe, in the presence of global-average warming.

Acknowledgement: Barry Huebert is thanked for assisting with this article.

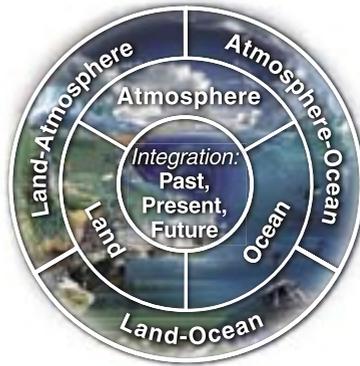
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Activities and Products

Planning for the Future

During 2004 much of the planning for the second decade of IGBP was completed, including the finalisation and peer-review of new Science Plans and Implementation Strategies for IMBER, iLEAPS, IGAC, LOICZ and GLP. Development of the Science Plan for the entire programme was further progressed. The project Science Plans describe the scientific foci for the IGBP projects and detail the approaches that will be taken to address key questions. The plans therefore provide both strategic guidance to the projects as they develop, and essential information to contributing scientists.



There was close collaboration amongst projects and with the IGBP Secretariat during the development of these Science Plans, which has paved the way for Earth System science integration. Earth System science integration within IGBP is facilitated by PAGES and AIMES (under development), and has also been fostered by new Fast-Track Initiatives. The first FTIs were: (i) Fire and the Earth System, (ii) the Global Iron Cycle (in collaboration with SCOR), and (iii) the Global Nitrogen Cycle (in collaboration with SCOPE). FTIs undertake a rapid synthesis and assessment, identify knowledge gaps and help to prioritise project research.

IGBP Projects



Global Analysis, Integration and Modelling (GAIM)

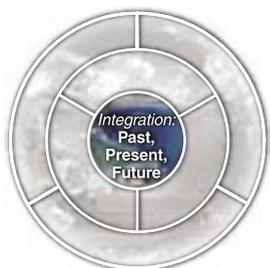
GAIM completed its decade-long mission in 2004. Project successes were highlighted at a workshop (Yokohama, Japan), held jointly with the Working Group on Coupled Modelling of WCRP.

Presentations covered aspects of Earth System processes (including results of IGBP Fast-Track Initiatives), Earth System observations (including the carbon cycle and the Earth System Atlas), Earth System modelling, land use issues, the economics of sustainable development and model intercomparisons. The workshop was attended by more than 30 participants from a dozen countries.

GAIM continued development of Earth System models of intermediate complexity during 2004, and the Integrated History Of People and Environment (IHOPE) project – a collaboration between GAIM, PAGES and IHDP – continued to develop.

During its last year, GAIM contributed to the development of the new Analysis, Integration and Modelling of the Earth System (AIMES) project (see below). GAIM is congratulated for its successful work and for contributing to the evolution of integration in IGBP.

Website: gaim.unh.edu



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

The successor to GAIM continued to take form during 2004. A project description was prepared for presentation at the SC-IGBP meeting in 2005, and was used as the basis for a proposal for IPO

support to the US National Science Foundation. This proposal was successful and the IPO was established at the National Center for Atmospheric Research (Boulder, Colorado, USA).

AIMES will focus on: (i) the functioning and interactions of global biogeochemical cycles; (ii) the causes and consequences of changes in atmospheric composition through glacial-interglacial cycles looking at coupled climate-biogeochemistry interactions; (iii) the interplay of environmental changes with human activities in history and prehistory; (iv) the operation of the contemporary Earth System, perturbed by, and influencing humans; and (v) 21st century scenarios for interactions between climate, biogeochemistry and society and their implications for sustainable development.

AIMES will work closely with ESSP partners and will be supported by an institutional network in 2005. AIMES will hold a workshop to launch a post-doctoral network that will foster communication and collaboration between the human and environmental sciences.

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Past Global Changes (PAGES)

The primary objective of PAGES for 2004 remained the facilitation of international collaboration and interdisciplinary science, aimed at improving the understanding of the Earth's past environment in order to predict the future. The emphasis remained on high-resolution studies of the past environments that assess natural variability and anthropogenic impact.



In late 2004 Thorsten Kiefer was appointed as the new Executive Officer for PAGES. The IPO continued its extremely valuable work

including supporting capacity-building efforts and helping to integrate developing-country scientists in the worldwide palaeo-research community.

Numerous research results from PAGES were published during the year, including ground-breaking studies with contributions from PAGES scientists such as the undisturbed climate record from the North Greenland Ice Core Project (NGRIP) ice core and the eight glacial cycles recorded in the European Project for Ice Coring in Antarctica (EPICA) ice core from Dome C.

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International Global Atmospheric Chemistry (IGAC)

In 2004 IGAC further advanced atmospheric chemistry by progressing its research tasks, organising focused scientific workshops and running its 8th Biennial International Conference.

Results from the Asia-Pacific Region Aerosol Characterisation Experiment (ACE-Asia) were published in a special issue of the *Journal of Geophysical Research*, containing an impressive 64 articles (see pg. 12 and 53). Two activities in Antarctica (the “Antarctic Tropospheric Chemistry Investigation” and the “Chemistry of the Antarctic Boundary Layer and the Interaction with Snow” project – part of the Air-Ice Chemical Interactions task) conducted experiments that revealed the interrelationship between atmospheric chemistry and meteorological processes in the Antarctic. The Intercontinental Transport and Chemical Transformation task conducted air pollutant field activities to assess the North American source region, the European receptor regions and North Atlantic transport and transformations.

IGAC workshops were held to discuss: organic aerosols (Hyytiälä, Finland), co-sponsored by iLEAPS and SOLAS; denitrification (Woods Hole, USA); and halogen chemistry (Heidelberg, Germany). The 8th Biennial International Conference (Christchurch, New Zealand) attracted 409 delegates from 38 countries, including 62 young scientists from 23 countries who received travel support from IGAC. IGAC is cosponsored by IGBP and CACGP.

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Integrated Land Ecosystem–Atmosphere Processes Study (iLEAPS)

2004 marked the start of iLEAPS implementation. Anni Reissell was appointed as Executive Officer, an 18-member SSC was approved and an inaugural SSC meeting was held in Finland. The official opening of the iLEAPS IPO – with over 130 guests – was held in October at the University of Helsinki, and a website was launched with downloadable copies of the project poster, brochure and presentation material.

