

IGBP 2 Annual Report 002

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IGBP Annual Report 2002

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Director's Report

The focus of IGBP shifted in 2002 to the implementation of plans for the programme's second decade of research. Building on the solid base of work that is documented in the synthesis project and was presented at the Challenges of a Changing Earth conference in Amsterdam in 2001, the programme has now settled into its new structure, sharpened the scientific questions that it will address, intensified the evolution towards a more integrated community that is building a more unified approach to global biogeochemistry, and enhanced the connections to its partner global change programmes under the framework of the Earth System Science Partnership.

The year saw the finalisation of the new IGBP structure, with a total of eight projects: three oriented towards the three major Earth System compartments - land, ocean and atmosphere; three concentrating on the interfaces that transport and transform matter and energy between the three compartments; and two focusing on the changing environment of the planet as a whole, from past through present to the future.

The Surface Ocean - Lower Atmosphere Study (SOLAS), the first of the new IGBP projects, developed rapidly during the year and has entered into the implementation phase. The first of the original IGBP projects - Biospheric Aspects of the Hydrological Cycle (BAHC) - reached its sunset at the end of 2002 and completed its work on time and in exemplary fashion. BAHC research has contributed significantly to a new understanding of the role of terrestrial biospheric processes in Earth System functioning and of the complex changes that are occurring in continental aquatic systems.

With the approval of the Integrated Land Ecosystem - Atmosphere Processes Study (ILEAPS), the atmosphere-related projects of IGBP are now in place. By the end of the year, the Integrated Global Atmospheric Chemistry Project (IGAC) had completed a rapid and smooth transition to its second decade with a completely new science plan and implementation strategy. The two most complex of the new projects - the land and ocean components - worked hard throughout the year to meet significant planning challenges and made significant progress towards the beginning of implementation.

Two of the pillars of IGBP - the Joint Global Ocean Flux Study (JGOFS) and the Global Change and Terrestrial Ecosystems (GCTE) project - completed their penultimate year, having already delivered much new science aimed at their original objectives. Three ongoing projects - Land-Ocean Interactions in the Coastal Zone (LOICZ), Past Global Changes (PAGES) and Global Analysis, Integration and Modelling (GAIM) all underwent significant re-orientation throughout the year to better fulfil their new roles in IGBP.

With the publication and wide distribution of the first volumes in the re-launched IGBP Global Change Book Series with Springer-Verlag the START (Global Change System for Analysis, Research and Training) synthesis and the collection of plenary presentations from the Global Change Open Science Conference in Amsterdam the legacy of IGBP's first decade is now reaching a broader audience. Furthermore, the extensive publications list illustrates that the scientific productivity of the programme is being maintained through the transition phase.

Collaboration with IGBP's partner programmes - DIVERSITAS (an international programme of biodiversity science), IHDP (the International Human Dimensions Programme on Global Environmental Change) and WCRP (the World Climate Research Programme) - grew strongly under the banner of the Earth System Science Partnership. The three joint projects on issues of global sustainability - carbon/energy systems, food systems and water resources - all made rapid progress, while early discussions were held on the establishment of a set of integrated regional studies.

Outreach and communication were also important activities for the programme in 2002. A strategic review of capacity building and regional research, aimed at improving interaction with START and other regional research networking organisations, was initiated. Discussions are ongoing with the Intergovernmental Panel on Climate Change (IPCC) and the Millennium Ecosystem Assessment to ensure that IGBP's research is of maximum value to the assessment community. Collaboration with the observation community also strengthened through IGBP's participation in the Integrated Global Observing Strategy Partnership (IGOS-P).

The past year was a pivotal one for the programme. IGBP has now established an exciting, integrative and functional structure for its next decade; has significantly enhanced its collaboration within the Earth System Science Partnership and beyond to the assessment, observation and regional networking communities; and is moving rapidly from discussion and planning into active and vigorous implementation of Earth System science.

Will Steffen
Executive Director
Stockholm, Sweden
April 2003

Science Highlights

Scientific research, published in the refereed scientific literature, lies at the heart of IGBP's work. It provides the fundamental basis on which all other products are derived. Below are a few examples of the type of research achievements arising from research in IGBP projects during 2002. Many more could be presented, but these examples give a taste of the variety, breadth and importance of IGBP research.

Earth-System Models of Intermediate Complexity - EMICs

In order to explore the relationships between components of the Earth System that may control the behaviour of the Earth System as a whole, it is necessary to develop models that capture the critical feedbacks and interactions that drive this highly non-linear system from one mode of operation to another. It is also essential to be able to run such models for long times to validate them, ensure model stability, and to explore long-term changes in system behaviour. Current full-complexity high-resolution models cannot operate over sufficiently long model times (thousands of years) in order for the full range of Earth System dynamics, as revealed in ice core and other palaeo records, to be simulated. Earth-System Models of Intermediate Complexity (EMICs, Fig. 1) have been developed to tackle these issues. EMICs address two fundamental requirements: first, being simple enough to permit numerical integration over many millennia and, second, being complex enough, by including more interactions, to yield a more realistic picture of the Earth System than is achieved by comprehensive models.

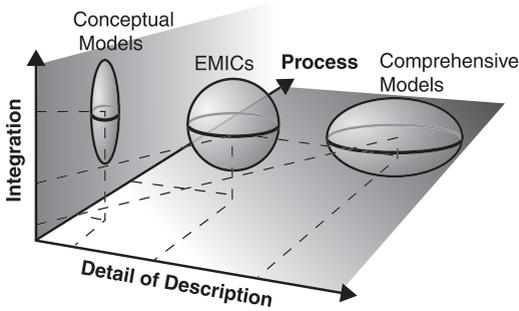


Figure 1

One success of EMICs was the retrodiction of the collapse of the Saharan ecosystem some 5500 years ago (Fig. 2, see also IGBP Science 4). The cave paintings in northern Sudan indicated a thriving ecosystem, but it rapidly changed to a desert, as indicated by the green curves, much more suddenly than the slow change in solar insolation (red line). The model runs captured the nonlinearities involved in solar radiation, precipitation, and land cover parameters.

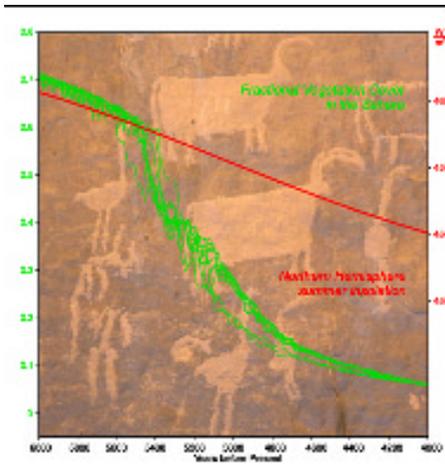


Figure 2

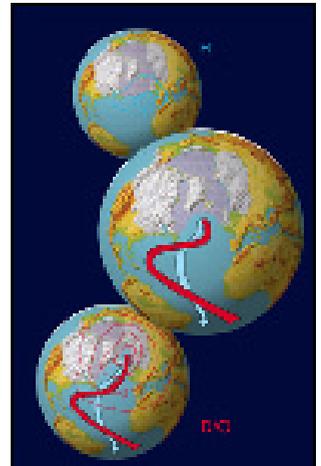


Figure 3

Another success of EMICs is their simulation of the three modes of planetary operation during glacial times, and the abrupt changes between them. The large Earth in the middle of Fig. 3 shows conditions during most of the last ice age. Below is the situation during a warm Dansgaard-Oeschger event, in which the Atlantic “conveyor belt” (the Gulf Stream) advances into the Nordic seas, developing a strong warm anomaly in the regional climate. The upper globe shows conditions during a

Heinrich event, in which the thermohaline circulation collapses and a cold climate anomaly develops over the mid-latitude Atlantic.

This project contributes to the work of the GAIM Task Force.