The SSC endorsed three projects as iLEAPS activities: (i) the African Monsoon Multidisciplinary Analyses project which aims to improve understanding of the West African monsoon system, its short- and long-term variability and its global consequences; (ii) the Fire-Land-Atmosphere Regional Ecosystem Studies project which aims to improve understanding of the effects of fire (particularly in the southern hemisphere) on local to global scales; and (iii) the Inter-American Network for Atmospheric/Biospheric Studies which studies anthropogenic aerosol emissions and their consequences in different regions in the Americas. The SSC also endorsed the Volatile



Organic Compounds in the Biosphere-Atmosphere System project as a supporting activity. iLEAPS was promoted at several international conferences, including the AGU Fall Meeting.

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Land-Use and Cover Change (LUCC)

During 2004 LUCC focused on synthesising and publishing its science, and contributing to the evolution of GLP. This included work on a synthesis book for the IGBP Series, with advanced chapter drafts circulated and a workshop held to finalise writing assignments prior to reviews in 2005. The quality of LUCC science is indicated by the Essential Science Indicators assessment by Thomson (ISI) that a LUCC article on the causes of land-use and cover change is in the top 1% within its field.

LUCC highlights include the refinement, in Focus 1 (Land Use Dynamics), of the notion of synergistic driver combinations underlying land change as a forcing function in global environmental change. Under Focus 2 (Land Cover Dynamics), satellite-derived land cover and agricultural census data have been synthesised to produce data sets of the global distribution of 18 major crop types, thus extending "BIOME 300" and complementing the global hot-spot analysis of land-cover change. Focus 1 and Focus 3 (Modelling) collaborations have continued to investigate the reasoning behind land-use decisions while providing a consistent view of the major factors driving large-scale and long-term land change. LUCC is co-sponsored by IHDP.

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Global Land Project (GLP)

The GLP – an emerging joint research effort of IGBP and IHDP – aims to improve the understanding of land system dynamics in the context of Earth System functioning. The research planning for GLP has built upon the IGBP and IHDP global networks of scientists, data and largely disciplinary understanding, particularly from the now-complete Global Change and Terrestrial Ecosystems project of IGBP and the joint IGBP-IHDP LUCC project. Scientific implementation will build on these efforts, promoting new networks addressing the coupled socio-environmental system at various scales.



The major work for GLP in 2004 was finalisation of the Science Plan and Implementation Strategy for submission to the IGBP and IHDP Scientific Committees in early 2005. The Science Plan provides a new integrated paradigm that focuses on two aspects of the coupled system: firstly, the interface between people, biota and natural resources in terrestrial systems, and secondly, linking detailed regional studies with a global comparative perspective. The Science Plan was the combined work of the GLP Transition Team (under the joint leadership of Dennis Ojima and Emilio Moran), and a GLP Advisory Team (under the leadership of Mark Stafford-Smith) appointed in May 2004 by the IGBP and IHDP Scientific Committees to assist in focusing and balancing the Science Plan and Implementation Strategy.

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Land-Ocean Interactions in the Coastal Zone (LOICZ)

In 2004 IHDP became a co-sponsor of LOICZ, and the SSC was restructured to reflect the co-sponsorship, being expanded to a maximum of 25 full members.

A Regional Project Office for Western Europe was established at the Institute for Coastal Research, GKSS Research Centre, Geesthacht, Germany, and subsequently, a Regional Project Office for South Asia was established at the National Science Foundation, Sri Lanka. Other Regional Project Offices are being considered for outreach and networking in East Asia, Oceania, Africa and the Mediterranean/Black Sea sub-region.

The priority for LOICZ in 2004 was the development of the Science Plan and Implementation Strategy. The first full draft was presented at the 2004 SC-IGBP and SC-IHDP meetings, and both committees approved the document subject to revisions suggested by reviewers.

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Global Ocean Ecosystem Dynamics (GLOBEC)

2004 was a busy year for GLOBEC which has a suite of regional programmes and over 18 national programmes. Two new regional programmes were approved and initiated in 2004: a pan-equatorial research activity on the “Climate Impact of Oceanic Top Predators” and a programme on “Ecosystem Studies of Sub-Arctic Systems”.

A major activity was the commencement of GLOBEC’s integration and synthesis phase which will continue until project conclusion in December 2009. Outcomes will contribute to the further development of IMBER after the completion of GLOBEC. The SSC developed a blue

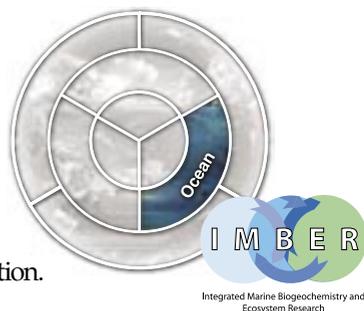
print for integration and synthesis that establishes goals, milestones and pathways. Community participation is being encouraged in this phase through regional symposia and online submissions.

With generous support from the UK Natural Environment Research Council and the Plymouth Marine Laboratory, the IPO is funded until early 2010, thus ensuring continuity through the synthesis phase. GLOBEC is co-sponsored by IGBP, IOC and SCOR.

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Integrated Marine Biogeochemistry and Ecosystem Research (IMBER)

Following several years of planning, the IMBER Science Plan and Implementation Strategy was reviewed by co-sponsors IGBP and SCOR early in 2004, and an SSC was formed to finalise the document and initiate implementation.



One of the first IMBER activities focuses on the ocean carbon cycle and an Implementation Plan for ocean carbon research has been written jointly with SOLAS. Several national and regional IMBER research initiatives are underway, including EUR-OCEANS, CARBOOCEAN and a multinational Southern Ocean project (Integrated Analyses of Circumpolar Climate Interactions and Ecosystem Dynamics).

The SSC is planning several small Open Science Conferences and working group activities to implement IMBER science and to encourage international participation. Following support for an interim IPO in New Zealand and the UK during 2004–05, a consortium of French agencies will fund an IPO in Brest, France, for three years from August 2005.

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Surface Ocean–Lower Atmosphere Study (SOLAS)

The SOLAS Science Plan and Implementation Strategy was published and distributed early in 2004. SOLAS has activities in 23 countries, several of which have undertaken major SOLAS cruises and field campaigns. New international activities approved by the SSC include the “Ocean-Atmosphere-Sea Ice-Snow” project and a task team (joint with IGAC) on “Halogens in the Troposphere”.

A successful Open Science Conference (Halifax, Canada) was held with 240 delegates from 24 countries, including 30 young scientists who were supported to attend. Major international planning continued in 2004, with the preparation of the following three Implementation Plans to aid the international coordination of SOLAS science: (i) Biogeochemical Interactions and Feedbacks between Ocean and Atmosphere; (ii) Exchange Processes at the Air-Sea Interface; and (iii) Carbon, Nitrous Oxide and Methane (joint with IMBER).

Recruitment of an Executive Officer for the IPO (funded by the UK Natural Environment Research Council) occurred during 2004, and Jeff Hare will take up his post in 2005. SOLAS is co-sponsored by SCOR, WCRP and CACGP.

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Fast-Track Initiatives

In 2003 the SC-IGBP launched 'Fast-Track Initiatives' (FTIs) as a means to foster integration and synthesis of IGBP science. These activities are designed to address cross-cutting topics of current interest in Earth System science; they last no more than three years, and should culminate in a review article, book, new research activity or database.

The first FTIs were investigations into: (i) the global iron cycle (in collaboration with SCOR); (ii) the role of fire in the Earth System; and (iii) the global nitrogen cycle (in collaboration with SCOPE). These FTIs were very active in 2004, producing several synthesis and overview papers and a major book.

The Global Iron Cycle

The objective of the Iron Fast Track Initiative was to conduct an analysis and review of the global dust/iron cycle cutting across conventional boundaries. It began with a workshop in April which brought together an unusual mix of 19 terrestrial, atmospheric and marine scientists from 12 countries. The FTI culminated in a review paper published in *Science* (see *Science Highlights*), with three more papers either submitted or in preparation for *Global Biogeochemical Cycles*. The first of these papers will focus on the production and atmospheric transport of dust, the second on deposition of dust to the oceans and the biogeochemical response to this addition, and the third on the palaeo-record of dust transport and deposition.

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The Role of Fire in the Earth System

The Fire FTI objectives are to synthesise quantitative knowledge on the impacts of changes in fire regimes worldwide on a range of ecosystem services, and assemble global and regional data for fire model development and testing. The FTI aims to produce a global map of fire regimes, a global compilation of parameters required for the calculation of emissions from

plants and soils and a synthesis publication on impacts of changes in fire regimes worldwide on a range of ecosystem services.

A workshop of 13 scientists from six countries in late 2004 began data compilation (e.g. palaeodata, Earth observation, forestry) for the production of maps of various aspects of past, present and future fire regimes. A review paper presenting a conceptual framework for the integrated analysis of vulnerability to fire at regional and global levels was prepared.

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The Global Nitrogen Cycle

The International Nitrogen Initiative (INI) began in early 2003 and was approved as an IGBP FTI the same year. It is jointly sponsored by SCOPE and IGBP, and its overall goals are to optimise nitrogen's beneficial role in sustainable food production, and to minimise nitrogen's negative effects on human health and the environment resulting from food and energy production. The INI is a large initiative with several international activities and regional centres in Africa, Asia, Europe, Latin American and North America. International activities in 2004 were: (i) a workshop to assess the fate of mineral nitrogen fertiliser with a view to enhancing the overall efficiency of mineral nitrogen use and reducing environmental impacts; a book (Mosier et al., 2004) and summary brochure were published from this workshop; (ii) a workshop on denitrification across terrestrial, freshwater and marine systems; several papers resulted; (iii) a workshop on nitrogen cycling issues in the Americas; several papers resulted; and (iv) co-sponsorship of the 3rd International Nitrogen Conference (Nanjing, China) with over 400 delegates which led to the "Nanjing Declaration on Nitrogen Management" for international policy makers.

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Website: www.initrogen.org

National Committee Activities

IGBP (or Global Change) National Committees (NCs) are an important IGBP network that links grass-roots research to the international projects and to the programme as a whole. NCs assist in the development of the research agenda and actively encourage their scientific communities to participate in project research and other IGBP activities. For that purpose, many NCs have specific project representation.

Most IGBP research is implemented through nationally funded projects. While NCs may not necessarily be involved in the funding process, they are usually aware of the relevant national research efforts, and can thereby assist projects to identify planned and on-going research that addresses IGBP priorities. Over half of the NCs contribute the funding that enables the IGBP Secretariat to run the programme. NCs also participate in IGBP Congresses, and programme and project scientific conferences where results are discussed and international research agendas are developed.

NCs initiate regional collaborations through the Global Change System for Analysis, Research and Training (START), the Inter-American Institute for Global Change Research, the Asia-Pacific Network for Global Change Research and emerging scientific networking partners (e.g. in Africa).

Networking

Following the NCs request from the 2003 IGBP Congress for improved internal communication via an internet discussion forum, a trial of a commercial password-protected internet site was undertaken. The "Webforum" service provides a discussion forum, an internet "chat" service and allows for exchange and editing of electronic documents. All National Committee members were invited to Webforum in August.

A further effort to improve networking was the inclusion of NC Chair contact details and short biographical sketches on the IGBP website.

During 2004 the IGBP Secretariat, in collaboration with NCs, developed a concept for policy-relevant roundtables and associated media briefings to be conducted alongside regional global change conferences and workshops (see below).

Selected Highlights

The **Romanian NC** hosted a successful two-day workshop on “Significant Scientific Research on Global Environmental Change in Central and Eastern Europe”, attended by scientists from Albania, Bulgaria, Poland, Romania and Greece. The workshop, which was held in conjunction with the IGBP Officers meeting in Sinaia, Romania, resulted in a “Sinaia Declaration” articulating the desire of scientists in the region to collaborate on studies of regional environmental change.



Photograph. Global change scientists from central and eastern Europe share their research with IGBP Officers and IGBP Secretariat staff through posters and presentations.

The directors of the ESSP partner programmes met with their National Committee counterparts at the US National Academy of Sciences to explore ways to enhance the connectivity of the large US research community to the international global change programmes. IGBP representatives subsequently met with the **US National Committee** to plan a larger IGBP-oriented meeting in 2005.

The **Science Council of Japan** sponsored an IGBP National Symposium: “The New Current of IGBP: towards Earth System science”. The event was attended by 45 scientists and included discussion on Japan’s scientific contributions to IGBP projects and to ESSP capacity-building activities and joint projects.