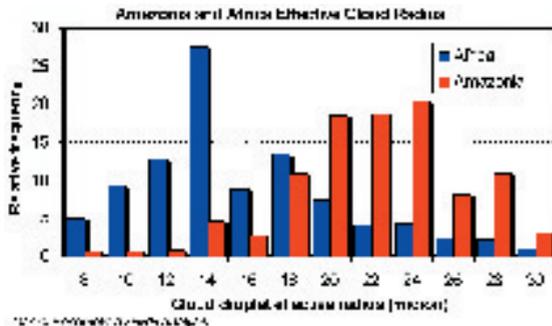
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Land-use Change, Aerosol Production and Climate: Size Matters!!

Recent research in the Amazon Basin, as part of the Large Scale Bio-
sphere-Atmosphere Experiment in Amazonia (LBA) project, has dem-
onstrated the importance of land-use change for the regional climate.
Biomass burning, a widespread practice associated with the initial
clearing of forest and its conversion to agricultural uses, produces
aerosols - small particles of various sizes and composition - which
affect the environment in a number of ways. In terms of climate,
the direct effects of aerosols are becoming increasingly well known.
Aerosols such as sulphate particles scatter incoming radiation and
thus lead to cooling, in contrast to the effect of greenhouse gases.
Carbonaceous aerosols, on the other hand, absorb solar and infrared
radiation and thus lead to warming.



Aerosols also produce an indirect climatic effect by acting as condensation nuclei for cloud formation. Here size matters. Production of large hygroscopic nuclei may enhance the coalescence process of rain formation. With the introduction of many small nuclei into the atmosphere, however, the formation of small drops is encouraged and cloud droplet spectra are skewed to the smaller size range. Rainfall production is consequently rendered more difficult and some evidence suggests that the process may even bring about a diminution of rainfall. In the Amazon this process appears to be occurring, with satellite measurements suggesting that the deep tropical clouds which form in the dry season are precipitating only half the amount of rainfall in the clouds. The small size of the water droplets, due to the small size of the aerosol particles acting as their condensation nuclei, is probably responsible for the suppressed coalescence.

This project contributes to the work of BAHC and ILEAPS.

The Role of Iron in Ocean Carbon Sinks

Planktonic algae in the well-illuminated surface ocean take up nutrients and CO_2 through the process of photosynthesis, which forms the basis for the 'biological pump' that removes CO_2 from the atmosphere and stores the carbon deeper in the ocean. In most areas of the ocean, the strength of the biological pump is controlled by the availability of macronutrients such as nitrate, phosphate and silicate in the upper layers of the ocean. This is not the case, however, in the subarctic Pacific Ocean, the equatorial Pacific, and the Southern Ocean, which comprise about 30% of the global ocean. The biological pump in these regions, often characterised as 'high nutrient-low chlorophyll (HNLC)' waters, may instead be controlled by iron.

Because algae require iron for the synthesis of enzymes involved in photosynthesis, respiration and nitrogen fixation, an insufficient supply of iron may result in low cell growth and hence lower capability to take up CO_2 . Palaeorecords obtained from the Vostok ice core in Antarctica provide tantalising evidence of an inverse relationship

between iron supply to the ocean and atmospheric CO₂ levels (Martin 1990, Petit et al. 1999). Does iron supply control the magnitude of algal biomass in HNLC regions? Major improvements over the last decade in the precision and accuracy of methods for measuring very small amounts of iron and the availability of sulphur hexafluoride as an inert tracer have made it possible to carry out in situ iron fertilisation experiments in the open ocean.

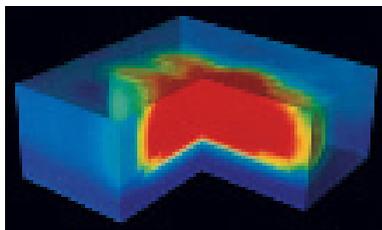


Figure 1

During the IronEx II experiment in the eastern equatorial Pacific, an area of 64 km² was fertilized with iron. Phytoplankton photochemical quantum efficiency increased in the area enriched with iron from less than 0.3 (blue) to greater than 0.55 (red) in surface waters down to 30 m depth.

Building on two iron fertilisation experiments in the eastern equatorial Pacific Ocean (Coale et al. 1996), in January 1999 an international JGOFS team conducted an in situ test of the iron limitation hypothesis in the Southern Ocean 2500 kilometres southwest of New Zealand. Although the response of the biota was much slower in the frigid Antarctic waters than in the equatorial region, participants in the Southern Ocean Iron Release Experiment (SOIREE) obtained clear evidence of enhanced planktonic growth as a result of iron addition (Boyd et al. 2000), which was consistent with the results for the equatorial Pacific. Strong observational evidence for iron fertilisation of carbon sinks in the southern Indian Ocean is presented in the Science Highlight ‘Atmospheric Transport of Aerosols and Iron Fertilisation of Ocean Carbon Sinks’.

Ocean-atmosphere exchanges such as the iron fertilisation described in this article are central to JGOFS and the new IGBP research project SOLAS.

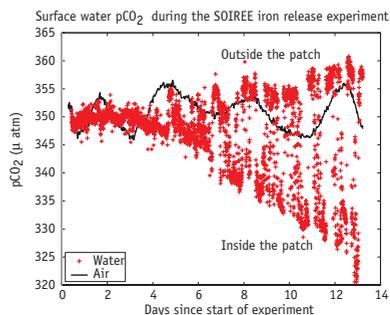


Figure 2

Left: The sites where in situ iron fertilization experiments have been performed are indicated - IronEx I (Oct 1993), IronEx II (April 1995) and SOIREE (Feb 1999).

Right: Enhanced uptake of CO_2 in the Southern Ocean due to the addition of iron (SOIREE Experiment). Data courtesy of Andrew Watson and Dorothee Baker, University of East Anglia

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Was the Medieval Warm Period as warm as the 1990s?

Long tree ring chronologies are one of the most important sources of information on climate variability over the last millennium. Figure 1 shows a recent, extra-tropical, tree ring based reconstruction (Esper et al. 2002) compared with an earlier hemispheric, multiproxy reconstruction (Mann et al. 1999) and their respective uncertainty estimates. The differences between these curves have been the subject of an active debate in the community (Briffa and Osborn 2002; Mann et al. 2002).

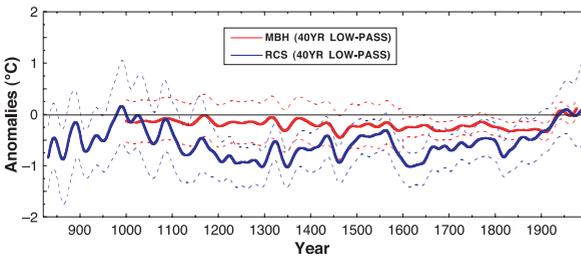


Figure 1

Two proxy-based reconstructions of mean Northern Hemisphere Temperature changes over the past millennium including uncertainty levels (Esper et al. 2002; Mann et al. 1999). Reprinted with permission from Esper et al. (2002) *Science* 295: 2250-2253. ©2002 American Association for the Advancement of Science.

Of particular interest has been the question of whether the Northern Hemisphere average warming measured in recent decades is indeed greater than that associated with the peak of the Medieval Warm Period approximately 1000 years ago. The amount of cooling that occurred several centuries later during the Little Ice Age, and whether this cooling was geographically restricted to certain regions in the extratropics, is another issue of considerable debate. Notable among many differences in the construction of these curves, the former contains records from multiple proxies and from the tropics while the latter (Esper et al. 2002) makes use of a novel technique (Regional Curve Standardisation) designed specifically to obviate the inherent loss of centennial scale variability in long chronologies constructed from a series of short, detrended records spliced together. Rather than

highlighting the differences between these two curves, one might consider their similarities. They capture many of the same decadal scale events and lie at least 95% within each others 95% confidence limits. They both show the remarkable power of long proxy- climate records to put modern changes in the perspective of the past and to use this perspective to better understand natural and anthropogenic drivers of global change. Together, they also indicate some of the most promising areas for future research: better calibration of the growth response of trees to climatic forcing; the need to quantify the range of frequencies that can be reasonably expected to be captured by given reconstructions of past climate variability; and the need to develop long, annually-resolved, quantitative, palaeoclimatic proxy records from the tropics.

This work involved the PAGES community.