The Netherlands IHDP Committee and the Netherlands IGBP/WCRP Committee of the Royal Netherlands Academy of Arts and Sciences merged to form the **Netherlands Global Change Committee**. The Committee aims to initiate and stimulate Dutch contributions to DIVERSITAS, IHDP, IGBP, WCRP and SCOPE.

The ProClim Forum for Climate and Global Change of the **Swiss Academy of Sciences** organised the 5th Swiss Global Change Day in Bern, where around 220 participants discussed current problems and presented new findings, highlights and challenges.

The UK launched a scheme to fund 129 PhD students from developing countries. More than 20 UK universities have been invited to participate in the pilot of the **Dorothy Hodgkin Postgraduate Awards** scheme (see www.rcuk.ac.uk/Hodgkin).

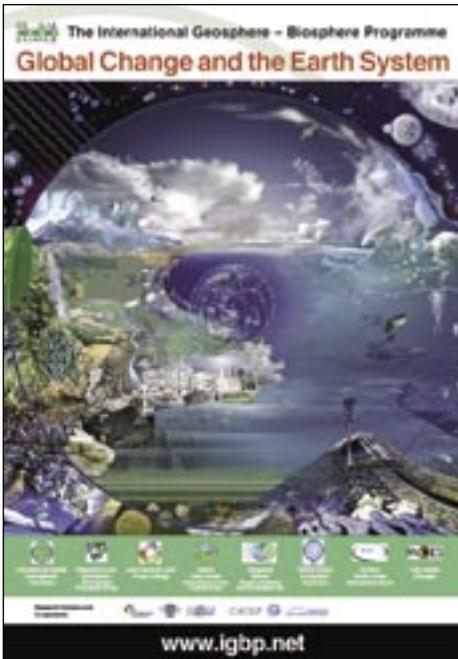
The **Egyptian SCOPE and IGBP National Committee** organised the first symposium in a series of five on global change and its effects on Egypt. Around 200 people from the region attended, including scientists, media and NGO representatives, and environmental managers.

Over the past five years the **Sri Lankan NC** has worked with LOICZ, START and SASCOM in conducting a series of regional workshops on coastal fluxes with participation from Bangladesh, India, Nepal, Maldives, Sri Lanka and Pakistan. The final report of this project and workshop proceedings are now available (www.nsf.ac.lk/slaas/cfweb). These activities have led to the establishment of the South Asia node of LOICZ in Colombo, Sri Lanka.

Communications and Outreach

In 2004 communications and outreach of the IGBP Secretariat focused on raising awareness of IGBP's new, integrated structure for Earth System science. Publications and outreach activities targeted the broader scientific community, policy makers, the education sector and the public (through media coverage).

Scientific Outreach



During 2004 UK artist Glynn Gorick was commissioned to create a detailed illustration of the complexity and interconnected nature of the Earth System. An initial version of the illustration was featured in the December issue of the Global Change Newsletter, and used in the design of new brochure and poster that will be refined in 2005. The brochure and poster were the basis of an IGBP booth at the AGU Fall Meeting which attracted wide interest. The illustration will underpin the further development of IGBP's visual identity and graphic design of IGBP outreach and educational products.

IGBP participated in the International Consultation on Education for Sustainable Development – “Learning to Change Our World” – in Gothenburg, Sweden. The consultation was part of the Swedish Government’s commitment made at the World Summit on Sustainable Development (2002), was attended by the Swedish Prime Minister, politicians and education professionals from several countries, and included a broadcast address from the UN Secretary General. The collaborative work of IGBP and the Global Change Information Network was displayed at the event, and the Executive Summary booklet of the IGBP synthesis book “Global Change and the Earth System: a planet under pressure” was distributed widely.

A session for the EuroScience Open Forum titled “Beyond global warming: where on Earth are we going?” was organised. The session comprised six presentations including: (i) new modelling approaches that reproduce Dansgaard-Oeschger events; (ii) potential “switch” and “choke” points in the Earth system; and (iii) likely effects of increased atmospheric CO₂ on ocean temperature, acidity and the marine life cycles. This extremely popular session generated substantial media coverage.

To assist in IGBP outreach a trial group of twelve IGBP Ambassadors (see pg. 50) was established in April 2004. The Ambassadors were chosen from current and past SC-IGBP members for their communication skills, credibility in scientific and policy arenas, and their knowledge of IGBP and Earth System science. Many of the outreach activities described above involved IGBP Ambassadors.

In 2004 the IGBP Officers approved the trial establishment of the honorary position of Chief Scientist to assist in the integration of IGBP science. The Officers appointed former Executive Director, Will Steffen, in this capacity for two years from July 2004.

Outreach to Policy Makers

Over the past two years IGBP has increased its outreach to policy makers; 2004 was a particularly busy year in this regard. Three IGBP scientists met politicians, journalists and the public in Denmark in June, to discuss critical thresholds in the Earth System with particular emphasis on the Gulf Stream; this generated significant media coverage in Denmark. The event highlighted the IGBP synthesis book “Global Change and the Earth System: a planet under pressure”, following the successful book launch in Stockholm in January.

In August, an IGBP presentation formed an integral part of the opening of a new exhibition on climate change at the Natural History Museum in Stockholm. The opening of the exhibition attracted policy makers and scientists from the Stockholm region.

In September, IGBP gave an invited briefing on global change to 45 members of the Swedish Environment Ministry. The Swedish Environment Minister later used IGBP presentation materials in a cross-ministry meeting.

In December, IGBP gave an invited presentation at a Swedish Education Ministry workshop on “Education for Sustainable Development”. The workshop focused on efforts of schools, universities, the general public and the policy sector to develop educational techniques that explain global change. The workshop was attended by more than 500 people from the education, industrial and political sectors.

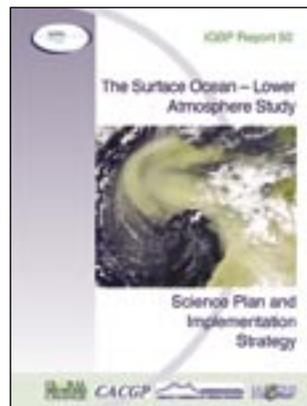
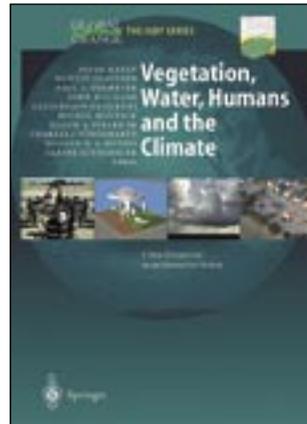
Media Coverage

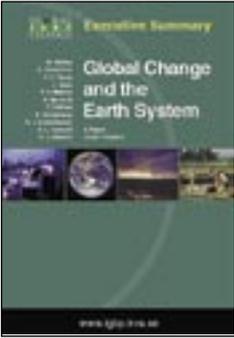
IGBP events and products attracted over one hundred items in the international media in 2004. The EuroScience Open Forum IGBP session generated more than 30 articles/broadcasts in international media, with highlights including a “page 4” article in the Financial Times. The GAIM “switch” and “choke” points concept presented at the Forum was well covered by the BBC and generated a feature article in the UK newspaper “The Guardian”. Ocean acidification was covered by the BBC, and the IGBP synthesis book inspired a new six-part BBC online series – “Planet Under Pressure”.

Publications

IGBP and its projects generated 32 major synthesis and review publications (see pg. 51) during 2004, and a new volume in the IGBP Series was published by Springer-Verlag – “Vegetation, Water, Humans and the Climate” – a synthesis of the now-complete IGBP project “Biospheric Aspects of the Hydrologic Cycle”.

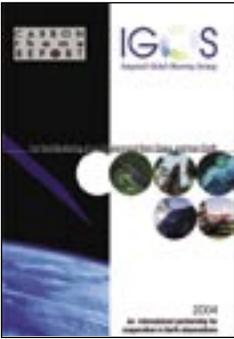
The IGBP Secretariat published the SOLAS Science Plan and Implementation Strategy: the first of the series of Science Plans documenting the IGBP research agenda for the coming decade. A new design for the IGBP Report Series was been developed, and the SOLAS Science Plan and Implementation Strategy was the first report to adopt the new design.





The IGBP Secretariat published an extremely popular 40 page executive summary of the IGBP Series book "Global Change and the Earth System – A planet under pressure". The initial print run of 5,000 copies was quickly used, and several thousand downloads of the electronic version were logged on the website.

A new IGBP Directory (2004–05) was produced and distributed during 2004, and the "Integrated Global Observing Strategy – Carbon Theme Report" was produced as a contribution to the IGOS Partnership.



As usual, four editions of the Global Change NewsLetter were published during the year with around 12,000 hard copies printed and distributed and around 1,000 electronic copies of each edition downloaded from the IGBP website. The NewsLetter was further improved during 2004 by the introduction of regular guest editorials, a new PinBoard page for global change science and policy news and a redesigned back cover describing IGBP.



IGBP Connections

IGBP is a extensive network, however, Earth System science is represented by an even larger network as recognised in the IGBP Objective. Connections to other organisations are vital for IGBP. The connections between IGBP and the Earth System Science Partnership (ESSP) and global observing community are described below. Other important connections for IGBP are the strong and long-standing collaborative relationship with the Scientific Committee on Oceanic Research (SCOR), and ongoing collaborations with the International Oceanographic Commission (IOC) and the Commission on Atmospheric Chemistry and Global Pollution (CACGP).

Earth System Science Partnership (ESSP)

The Earth System Science Partnership is a partnership of ISCU's four international global change research programmes (DIVERSITAS, IGBP, IHDP and WCRP), created to foster integrated study of the Earth System, the changes that are occurring to the system and the implications of these changes for global sustainability. The ESSP is governed by the Chairs and Directors of the four partners, acting on behalf of the Scientific Committees of DIVERSITAS, IGBP and IHDP and the Joint Scientific Committee of WCRP.

The central activities of the ESSP are projects on issues of global sustainability designed to address the global change aspects of the following four critical issues for human well-being: energy and the carbon cycle, food systems, water resources, and human health. The progress of these projects is described below.





Global Carbon Project (GCP)

In 2004 GCP conducted its largest international workshop to-date (Beijing, China) with participation from 25 countries. The main goal was to foster harmonisation of the methods used to develop dynamic carbon budgets at the regional level. The workshop led to the drafting of four scientific papers, and a forthcoming proposal for a book synthesising regional budgets.

The GCP Science Framework was translated into Mandarin Chinese by scientists from the Institute of Botany in Beijing and the Chinese National Science Foundation. It has also been translated into Russian.

In November, the Chinese Academy of Sciences and its Institute of Geographical Sciences and Natural Resource Research made a formal commitment to establish and fund a regional GCP office to: (i) coordinate carbon research in China; (ii) foster regional coordination of carbon research; (iii) provide regional capacity building opportunities; (iv) provide regional data management; and (v) contribute to GCP regional efforts.

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Global Water System Project (GWSP)

The GWSP established itself strongly during 2004. The Science Framework and Implementation Activities report was finalised and approved, thus formalising the scientific basis of the project. Co-chairs and other Executive Members of the SSC were appointed and met to agree on nominations for remaining SSC members.

The IPO was strengthened by the appointment of a Deputy Executive Officer. The IPO updated the project website, began production of electronic briefing notes, and produced a project brochure and poster to profile the project at World Water Week in Stockholm, Sweden. As one of the co-sponsors, GWSP put considerable effort into preparations for the early 2005 International Conference on Integrated Assessment of Water Resources and Global Change.

National activities and important collaborative relationships were established via development of a database of relevant organisations, attendance at many relevant meetings and conferences, and hosting of a Consultation Workshop in Bonn late in the year.

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E-mail: eric.craswell@uni-bonn.de
Website: www.gwsp.org

Global Environmental change and Food Systems (GECAFS)



In 2004 GECAFS established an IPO in Wallingford at the Centre for Ecology and Hydrology – part of the Natural Environment Research Council (UK). Funding for this IPO has been secured for 2003–2008. A project Science Plan and Implementation Strategy was drafted in 2004, including the following revised project goal:

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.

During 2004 GECAFS promoted 21 international workshops and other meetings covering all continents (see website for outputs). Activities addressed innovative conceptual and methodological research, refining food systems concepts and initial typologies for global environmental change studies, development of the GECAFS vulnerability research portfolio (particularly through an emergent network on vulnerability of food systems), development of GECAFS scenario research (namely prototype scenarios for the Caribbean), and development of a decision support system research portfolio. Initial regional projects included the Indo-Gangetic Plain, the Caribbean and Southern Africa.