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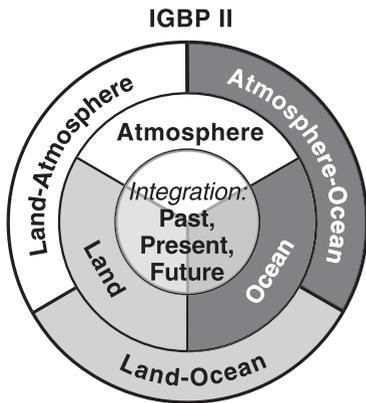
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IGBP 2002: Status of the Programme

Introduction

There has been a strong change in emphasis in IGBP over the last couple of years as the first set of projects concludes and a second generation of projects develops. The emphasis has shifted from the individual compartments of the Earth System, such as terrestrial ecosystems, oceans, atmosphere, to the Earth System itself as an integrated whole. This is a significant shift that implies that the 'culture' of IGBP is changing from being an umbrella organisation for a set of largely independent projects focused on their own science to a more connected, cohesive programme where all projects are working more closely together with common objectives.

These new directions in IGBP, built around a new set of scientific questions, require a carefully designed structure. The new structure is simpler than the one under which IGBP operated through the 1990s. It consists of three projects on the major compartments of the Earth System - ocean, land and atmosphere - and on the three interfaces that connect these compartments - land-ocean, land-atmosphere and ocean-atmosphere. In addition, two projects integrate biogeochemical cycling in the whole Earth System - PAGES, which studies past changes into the present, and GAIM, which analyses past and present changes with a view towards projecting change into the future. GAIM and PAGES are already working together closely in this second phase of IGBP, and both aim to integrate the work of the core projects much more effectively than has been the case previously.



The past year has been a pivotal one for the programme in moving from the previous to the new structure. The first of IGBP's research projects to formally conclude its work was BAHC (Biospheric Aspects of the Hydrological Cycle), which finished at the end of 2002. Two of IGBP's initial projects - JGOFS (Joint Global Ocean Flux Study) and GCTE (Global Change and Terrestrial Ecosystems) - complete their work in 2003.

The status report for the IGBP projects given below is organised around the new structure.

IGBP Projects

Ocean

The Ocean compartment of IGBP II is composed of the ongoing GLOBEC project, and a new project under development on ocean biogeochemistry and ecosystems analysis, which will come online early in 2004 after the end of JGOFS.

The New Ocean Project

The first stages of developing the new project, co-sponsored by SCOR (Scientific Committee on Oceanic Research) began in 2001 and the final report of that group, a "Draft framework on chemical and biological aspects of global change in the ocean" was reviewed and presented to the SC-IGBP in early 2002. Much of this report will be used as the basis for developing the new project. A Transition Team was formed in April 2002 under the leadership of Julie Hall (New Zealand) with the task of designing an Open Science Conference (planned for January 2003) that would gather community input to the developing Science Plan and Implementation Strategy for the new project. The new project currently called Ocean Biogeochemistry and Ecosystems Analysis, will be designed to carry out research in close collaboration with GLOBEC. The Transition Team prepared a discussion document for the Confer-



ence based around 3 scientific questions: How does global change, represented by changes in natural climatic modalities and anthropogenic forcings, impact marine biogeochemical cycles and ecosystem dynamics? How do these impacts alter the mechanistic relationships between elemental cycling and ecosystem dynamics? What are the feedback mechanisms to the Earth System from these changes?

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Global Ocean Ecosystem Dynamics (GLOBEC)

One of the highlights of 2002 for GLOBEC was the 2nd Open Science Meeting, held in Qingdao P.R., China and attended by approximately 250 scientists from 30 countries. Meetings of the GLOBEC Scientific Steering Committee and of three working groups were held adjacent to the OSM, as were meetings with the North Pacific Science Organisation (PICES) and the Census of Marine Life (CoML). The GLOBEC national and regional studies have continued to be very productive in 2002 and new national programmes were initiated in Germany, Spain, Italy and Mexico. There were also significant developments in the GLOBEC regional studies and working groups, in particular the Southern Ocean GLOBEC which initiated field activities in 2001 on the integrated study of society and marine foodwebs, entitled Feedbacks from Changes in Marine Ecosystem Structure. GLOBEC has actively participated in the development of the new Ocean Biogeochemistry and Ecosystems Analysis project throughout 2002.

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Joint Global Ocean Flux Study (JGOFS)

In its penultimate year of operation, JGOFS was still very active, with the submission of the final Springer Synthesis Volume for the project. Synthesis and modelling work has continued in all areas of JGOFS study, and synthesis books are also in preparation for the Continental Margins (in collaboration with LOICZ) and the Indian Ocean. The JGOFS Data Management Task Team (DMTT) was also extremely

active in gathering the many datasets collected during JGOFS and archiving them at the appropriate data centres. The DMITT also documented the lessons learned from JGOFS concerning data management and made recommendations to funding agencies and future ocean projects. The 17th JGOFS SSC was held in Chile in September, while planning for the final Open Science Conference in 2003 was ongoing.

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Land

The New Land Project

The planning process for a new, integrated Land project, co-sponsored by IHDP, gained further momentum in 2002. The year began with the appointment of a transition team under the guidance of four co-chairs: Lisa Graumlich (USA), Sandra Lavorel (France), Emilio Moran (USA) and Dennis Ojima (USA). Activities during the first half of the year focused on the development of linkages with other groups in the Earth System Science Partnership: ILEAPS and LOICZ, the two interface projects that intersect with the Land domain; the Global Carbon Project (GCP), which has a number of research themes that emphasise the terrestrial carbon cycle; and the Integrated Regional Studies, which will provide testbeds for Land research that is oriented towards a place-based approach. In October the transition team held a major planning workshop in Bilthoven, The Netherlands, which drew on the informal discussions earlier in the year to sharpen and develop further the broad science plan that will define the next decade of land research in IGBP and IHDP.

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Global Change and Terrestrial Ecosystems (GCTE)

Two existing projects which form the pillars for the new Land project - GCTE and LUCC (Land Use/Cover Change) - also had very productive years in 2002. GCTE continued its high output of scientific publications based on a number of international networks established during the 1990s. In addition, it launched several research activities that build on its existing scientific framework and community but are aimed at contributing to the new Land project when it is operational. These include: urban development and greenhouse gas emissions; integrated research on fire dynamics; land degradation and desertification; biodiversity and ecosystem functioning in terrestrial systems; functional biodiversity in freshwater and forests; and integrating and scaling research on food production systems. The two activities on fire and land degradation are being carried out jointly with LUCC.

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Land-Use/Cover Change (LUCC)

During 2002, the LUCC project was able to systematically integrate and synthesise research results from land change classes (Focus 1) on causes of global land use change with those on global land cover dynamics (Focus 2). The increasing realism of simulations of processes leading to land-use change will enable the LUCC project to soon provide quantitative, spatially explicit data for scenario development for modelling (Focus 3) and the broader science community. Focus 1 (Understanding land use dynamics- Comparative case study analysis) increased the number of endorsed case studies from 39 to 47 in addition to developing two new regional networks that are more inclusive of developing countries in order to build upon their knowledge of land use change. Focus 2 (Land cover dynamics- Empirical observations and diagnostic models) focused efforts on producing a synthesis of knowledge on areas of rapid land-cover change, and on integrating rates of change with causal patterns. To that effect, the LUCC-IPO held an international workshop in April 2002 dealing in particular with 'Linking causes, drivers and pathways with rates and patterns of

land change'. Focus 3 (Regional and global integrated models) made great strides in applying new technologies, for example, in the field of agent-based modelling and cellular automata. As a major step, the agent-based modelling framework was incorporated into the study of land-use change and land-cover change processes. Novel concepts of land-use transition were developed to support scenario development and provide a better empirical foundation to predict future or alternative trajectories of land change. About 47 fully endorsed LUCC projects have been thoroughly evaluated by members of the LUCC International Project Office and Scientific Steering Committee.

As LUCC matures, it is also increasing its effort in capacity-building and outreach. A highlight of this aspect of LUCC work was the advanced study course 'Modelling Land Use Change', held in October/November 2002 in Louvain-la-Neuve, Belgium, with the support of the European Commission.

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Atmosphere

International Global Atmospheric Chemistry (IGAC)

The IGAC project went through a rapid and successful transition in 2002, under the leadership of Tim Bates (USA) and Mary Scholes (South Africa). Planning for the new decade's research began with a scoping workshop in January in Stockholm, Sweden, involving over 30 scientists from 15 countries around the world. The workshop proposed two major themes for the new IGAC - chemistry-climate coupling, and intercontinental transport and chemical transformation - and also suggested new approaches for implementing the agenda. In addition to the more traditional IGBP activities of networking and field campaigns, IGAC will also undertake rapid syntheses of specific topics. The output from the Stockholm meeting was refined at a meeting of the IGAC Scientific Steering Committee in March in South Africa.



The SSC meeting also focused on the transition of existing IGAC activities into the new project, and into the interface projects SOLAS and ILEAPS, as appropriate. The IGAC Open Science Conference in Crete in September offered an excellent opportunity for the wide scientific community to give input on the new IGAC scientific agenda; over 500 scientists attended a special session on the draft IGAC science plan, which was further developed as a result of the input. The year concluded with the wide circulation of an advanced draft of the new science plan and the approval of a new Scientific Steering Committee, under the leadership of Tim Bates (USA), Sandro Fuzzi (Italy) and Shaw Liu (China-Taipei).

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Land-Ocean



Land-Ocean Interactions in the Coastal Zone (LOICZ)

LOICZ has been fully engaged in completing its Phase I (1993-2002) commitments and developing a new plan and appropriate operational structure for Phase II (2003+) that fits the evolving Earth System Science Partnership. A number of regional assessments of changes in the coastal zone were completed throughout the year and published in the LOICZ R&S Series. Special journal publications and thematic publications attracted considerable attention from international agencies with interests in river catchment management and led to further opportunities for research support at national and regional levels. The LOICZ synthesis book was also developed further, involving a large number of scientists from many countries organised in writing teams and led by a chapter author. While the synthesis has considerable focus at regional levels the research also supports global assessments and delivery of findings stated in the five LOICZ objectives. Throughout 2002, LOICZ SSC consulted widely in the development of a comprehensive discussion document aimed at identifying the key issues for LOICZ Phase II. Recognising the crucial human dimensions

influence in the global coastal zone, the traditional physical-chemical-biological community of LOICZ has increasingly engaged with the human dimension community (notably within IHDP) in developing the discussion document and identifying five core thematic for LOICZ 2. A major international Synthesis and Futures meeting held in Miami (May 2002) provided a crucial forum for discussion of both the LOICZ synthesis findings and consideration of outcomes, and a lively forum for debate and concurrence towards the LOICZ 2 research thematic.

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Land-Atmosphere

Biospheric Aspects of the Carbon Cycle (BAHC)

December 2002 marked the end of an era in IGBP with the formal conclusion of the BAHC project, the first IGBP project to reach its sunset. BAHC was an outstanding success, providing fundamental insights into four major aspects of Earth System functioning: the role of the terrestrial biosphere as an active player in the dynamics of the Earth System; the role of the land surface/vegetation in modulating the lateral transfer of water and materials between the land and the ocean; analytical and modelling approaches for including land-atmosphere interactions in Earth System science and an improved scientific basis for the management of water resources in the context of a changing global environment. The legacy of BAHC continues in the next decade of IGBP research, primarily through contributions to the ILEAPS project of IGBP and to the Global Water Systems Project (GWSP) of the ESSP.



Website: <http://www.pik-potsdam.de/~bahc>

Integrated Land Ecosystem-Atmosphere Processes Study (ILEAPS)

The February 2002 SC-IGBP meeting in Stockholm gave formal approval for the development of a project oriented around the land-atmosphere interface, adding the final piece required for the programme to undertake a systematic study of global biogeochemistry. The aim of ILEAPS is to understand how interacting physical, chemical and biological processes transport and transform energy and matter through the land-atmosphere interface. ILEAPS builds on a strong base of research that was spread among three projects, GCTE, BAHC, and IGAC, in the fields of terrestrial ecology, hydrometeorology and atmospheric chemistry during the first decade of IGBP research. The development of the ILEAPS science plan accelerated after an intensive and very successful scoping meeting in Paris; on that foundation a Transition Team, co-chaired by Meinrat (Andi) Andreae and Pavel Kabat, was formed to guide the development of the project. A key aspect of ILEAPS will be close collaboration with the WCRP project GEWEX (Global Energy and Water Experiment), which is fully involved in the planning process. An open science conference to further develop ILEAPS will be held in Helsinki, Finland, in September 2003.

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Ocean-Atmosphere



Surface Ocean - Lower Atmosphere Study (SOLAS)

2002 was a very active first full year of operation for SOLAS. A meeting of National Representatives was held in June in Amsterdam to exchange ideas, gather information on national activities and to obtain contributions for developing the SOLAS Implementation Strategy. The World Climate Research Programme joined IGBP, the Scientific Committee on Oceanic Research (SCOR) and the Commission on Atmospheric Chemistry and Global Pollution, as co-sponsors of SOLAS,

and a workshop was held to develop Focus 2, “Exchange Processes at the Air-Sea Interface and the Role of Transport and Transformation in the Atmospheric and Oceanic Boundary Layers”. The second SOLAS SSC meeting further developed the Science Plan and Implementation Strategy. Decisions were made to form 4 Working Groups to implement the scientific foci of SOLAS and to develop a management approach for data and modelling. Planning was initiated in 2002 for the first SOLAS Open Science Conference in October 2004.

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Integrating projects

Past Global Changes (PAGES)

PAGES is expected to play a central integrating role (Past, Present, Future) in the new IGBP, creating linkages with other IGBP projects studying Atmosphere, Land and Ocean Sub-systems. In response to its new role, PAGES has moved beyond the storytelling mode of research, involving the collection and interpretation of data, towards a hypothesis-driven approach in which certain data is sought in order to confirm or rule out specific scenarios. The PAGES structure was also streamlined into five foci, with continued strong emphasis on networking and scientific excellence. One of PAGES primary goals is to involve scientists from less-developed countries in international activities. To that effect a major meeting was organized in Moscow (High Latitude Eurasian Paleoenvironments, the proceedings of which are to be published in Elsevier’s Palaeogeography, Palaeoclimatology and Palaeoecology). PAGES has funded 62 workshops since 1999 and funded the attendance of more than 90 scientists from developing countries at such meetings.

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Global Analysis, Integration and Modelling (GAIM)

The GAIM project undertook several important steps in 2002 to move towards its Phase II role as an integrator of IGBP research on Earth System dynamics, emphasising links with IGBP's partner programmes in the ESSP. First, GAIM's traditional model intercomparison projects focused on the carbon cycle were moved to the Global Carbon Project, where they will contribute in particular to an understanding of source-sink distribution. Second, through its development and communication of the 23 Earth System questions, GAIM has provided challenges within and beyond Earth System science for observing, understanding and managing our planetary life support system. Third, as one of its central activities for the coming decade, it was decided that GAIM will develop truly integrated Earth System models in a number of ways. The growing collaboration between GAIM and the WCRP's Working Group on Coupled Modelling is leading to a new genre of coupled GCM-Biogeochemistry models. Complementary to this approach, GAIM has worked on coordinating the development and intercomparison of Earth System Models of Intermediate Complexity (EMICs). The final activity developed was for GAIM to provide active support to IGBP's aim to develop an integrated approach to its research by evaluating the science plans of all of IGBP's phase II projects from the perspective of a holistic Earth System science. The GAIM leadership also evolved during 2002, with Colin Prentice of the Max Planck Institute for Biogeochemistry in Jena, Germany, joining John Schellnhuber as Co-Chairs. GAIM continues to be supported by an international project office located at the University of New Hampshire, USA.

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IGBP National Committees

Background

The IGBP provides an intellectual framework established and approved by the international scientific community for global environmental change research. The National Committees (NCs) provide the formal interface between researchers in participating countries and the international programme. In IGBP II efforts are being made to adopt a clear policy across the programme to help optimise and make transparent networking and outreach efforts at the national level as well as to find alternative ways to integrate communities in countries without NC representation.