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Global Environmental Change and Human Health

In January 2004 a second planning meeting was held at ICSU to progress the drafting of a project Science and Implementation Plan. The meeting produced a revised Science Plan and a first draft of an Implementation Strategy. The Science Plan was presented to the ESSP Chairs and Directors meeting in June, where it benefited from additional comments. A small team was formed and tasked with reviewing the different parts the Implementation Strategy and preparing a revised version. In November the project Co-chairs met and discussed the Science Plan and the Implementation Strategy, and drafted shorter versions. By the end of 2004 these documents were undergoing revisions, for distribution in early 2005 to ESSP partners and WHO for final comment.

The Science Plan identifies five major areas for the project: (i) changes in atmospheric composition and water cycling and the consequences for human health; (ii) food producing ecosystems and human health; (iii) biodiversity changes and human health; (iv) urbanisation and human health; and (v) interdisciplinary methods and data needs.

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Website: www.diversitas-international.org/essp_global.html



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

During 2004 over 1,000 scholars from developing countries were involved in various START activities, including regional science planning and research workshops, collaborative research networks, Fellowships and Visiting Scientists and Lecturer Awards (24 this year), African Doctoral Fellow Awards (6 this year), Young Scientists Awards (11 this year), and the Small Grants Programme. A major activity was the continued coordination of 24 regional projects involving 45 countries – in Africa, Asia, South America, Caribbean and Oceania – on Assessments of Impacts and Adaptations to Climate Change that engages 235 scientists from developing countries, including 60 graduate and undergraduate students.

START, using funding from its small grants programme, co-sponsored the PAGES in Africa Meeting (Nairobi) and co-sponsored the International Workshop on Nitrogen Fertiliser held in Uganda (part of a SCOPE/IGBP Fast-Track Initiative).

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Website: www.start.org

Monsoon Asia Integrated Regional Study (MAIRS)

MAIRS commenced in 2004 under the guidance of START. The effort this year focused initially on sub-regional scoping/rapid assessment studies in east, south and southeast Asia, undertaken jointly by START (and its regional networks) and SCOPE. These studies systematically reviewed current knowledge of regional aspects of global change in Monsoon Asia.

MAIRS will include intensive field studies and observations as well as numerical modelling. In addition to conducting research in selected Asian regions and providing a means for regional collaboration amongst projects of the ESSP partner programmes, MAIRS will contribute information to the Global Earth Observing System. Each sub-regional rapid assessment study is expected to produce an authoritative book.

Contact: Alix Cotumaccio
Email: acotumaccio@agu.org
Website: www.start.org/project_pages/irs_monsoon_asia.html

The Observing Community

IGBP participates in global observation programmes as a member of the Integrated Global Observing Strategy Partnership (IGOS-P) and a participating organisation in the Group on Earth Observations (GEO).

IGOS-P consists of five major groups: the Committee on Earth Observation Satellites, the Global Observing Systems (such as the Global Climate Observing System and the Global Terrestrial Observing System), the sponsors of the Global Observing Systems, the International Group of Funding Agencies, and the international global change research community represented by IGBP and WCRP. The former Chair of IGBP, Berrien Moore III, represents IGBP on IGOS-P.

In 2004, IGBP contributed to the Integrated Global Carbon Observing (IGCO) theme and the coastal and atmospheric chemistry themes. IGBP organised the publication and distribution of the IGCO theme report which can be downloaded from the IGBP website. A meeting at ESRIN/ESA in Frascati, Italy progressed the IGCO Implementation Plan. This and the coastal theme report were presented at the IGOS-P meeting in Beijing (November).

IGBP continued its participation in GEO, which adopted a framework for its 10-year implementation of the Global Earth Observation System of Systems (GEOSS) at the Earth Observation Summit II meeting in Tokyo. Development of the implementation plan continued, in preparation for adoption at the Earth Observation Summit III in February 2005.

Linkages between IGBP and the observation community are supported by an annual grant from ESA, which funds a liaison person to elaborate, organise and deliver data products and services in support of IGBP research.

IGBP Community

IGBP Scientific Committee (2005)

ICSU-Appointed Members

Guy Brasseur (Chair)

Max Planck Institute for Meteorology
GERMANY

Zhisheng An (Vice-Chair)

Chinese Academy of Sciences
CHINA (Beijing)

Karin Lochte (Vice-Chair)

University of Kiel
GERMANY

Seth Krishnaswami (Treasurer)

Physical Research Laboratory
INDIA

Dagoberto Arcos

Fishery Research Institute
CHILE

Robert Duce

Texas A & M University
UNITED STATES

Takashi Kohyama

Hokkaido University
JAPAN

Sandra Lavorel

Joseph Fourier University
FRANCE

Ulrike Lohmann

Swiss Federal Institute of Technology
SWITZERLAND

Taroh Matsuno

Yokohama Institute for Earth Sciences
JAPAN

Steven Running

University of Montana
UNITED STATES

Lynn Russell

University of California (San Diego)
UNITED STATES

Mary Scholes

University of the Witwatersrand
SOUTH AFRICA

Sybil Seitzinger

Rutgers University
UNITED STATES

Mark Stafford-Smith

*Desert Knowledge Cooperative
Research Centre*
AUSTRALIA

Project Chairs and Co-chairs

Meinrat Andreae (iLEAPS)
Max-Planck-Institute for Chemistry
GERMANY

Julie Brigham-Grette (PAGES)
University of Massachusetts
UNITED STATES

Sandro Fuzzi (IGAC)
Institute of Atmospheric Sciences and Climate
ITALY

Julie Hall (IMBER)
National Institute of Water and Atmospheric Research
NEW ZEALAND

Pavel Kabat (iLEAPS)
Climate Change and Biosphere Centre
NETHERLANDS

Eric Lambin (LUCC)
Catholic University of Louvain
BELGIUM

Peter Liss (SOLAS)
University of East Anglia
UNITED KINGDOM

Shaw Liu (IGAC)
Academia Sinica
CHINA (Taiwan)

Philip Rasch (IGAC)
National Center for Atmospheric Research
UNITED STATES

Liana Talaue-McManus (LOICZ)
University of Miami
UNITED STATES

Francisco Werner (GLOBEC)
University of North Carolina
UNITED STATES

Partner Programme Chairs

Peter Lemke (WCRP)
Alfred Wegener Institute for Polar and Marine Research
GERMANY