Current Status

There are presently about 70 active National Committees and a large number of them contribute to the programme with an annual fee (see 'Financial Report'). The monetary contributions assist in the organisation of the annual meetings of the Scientific Committee of IGBP (SC-IGBP) and the projects' Scientific Steering Committees (SSC), as well as in the central operation of the IGBP Secretariat. The level of development of National IGBP Committees varies greatly – from incipient to fully-fledged committees.

IGBP's main objective is to achieve truly global coverage, hopefully influencing national research priorities to match IGBP's goals and

working in synergy with well established NCs and partner Global Change agencies. These include IAI, the Inter-American Institute for Global Change Research and APN, the Asia-Pacific Network for Global Change Research. The optimum structure of NCs includes members from all IGBP Core Projects and, increasingly, IGBP projects co-sponsoring programmes (the Earth System Science Partnership [ESSP], i.e. IGBP, WCRP, IHDP and DIVERSITAS). START, the Global Change System for Analysis, Research and Training, co-sponsored by the ESSP has a particular role in improving the capacity of the developing regions of the world to participate fully in the international global change programmes. More “traditional” IGBP NCs will need to quickly adjust to the rapidly evolving ESSP joint projects on Food, Carbon and Water at interlinked national, regional and international contexts. Other crucial challenges are linked to priorities and constraints pertaining to “parallel worlds” of NC’s geopolitical integration, with their own specific priorities and funding realities.

Strategy of Development for National Committees

Planning got underway in 2002 to incorporate a special NCs day into the programme for the 3rd IGBP Congress (Banff, Canada, 2003). A major funding effort was initiated and it is hoped that sufficient funds will be raised for approximately 25 NC chairs from less developed countries to participate in the Congress. This will form a pilot for future IGBP or ESSP meetings (e.g. Open Science Conferences) at which NCs will be held.

Another way to better engage with NCs is to use the opportunity provided by regular meetings (such as the annual SC-IGBP meeting) to meet with the local scientific community and partner global change agencies. Such an approach will be taken for the 2003 SC IGBP, in Punta Arenas (with an associated South American symposium, 20-24 January 2003) and a joint IAI-IGBP meeting (27-28 January 2003, Mendoza, Argentina).

In summary, efforts in 2002 to revamp the role of NCs in IGBP, included the realisation that:

- A major strength of IGBP is the large number of active NCs. IGBP will build on this strength. Initiatives are being taken to have NCs report regularly in the IGBP NewsLetter and Email Bulletin, to develop active links to NC websites and initiatives, to invite NC representatives to IGBP meetings, to strongly work with NCs and their scientific communities in implementing studies in their region and for SC and SSC-IGBP members to give lectures and learn about NC activities on Global Change Research when travelling;
- There is a need to raise the profile of IGBP in regions through contact with agencies and by working together with NCs. NCs could work in synergy with the programme in communicating IGBP's agenda to the local scientific community, local authorities and national academies;
- Rotations in IGBP scientific committees and National Committees should stress the need to help bring young and bright people into the community;
- To better promote NC activities, the IGBP Secretariat needs annual reports on national/ regional scientific initiatives and publications from the NC secretariats and national chairs;
- It would be useful if NCs would take the initiative to translate material into local languages to improve communication with policymakers/ agencies; in helping promote IGBP's science to broader audiences, the IGBP website will provide some of the tools (e.g. PowerPoint presentations) to disseminate such knowledge and build new bridges.
- Global Change committees, rather than IGBP committees, should be promoted in collaboration with Earth System Science Partners;

IGBP National Committee Chairs

List of Chairs of active IGBP National Committees

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IGBP Synthesis Project

The IGBP synthesis project is the culmination of the programme's first decade of research and sets out the major scientific advances to which IGBP projects made major contributions. The first of the synthesis books, that of START (Global-Regional Linkages in the Earth System) and the volume containing the plenary publications of the Global Change Open Science Conference in Amsterdam in July 2001 - were published in 2002. Several other synthesis books were in press at the year's end and will appear in early 2003. The first phase of the synthesis project will be completed in 2003 with the publication of volumes based on the work of the first set of IGBP projects (PAGES, IGAC, BAHC, JGOFs, LOICZ - the GCTE synthesis volume was published in 1999) along with an IGBP-wide synthesis volume, which pulls together work across the entire programme.

Global-Regional Linkages in the Earth System

This book synthesizes current knowledge of regional-global linkages in four regions to demonstrate that study of environmental change on a regional scale can enhance understanding of global-scale environmental changes. The atmospheric circulation over Southern Africa links regional nutrient and pollutant sources to distant sinks affecting both regional and global ecosystem functioning. Extended human modification of land cover in East Asia has altered the complex surface-atmosphere exchanges impacting the Asian monsoon system. Biogenic and anthropogenic emissions over South Asia are implicated

in changes in global tropospheric ozone and oceanic biogeochemical balances. Economic globalisation has negatively impacted regional environments of Southeast Asia.

Full Citation: Tyson, P., Fuchs, R., Fu, C., Lebel, L., Mitra, A.P., Odada, E., Perry, J., Steffen, W. and Virji, H. (eds.) (2002). Global-Regional Linkages in the Earth System. The IGBP Global Change Series, Springer-Verlag, Berlin, Heidelberg, New York, 198 pp.

Challenges of a Changing Earth. Proceedings of the Global Change Open Science Conference, Amsterdam, 10-13 July 2001

This book presents a state-of-the-science overview of global change and its consequences for human societies. It highlights four areas of critical importance - food, water resources, air quality and the carbon cycle - from both science and policy perspectives, and points the way towards the new scientific approaches needed to study the Earth System in the future. The book also summarises recent advances in understanding in global change science: the climate system, global biogeochemistry, land-ocean interactions and changing land cover and the Earth System

Full Citation: Steffen, W., Jäger, J., Carson, D.J. and Bradshaw, C. (eds.) (2002). Challenges of a Changing Earth. Proceedings of the Global Change Open Science Conference, Amsterdam, 10-13 July 2001. The IGBP Global Change Series, Springer-Verlag, Heidelberg, New York, 216 pp.



Earth System Science Partnership

Introduction

The Earth System Science Partnership is a partnership of four international global change research programmes (DIVERSITAS, IGBP, IHDP and WCRP) for the integrated study of the Earth System, the changes that are occurring to the System and the implications of these changes for global sustainability. The governance of the ESSP is provided through the annual meetings of the Chairs and Directors of the four constituent programmes. However, the ultimate authority resides with the three scientific committees (DIVERSITAS, IGBP, IHDP) and the joint scientific committee of the WCRP, on whose behalf the Chairs and Directors act.

The ESSP undertakes five types of activities:

- Earth System analysis and modelling, via collaboration among existing projects/ activities of the four constituent programmes.
- Joint projects on issues of global sustainability, designed to address the global change aspects of a small number of critical issues for human well-being: carbon cycle/energy systems, food systems, and water resources.
- Regional activities, including capacity building, networking and integrated regional studies.

- Global Change Open Science Conferences, the first of which was Challenges of a Changing Earth, held in Amsterdam in July 2001. The second Open Science Conference is scheduled for 2006.
- Communication activities, currently under development. These will include an ESSP website, a report series, a common design profile for the joint projects and a proposed biannual newsletter.

Joint Projects

Global Carbon Project (GCP)

The GCP has completed its first full year of operation in a strong position, having virtually completed its science plan/implementation strategy, established a global network of support infrastructure, and delivered its first fast-track products. The international project office in Canberra, Australia, which previously supported the GCTE project of IGBP, has successfully completed the transition to supporting the GCP. In addition, a second international project office has been established in Tsukuba, Japan, to support the GCP flagship activity of integrating the human and biophysical aspects of the carbon cycle as well as to help coordinate carbon cycle research in Asia. A small linking node between the GCP and the European Commission's CarboEurope project has been established in Jena, Germany; an affiliate office on ocean carbon research has been established with the Intergovernmental Oceanographic Commission (UNESCO), Paris, France, and a supporting office in the USA is under development. In addition, the GCP has built an excellent working relationship with the Integrated Global Carbon Observation (IGCO) of the Integrated Global Observing Strategy Partnership. This is crucial to meet the joint GCP/IGCO objective of determining the pattern of carbon sources and sinks in space and time to a much higher accuracy than at present.

Beyond the very fast and effective establishment of the necessary infrastructure and scientific planning, the GCP has also delivered a number of fast-track products to make 2002 a truly outstanding year. The first



summer institute on Data Assimilation for Carbon Cycle Research was held in June 2002 in Boulder, Colorado, with outputs published soon after the institute on <http://dataportal.ucar.edu/CDAS/>. A workshop ‘Terrestrial Carbon Sinks: Science, Technology and Policy’, held in Wengen, Switzerland in September, provided a fast-track product aimed at one of the GCP’s most important goals - to improve the knowledge base required to manage the carbon cycle more effectively. Finally, the first of many national workshops on carbon cycle research was held jointly by the GCP and the German Committee on Global Environmental Change in the second half of 2002. Collaboration with the many national-level carbon cycle research programmes is a key implementation strategy for the GCP.

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Global Environmental Change and Food Systems (GECAFS)

GECAFS developed rapidly during 2002, particularly regarding regional project planning for research on the Global Environmental Change (GEC) and the food systems of (i) the Indo-Gangetic Plain and (ii) the Caribbean. GECAFS planning workshops concentrated on establishing the key GEC research issues of interest to regional scientists, managers and policymakers. Plans are now also underway for research in Eastern Pacific Coastal Fisheries, and Southern Africa.

The planning process for regional projects started by identifying the nature of the questions that need to be researched to aid local and regional policy formulation. The next step has been to establish methodologies and research approaches that can be developed to best address them. Working to the specific questions identified in the 2002 regional planning meetings, workshops involving representatives from IGBP, IHDP and WCRP Core and Joint Projects (and other groups, e.g. CGIAR) have since been held to establish research strategies and to identify relevant ongoing and immanent work within the Programmes so that research proposals can be jointly developed.

Regional research needs to be underpinned by improved understanding on the nature of vulnerability, especially in relation to food systems, and the development of comprehensive scenarios within which research is set. Research plans in both areas are now underway, and an initial work programme for vulnerability research is already funded.

The GECAFS Scientific Advisory Committee (SAC) was inaugurated in April 2002, with members drawn from a wide range of scientific disciplines. The SAC also includes representatives from GECAFS' strategic partners (the CGIAR, FAO and WMO) together with liaison members from a number of types of donor agency. The GECAFS IPO is now well established in the UK-Natural Environment Research Council's Centre for Ecology and Hydrology, in Wallingford, UK.

The first major GECAFS science product is a paper "Global Environmental Change and Food Provision: A New Role for Science" requested by ICSU, The International Council for Science, for the World Summit on Sustainable Development (WSSD) in August 2002. The paper, published in the ICSU Series on Science for Sustainable Development, was widely distributed in Johannesburg. Authorship included all three sponsors' science and also included contributions from members of the FAO Inter-Departmental Working Group on Climate Change in Relation to Agriculture and Food Security. GECAFS was also asked by ICSU to co-convene a Special Session "Science for Food Security in Africa" as part of the WSSD Science Forum. A synthesis paper (Ingram & Jaeger) has since been published as part of the ICSU Series. A 20-page GECAFS Prospectus also has been published and is being widely circulated.

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Global Water System Project (GWSP)

Significant developments were made in the Joint Water Project during 2002, including the renaming of the project as the Global Water System Project. Three meetings were held during 2002 to develop the scientific questions for the project, which are outlined in the Scoping Document,



The Water Challenge. The overarching question for the project is: 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? An Open Science Meeting is planned for 2003 to gather community input to further develop the Scientific Framework for the project.

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Other Joint Activities

Earth System analysis and modelling

The core of ESSP joint work is built around Earth System analysis and modelling, which is undertaken via collaboration among existing projects/ activities of the four constituent programmes. This activity is initially built around collaboration between IGBP/GAIM (Global Analysis, Integration and Modelling) and WCRP/WGCM (Working Group on Coupled Modelling). The two groups met together for the first time in October 2002 and agreed to meet together every second year, with cross-representation at each other's meetings in intervening years.

The first major effort of the GAIM-WGCM partnership is the Coupled Carbon Cycle - Climate Modelling Intercomparison Project (C4MIP). The first two pilot studies coupling carbon cycle models with General Circulation Models both show positive feedbacks—the projected temperature rise by 2100 is larger when an interactive carbon cycle is included. An even more challenging goal is to integrate the human dimensions into Earth System analysis and modelling, via: (i) The Oslo Group (TOG), an IGBP-IHDP group exploring theoretical and methodological aspects of natural-social science integration, and (ii) the modelling work of the Global Carbon Project (GCP), which aims to develop fully integrated carbon cycle models coupling biophysical processes with the dynamics of energy systems, land-use change and

institutional/ political change. The implications of changes in biodiversity for Earth System functioning will be integrated into the effort in due course.

Regional Activities

The ESSP endeavours to ensure that the Earth System science initiated under its auspices is truly global and directly addresses the differences in scientific capabilities in various regions of the world. A regional approach to global change is also important because regions manifest significantly different yet coherent Earth System dynamics and have broadly common socioeconomic and geopolitical characteristics. IGBP and the other programmes in the ESSP are responding to the regional challenge by undertaking their own capacity-building activities, integrating these activities within the research effort itself, and carrying out research activities in all parts of the world. In addition, the ESSP sponsors two types of regionally-oriented activities:

- START (the global change SysTem for Analysis, Research and Training) carries out regional networking and research projects, often in collaboration with projects of its sponsoring programmes. START also undertakes specific capacity-building activities, including training workshops and institutes, a fellowship scheme, and guest lectureships. Strong partnerships were also forged with groups such as the Inter-American Institute for Global Change Research (IAI) and the Asia Pacific Network (APN).
- A small set of Integrated Regional Studies (IRS) is being developed to contribute sound scientific understanding to support the sustainable development of the region and to improve understanding of regional-global linkages in the context of Earth System dynamics. The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) is the first study in this set. A companion study in Monsoon Asia is in the early stages of development.

Communication

Introduction

With the emphasis on transition in 2002, the communications strategy focused on improving avenues of internal communication. Good progress was made, with a number of new initiatives introduced. Major new products included a regular IGBP Email Bulletin, a special IGBP Phase II Issue of the Global Change NewsLetter (no. 50) and an IGBP presentation package.

Internal Communication

Email Bulletin

An email bulletin circulating internal information to the IPO Executive Officers, the IGBP SC, IGBP Secretariat, Transition Team Chairs, Joint Project Chairs and Executive Officers, Chairs and Directors of the GEC programmes, and ICSU began in March 2002. The bulletin has been well received by the IGBP community and associated groups.

IGBP Presentation Package

A PowerPoint presentation package on IGBP Phase II was produced and made available on the IGBP website. This enables members of the IGBP community to represent IGBP at various scientific and policy meetings with an attractive and professional presentation. IGBP proj-

ects were encouraged to add their own modules and tailor the presentation to suit their own needs.

Communications Think Tank

Following approval by the SC in February, the IGBP 'Communications Think Tank' is now in action. The main objective is to develop the long-term strategic directions of IGBP in terms of communication. They are a group of key interested IGBP scientists (In 2002 they were: Bert Bolin, Chris Crossland, Paul Crutzen, Pavel Kabat, Pam Matson, Tom Pedersen, Kathy Richardson and Bob Wasson, with Will Steffen, Guy Brasseur and Berrien Moore as ex-officio members), who discuss by email various IGBP communications issues.

Global Change NewsLetter (NL)

A number of changes were made to the IGBP Global Change NewsLetter in 2002. A new section, 'Integration', was introduced to highlight the increasing integration of different fields of Earth System science and of IGBP science with other global change programmes. All articles submitted to the NL are 'friendly reviewed' by scientists at the IGBP Secretariat, to ensure the quality of the science. Also, NL articles can now be downloaded individually from the IGBP website.

A survey was conducted in mid 2002 in order to: a) identify readers who want to receive the NL electronically; b) get information on changes in contact details; c) to solicit feedback on the content of the NL. Over 1200 replies were received (more than 10% of the readership).

Summary of NewsLetter survey results:

1. More than 300 people preferred to receive the NL electronically (an email alert with a web link), and this procedure began with NL 51. We have also sent out follow-up emails to the NL mailing list encouraging people to opt for the electronic version.
2. Most comments on the format and content were overwhelmingly positive. Only 6% of those that responded wanted to be removed from the mailing list.