Michel Loreau (DIVERSITAS)
Ecole Normale Supérieure
FRANCE

Coleen Vogel (IHDP)
University of Witwatersrand
SOUTH AFRICA

The following people served on the SC-IGBP until the end of 2004:

Timothy Bates
IGAC, UNITED STATES

Wandera Ogana
ICSU-Appointed, KENYA

Katherine Richardson
ICSU-Appointed, DENMARK

Colin Prentice
GAIM, UNITED KINGDOM

John Schellnhuber
GAIM, UNITED KINGDOM

National Committee Chairs

Chairs (or contacts) of IGBP
(or Global Change) National
Committees:

ARGENTINA

Mario Nuñez
Inter-America Institute

AUSTRALIA

Michael Manton
Bureau of Meteorology Research Centre

AUSTRIA

Georg Grabherr
University of Vienna

AUSTRIA

Gunter Köck (Contact)
Austrian Academy of Sciences

BANGLADESH

A. Choudhury
*National Science and Technology
Museum*

BELGIUM

Jurgen Tack
Institute of Nature Conservation

BENIN

Michel Boko (Vice-Chair and Contact)
University d'Abomey-Calavi

BOLIVIA

Jaime Argollo
University Major de San Andrés

BOTSWANA

Pauline Opha Dube
University of Botswana

BRAZIL

Eduardo Moacyr Krieger
São Paulo University

BRAZIL

Carlos Nobre (Contact)
National Institute of Space Research

BULGARIA

Nadezda Petrova
Bulgarian Academy of Sciences

CAMEROON

Maurice Tsalefac
University of Yaoundé

CANADA

Thomas Pedersen
University of Victoria

CHILE

Francesco Rothhammer
Chilean Academy of Sciences

CHINA (BEIJING)

Jiayang Li
Chinese Academy of Sciences

CHINA (TAIPEI)

Chao-Han Liu
National Central University

COLOMBIA

José Lozano
*Columbian Academy of Exact, Physical
and Natural Sciences*

COMOROS

Ainouddine Sidi
National Centre for Scientific Research

CONGO, DEMOCRATIC
REPUBLIC OF
Philippe Noki Vesituluta
University of Kinshasa

CUBA
Rene Capote López (Contact)
*Ministry of Science, Technology and
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CZECH REPUBLIC
Jan Safanda
*Academy of Sciences of the
Czech Republic*

DENMARK
Bente Lomstein
University of Aarhus

EGYPT
Mohammad Saber Ismail
National Research Centre

ESTONIA
Rein Vaikmäe
Ministry of Education

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Markku Löytönen
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Wolfram Mauser
University of Munich

GHANA
Charles Biney
Water Research Institute

GREECE
George Contopoulos
Academy of Athens

HUNGARY
Joseph Tigyí
University of Pecs

ICELAND
Halldor Thorgeirsson
Ministry for the Environment

INDIA
Jai Singh
Banaras Hindu University

INDONESIA
Mahdi Kartasasmita
*National Aeronautical and
Aerospace Agency*

IRELAND
John Sweeney
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Science Editor

Chief Scientist



Will Steffen

Bureau of Rural Sciences

AUSTRALIA

For information on the Chief Scientist role see pg. 33.

IGBP Ambassadors

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Seth Krishniswami

*Physical Research Laboratory
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Sandra Lavorel

*Joseph Fourier University
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*University of Kiel
GERMANY*

Berrien Moore III

*University of New Hampshire
UNITED STATES*

Carlos Nobre

*National Institute of Space Research
BRAZIL*

Thomas Pedersen

*University of Victoria
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Katherine Richardson

*Århus University
DENMARK*

John Schellnhuber

*University of East Anglia
UNITED KINGDOM*

Mary Scholes

*University of the Witwatersrand
SOUTH AFRICA*

For information on the
Ambassadors see pg. 33.

Publications List

The following list of publications includes the more significant peer-reviewed publications generated by IGBP, including those from IGBP projects, ESSP projects, IGBP Fast-Track Initiatives and the IGBP Secretariat. These are primarily books, special journal issues, and synthesis and overview papers. Many more focussed papers have also been published; in many cases listings of these, and less formal publications such as projects newsletters, can be found on project websites.

- Aggarwal PK, Joshi PK, Ingram JSI and Gupta RK. (2004) Adapting food systems of the Indo-Gangetic plains to global environmental change: key information needs to improve policy formulation. *Environmental Science and Policy* 7(6): 487–498.
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- Beaugrand G. (2004) Continuous plankton records: plankton atlas of the North Atlantic Ocean (1958–1999). 1. Introduction and Methodology. *Marine Ecology Progress Series Supplement* 3–10.

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- Christen-Witton L. (Ed.) (2004) Back to the future. *Eos* 85(11): 107.
- de Young B, Heath M, Werner FE, Chai F et al. (2004) Challenges of modelling ocean basin ecosystems. *Science* 304(5,676): 1,463–1,466.
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- Field C and Raupach M. (Ed.s) (2004) *Global Carbon Cycle: integrating humans, climate, and the natural world*. Island Press, Washington DC. Pp453.
- Flanagan LB, Ehleringer JR and Pataki DE. (Ed.s) (2004) *Stable Isotopes and Biosphere-Atmosphere Interactions: processes and biological controls*. Academic Press, San Diego. Pp400.
- Geist HJ and Lambin EF. (2004) Dynamic causal patterns of desertification. *BioScience* 54(9): 817–829.
- Granier C, Artaxo P and Reeves CE. (Ed.s) (2004) *Emissions of Atmospheric Trace Compounds*. Kluwer Academic Publishers, London. Pp560.
- Gutman G, Janetos AC, Justice CO Moran EF et al. (Ed.s) (2004) *Land Change Science: observing, monitoring and understanding trajectories of change on the Earth's surface*. Remote Sensing and Digital Image Processing Series 6. Springer-Verlag, Berlin. Pp461.
- Haberl H, Wackernagel M and Wrbka T. (Ed.s) (2004) Land use and sustainability indicators. *Land Use Policy* 21(3).