3. The most popular section was the 'Science Features'. Common comments included 'very informative', 'well-balanced topics' and 'up-to-date'. Several people said that they used the articles in teaching and others thought that the articles could go into more detail.

External Communication

IGBP Website

The IGBP website is an important communication tool, offering information to both the IGBP community and the public. As the Programme has undergone changes and has entered a new phase, the IGBP site is continuously developed to reflect these changes. In addition to the ongoing work of updating and enhancing existing information, new features are added to offer specific information (Powerpoint Presentation page, NewsLetter articles offered as individual pdfs), and others are under development (graphics archive, NewsLetter in html format for online viewing).

<http://www.igbp.kva.se/>

OCEAN Open Science Conference Website

A extensive website was created in preparation for the OCEAN Open Science Conference, containing information relevant to the meeting as well as interactive features such as registration and abstract submission.

<http://www.igbp.kva.se/obe/>

Prepcom Website

A website was created prior to the media event at PrepCom4 leading up to the World Summit on Sustainable Development (WSSD).

<http://www.igbp.kva.se/prepcom4/>

Media

As the focus of the communication strategy in 2002 was on the development of internal communication tools, there was minimal media coverage of IGBP. However, two events attracted media attention for IGBP:

1. Science Roundtable for the Media (Bali, 4 June). See ESSP Communications.
2. Publication of a PAGES paper in *Nature*, 'Climate change in the North Pacific region over the past three centuries' by GWK Moore, G Holdsworth & K Alverson (Vol 420, 28 Nov 2002). A press release was sent out in collaboration with University of Toronto, and resulted in widespread coverage through Reuters, BBC, various online news services and the Canadian press.

Press releases and media alerts continue to be posted on the Media Room section of the IGBP website.

Two film projects are under development:

- (i) A Swedish company, Charon Films, has made progress with fundraising from Swedish Television, the Swedish Film Institute and the EU, and they plan to start research trips in 2003.
- (ii) A second proposal was put forward by well-known Swedish film producer, Anders Grönros. This project will target a different audience to the Charon Films project.

Education

Internet Portal

IGBP, through its parent body, ICSU, has signed an agreement with a Swedish company (Global Change Information Network – GCIN) to adapt and modify IGBP information and market it for a secondary and tertiary education audience. A pilot project was begun in Sweden in 2002 and is expected to be complete in 2004.

Use of IGBP products in Education

IGBP products continue to be a valuable resource for educators. The Science series, the IGBP Book series and the Global Change Newsletter are often used in university courses. In 2003, more effort will be made to encourage use of IGBP products available on the website.

ESSP Communications

The Earth System Science Partnership has an active team of communication professionals (representing the four programmes and START) who discuss strategies and collaborate on communication initiatives. In 2002, there were two major communication initiatives:

- A science roundtable for the media at PrepCom 4 in the lead up to the World Summit on Sustainable Development (WSSD);
- A strategy for developing a common visual profile for ESSP activities

Media Roundtable at PrepCom4 for the WSSD - Bali, Indonesia 4 June 2002

This event was co-organised by IHDP, IGBP, WCRP, DIVERSITAS and START and fully funded by ICSU. The objective was to make use of ICSU's contribution to the WSSD process, as a forum for the multidisciplinary global change research being carried out by the four global environmental change programmes and START. The concept was a collaborative media campaign aimed at highlighting the crucial role science can and should play in sustainable development, using timely and relevant results from the global change research community.

The event attracted journalists from the South East Asian region and was reported by Reuters News Agency, Indonesian TV (RCTI) and radio (68 H), Jakarta Post, Sinar Harapan (Indonesian newspaper) and the Indonesian News Agency, Antara. There were also four follow-up reports on the World Radio Network, South Africa. It was crucial in

broadening our media database to Asian and South African media networks, and in raising IGBP's profile to new audiences.

A new website was set up specifically for the event at www.igbp.kva.se/prepcom4/

ESSP Graphic Profile

IGBP has taken the lead in the development of the ESSP visual identity. An ESSP logo was developed and the visual elements for ESSP websites and publications underwent significant development in 2002.

Looking forward

Until now the major focus of the communications effort has been on internal communication and the development of a series of high quality communication tools (Science Series, website, NewsLetter etc). Now that this has been achieved we can focus more on developing the reach and impact of these products in the wider community. The launch of IGBP II in 2003 presents us with a good opportunity to raise our profile with a variety of audiences externally. The strategy in 2003 and 2004 will include greater emphasis on reaching policy makers and the education sector.

Scientific Publications

The following list summarises major publications - synthesis and integration papers, special journal editions and books - published by IGBP and its projects during 2002.