- Hofmann EE, Wiebe PH, Costa, DP and Torres JJ. (Ed.s) (2004) Integrated ecosystem studies of Western Antarctic Peninsula continental shelf waters and related Southern Ocean regions. *Deep-Sea Research II* 51(17–19): 1,921–2,344.
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- IGAC (2004) Special Issue (26 papers): Characterisation of Asian aerosols and their radiative impacts on climate. *Journal of Geophysical Research-Atmospheres* 109.
- Leng M. (Ed.) (2004) Isotopes in Quaternary palaeoenvironmental reconstruction. *Quaternary Science Reviews* 23(7–8).
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Financial Report

IGBP activities are predominantly funded by contributions from member countries. Central funds support the operation of the IGBP Secretariat, the meetings of the Scientific Committee of IGBP and the Scientific Steering Committees of IGBP projects, and IGBP contributions to ESSP activities.

Income and Expenditure

In the year ending 31 December 2004, financial contributions were received from 39 countries, listed below in order of level of contribution.

1	USA	14	Canada	27	Israel
2	Sweden	15	China (Beijing)	28	Ireland
3	Germany	16	Austria	29	Indonesia
4	Japan	17	Denmark	30	Malaysia
5	United Kingdom	18	Korea	31	Thailand
6	Italy	19	Argentina	32	Syria
7	Russia	20	Finland	33	Sri Lanka
8	Spain	21	South Africa	34	Chile
9	Netherlands	22	Czech Republic	35	Estonia
10	Australia	23	India	36	Iceland
11	Switzerland	24	Greece	37	Kenya
12	China (Taipei)	25	Poland	38	Romania
13	Belgium	26	New Zealand	39	Colombia

Income

	US Dollars
National Contributions	1,328,190
Grant from ICSU Fund	184,000
Contracts	253,146
Other income (including NSF grant to PAGES)	257,196
Operating Assets from 2003	595,576
TOTAL INCOME	2,618,108

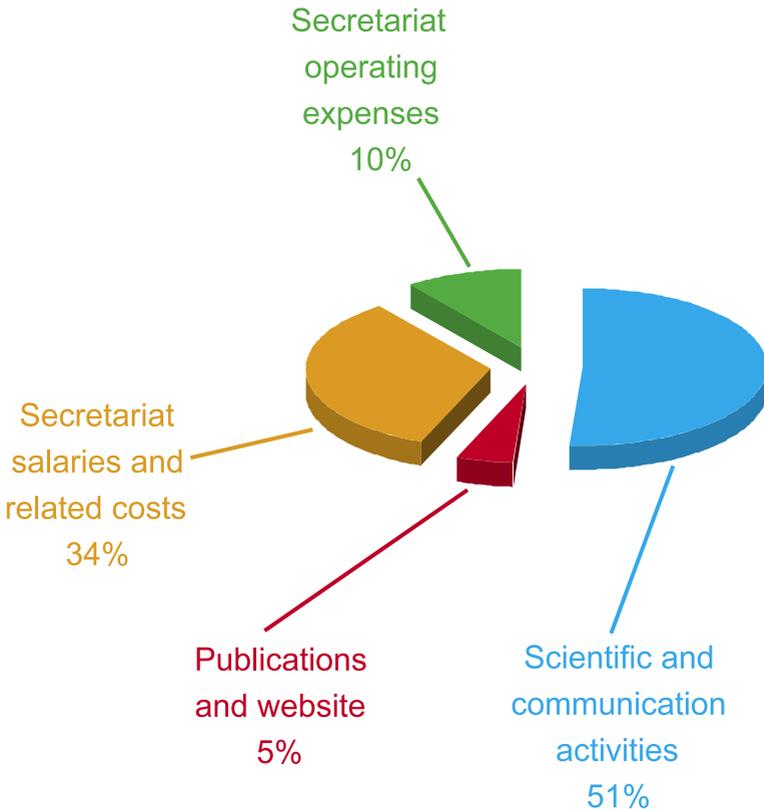
Expenditure

	US Dollars
Scientific and communication activities	882,442
NSF grant to PAGES	235,469
Publications and website	112,256
Secretariat salaries and related costs	733,871
Secretariat operating expenses	225,526
Reserve fund to the Royal Swedish Academy of Sciences	223,214
TOTAL EXPENDITURE	2,412,778

Operating assets 2005 **205,330**

Proportional Expenditure for 2004

Proportional expenditure for 2004 was similar to previous years. The chart below however, presents this information using a different categorisation of expenditure than that used in previous years. Note that a significant fraction of the IGBP Secretariat salary and operating costs directly support the scientific activities of the network.



Acronyms

ACE	Aerosol Characterisation Experiment
AGU	American Geophysical Union
AIMES	Analysis, Integration and Modelling of the Earth System
CACGP	Commission on Atmospheric Chemistry and Global Pollution
CTM	chemical transport model
DEKLIM	German Climate Research Programme
DIVERSITAS	an international programme of biodiversity science
ESA	European Space Agency
ESRIN	European Space Research INstitute (ESA)
ESSP	Earth System Science Partnership
FTI	Fast-Track Initiative
GAIM	Global Analysis, Integration and Modelling
GCP	Global Carbon Project
GECAFS	Global Environmental Change and Food Systems
GEO	Group on Earth Observations
GEOSS	Global Earth Observation System of Systems
GLOBEC	Global Ocean Ecosystem Dynamics
GLP	Global Land Project
GWSP	Global Water System Project
ICSU	International Council for Science
IGAC	International Global Atmospheric Chemistry
IGBP	International Geosphere-Biosphere Programme
IGCO	Integrated Global Carbon Observing theme
IGOS-P	Integrated Global Observing Strategy Partnership

IHDP	International Human Dimensions Programme on Global Environmental Change
iLEAPS	Integrated Land Ecosystem–Atmospheric Processes Study
IMBER	Integrated Marine Biogeochemistry and Ecosystem Research
INI	International Nitrogen Initiative
IOC	Inter-governmental Oceanographic Commission (of UNESCO)
IPO	International Project Office
LiDAR	Light Detection And Ranging
LOICZ	Land-Ocean Interactions in the Coastal Zone
LUCC	Land-Use and Cover Change
MAIRS	Monsoon Asia Integrated Regional Study
NC	National Committee
NGO	Non-governmental organization
NSF	National Science Foundation (USA)
PAGES	Past Global Changes
SASCOM	South Aisia START regional Committee
SCOPE	Scientific Committee on Problems of the Environment
SCOR	Scientific Committee on Oceanic Research
SOLAS	Surface Ocean–Lower Atmosphere Study
SSC	Scientific Steering Committee
START	Global Change SyTem for Analysis, Research and Training
WCRP	World Climate Research Programme
WHO	World Health Organisation