- Alverson, K., Kull, C., Moore, G.W.K., LeGrand, P. and Ginot, P. (eds) (2002), A dynamical perspective on high altitude paleoclimate proxy timeseries, (Reason, M. and et al) (eds) (2002), *Global Change and Mountain Regions-A state of knowledge overview*. Elsevier (in press)
- Anadon, R. and Estrada, M. (eds) (2002), Carbon Fluxes in High Productivity Areas in the Antarctic Peninsula - Fruela Cruises. *Deep Sea Research II*, Vol. 49: Nos. 4-5
- Beuning, K. and Wooller, M. (eds) (2002), Reconstruction and Modeling of grass-dominated ecosystems. *Paleogeography, Paleoclimatology, Paleoecology*, Vol. 177: Nos. 1-2, pp 1-214
- Briffa, K. and Mathews, J. (eds) (2002), Analysis of dendrochronological variability and associated natural climates in Eurasia. *The Holocene*, Vol. 12: No. 6, pp 639-794
- Canadell, J. and Pataki, D. (2002), New advances in carbon cycle research. *Trends in Ecology and Evolution*, 17: 156-158
- Canadell, J., Steffen, W. and White P.S. (eds) (2002), IGBP / GCTE Terrestrial Transects: Dynamics of terrestrial ecosystems under environmental change. *Journal of Vegetation Science*, Vol.13, No. 3.
- Canadell, J., Zhou, G. and Noble, I. (eds) (2002), Land use / cover change effects on terrestrial carbon cycle in the Asian Pacific region. *Science in China*, Series C, Vol. 45 Supplement. 141 pp + 10 colour plates
- Catto, N., Chlachula, J. and Kadlec, J. (eds) (2002), Late Pleistocene and Holocene Climate and Geochronology, *Quaternary International*, Vol. 89: No. 1, pp 1-178
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- Clark, P. U. and Mix, A.C. (2002), Ice Sheets and Sea Level of the Last Glacial Maximum. *Quaternary Science Reviews*, Vol. 21: No. 1-3, 1-7
- Claussen, M., Mysak, L.A., Weaver, A.J., Crucifix, M., Fichefet, T., Loutre, M-F, Weber, S.L., Alcamo, J., Alexeev, V.A., Berger, A., Calov, R., Ganopolski, A., Gooose, H., Lohman, G., Lunkeit, F., Mokhov, I.I., Petoukhov, V., Stone, P. and Wang, Zh. (2002), Earth System Models of Intermediate Complexity: Closing the Gap in the Spectrum of Climate System Models. *Climate Dynamics*, 18: 579-586
- D'Antonio, C.M. and Kark, S. (eds) (2002), Impacts and extent of biotic invasions in terrestrial ecosystems. *Trends in Ecology and Evolution*, 17: 203-204
- Diaz, S., McIntyre, S., Lavorel, S. and Pausas, J.G. (eds) (2002), Does hairiness matter in Harare? - Global comparisons of Plant trait responses to disturbance. *Annual Forestry Science*, 58: 713-721
- Doney, S., Sarmiento, J. and Falkowski, P. (eds) (2002), The US JGOFs Synthesis and Modeling Project: Phase I. *Deep Sea Research II*, Vol. 49: Nos. 1-3, 1-20
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- H., Follows, M., Gao, Y., Gruber, N., Hecht, M.W., Ishida, A., Joos, F., Lindsay, K., Madec, G., Maier-Reimer, E., Marshall, J.C., Matear, R.J., Monfray, (eds) (2002), Evaluation of ocean model ventilation with CFC-11: comparison of 13 global ocean models. *Ocean Modelling*, 4:89-120
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- Fox, J., Rindfuss, R.R., Walsh, S.J. and Mishra, V. (eds) (2002), People and the environment: Approaches for linking household and community surveys to remote sensing and GIS. Kluwer Academic Publishers: Boston, Dordrecht, 344 pp.
- Friedlingstein, P., Cox, P. and Rayner P (2002), How positive is the feedback between climate change and the carbon cycle? *Tellus*, (in press)
- Geist, H.J. and Lambin, E.F. (2002), Proximate causes and underlying driving forces of tropical deforestation. *BioScience*, 52: 143-150
- Gregory, P.J., Ingram, J.S.I., Andersson, R., Betts, R.A., Brovkin, V., Chase, T.N., Grace, P.R., Gray, A.J., Hamilton, N., Hardy, T.B., Howden, S.M., Jenkins, A., Meybeck, M., Olsson, M., Ortiz-Monasterio, I.O., Palm, C., Payne, T., Rummukainen, M., Schulze, R.E., Thiem, M., Valentin, C. and Wilkinson, M.J. (2002) Environmental Consequences of Alternative Practices for Intensifying Crop Production. *Agriculture, Ecosystems and Environment*, 88: 279-290
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- Gurney, K.R., Law, R.M., Denning, A.S., Rayner, P.J., Baker, D., Bousquet, P., Bruhwiler, L., Chen, Y-H., Giais, P., Fan, S., Fung, I.Y., Gloor, M., Heimann, M., Higuchi, K., John, J., Maki, T., Maksyutov, S., Masarie, K., Peylin, P., Prather, M. and Pak, B. (eds) (2002), Towards Robust Regional Estimates of CO₂ Sources and Sinks Using Atmospheric Transport Models. *Nature*, 415: 626-630
- Jäger, J. (guest ed) (2002), Sustainability Science: Special Section of Papers from the Global Change Open Science Conference. *Science*, Vol: 292: No. 5517
- Lavorel, S. and Garnier, E. (2002), Predicting changes in community composition and ecosystem functioning from plant traits: revisiting the Holy Grail. *Functional Ecology*, 16: 545-556
- Le Borgne, R., Feely, R.A. and Mackey, D.J. (eds) (2002), Carbon fluxes in the equatorial Pacific: a synthesis of the JGOFS programme. *Deep Sea Research II*, Vol. 49: Nos. 13-14
- Loreau, M., Naeem, S. and Inchausti, P. (eds) (2002), Biodiversity and ecosystem functioning: synthesis and perspectives. Oxford University Press, 304 pp.
- Marty, J.C. (ed) (2002), Studies at the DYFAMED (France JGOFS) Time-Series Station, N.W. Mediterranean Sea. *Deep Sea Research II*, Vol. 49: No. 11
- Matsumi, Y., Comes, F.J., Hancock, G., Hofzumahaus, A., Hynes, A.J., Kawasaki, M. and Ravishankara, A.R. (2002), Quantum yields for production of O(1D) in the ultraviolet photolysis of ozone: Recommendation based on evaluation of laboratory data, *Journal of Geophysical Research*, 107, No. D3
- Pendall, E. (2002), Where does all the carbon go? The missing sink. *New Phytologist*, 153: 199-211
- Ramankutty, N., Foley, J.A. and Olejniczak, N.J. (2002) People on the land: Changes in global population and croplands during the 20th century. *Ambio*, 31: 251-257
- Reynolds, J. and Stafford Smith, M. (eds) (2002), Global Desertification: Do humans cause deserts? Dahlem Workshop Report #88, Dahlem University Press, Berlin, 438 pp.
- Rodó, X. and Comin, F.A. (eds) (2002), Global Climate: Current research and uncertainties in the climate system. Springer-Verlag Berlin Heidelberg New York, 286 pp.
- Rusch, G. and Pausas, J. (eds) (2002), Functional analysis of plant response to land use and natural disturbance. *Journal of Vegetation Science*, (in press)
- Schulmeister, J. and Dodson, J. (2002), Late Quaternary climate change in the New Zealand region. *Global and Planetary Change*, Vol. 33: Nos. 3-4, 205-362
- Smith, S.L. (ed) (2002), The 1994-1996 Arabian Sea Expedition: Oceanic Response to Monsoonal Forcing, Part 5. *Deep Sea Research II*, Vol. 49: No. 12
- Steffen, W., Jäger, J., Carson, D.J. and Bradshaw, C. (eds.) (2002). Challenges of a Changing Earth.

Proceedings of the Global Change Open Science Conference, Amsterdam, 10-13 July 2001. The IGBP Global Change Series, Springer-Verlag, Heidelberg, New York, 216 pp.

Thompson, A.M., Witte, J.C., Freiman, M.T., Phahlane, N.A. and Coetzee, G.J.R. (2002), Lusaka, Zambia, during SAFARI-2000: Convergence of local and imported ozone pollution. *Geophysical Research Letters*, 29: No. 20

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Financial Report

Funding for IGBP central activities comes mainly from contributions from its member countries. In addition, Secretariat staff seek external grants to support specific activities. The central funds are used to support the Scientific Committee of the IGBP, the Scientific Steering Committees of its projects, IGBP's contribution to ESSP activities, the IGBP Secretariat and a number of scientific liaison and outreach activities. Over the past several years, IGBP has significantly increased resources allocated to communication and publications.

In 2002 IGBP received financial contributions from 44 of its 78 member countries (Table 1). As well as national contributions, several special grants were awarded to IGBP for special activities. More than 70% of total IGBP funds were spent on scientific activities in 2002 (pie chart). Administration accounted for 16% and publications and communication 13% of expenditure.

Statement of income and expenditure

For the year ending 31 December 2002

I. Income

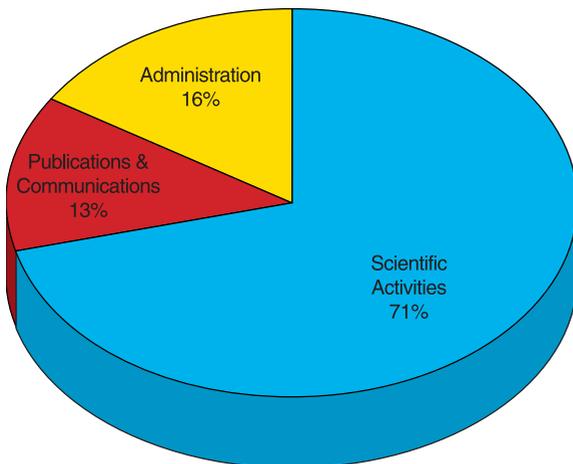
USD

National Contributions arranged by level of Contribution:

1 USA	16 Austria	31 Malaysia
2 Germany	17 Denmark	32 Chile
3 Japan	18 Korea Republic	33 Philippines
4 Sweden	19 Finland	34 Thailand
5 United Kingdom	20 South Africa	35 Sri Lanka
6 Italy	21 Czech Republic	36 India
7 Spain	22 Greece	37 New Zealand
8 The Netherlands	23 Hungary	38 Botswana
9 Australia	24 Poland	39 Iceland
10 China, Taipei	25 Israel	40 Kenya
11 Switzerland	26 Ireland	41 Syria
12 Belgium	27 Portugal	42 Romania
13 Norway	28 Bulgaria	43 Colombia
14 Canada	29 Indonesia	44 Bolivia
15 China, Beijing	30 Singapore	
		sub.tot. 1 309 717
Grant from ICSU Fund	24 464	24 464
Special Contributions:		
MISTRA, Sweden	9 524	
NASA/NSF, USA	16 021	
ESA, France	82 601	
CNES, France	16 805	
APN, Japan	4 351	
NWO, Netherlands	29 683	
SIDA, Sweden	24 590	
Other income: incl. special NSF grant to IPO	198 952	
		sub.tot. 382 527
Operating Assets from 2002		586 379
Total Income		2 303 087

II. Expenditure	USD
Scientific Activities:	
Meetings and work shops	1 316 087
Other expenditure, special NSF grant to IPO	132 988
Publications and Information:	
Publications & Communications	265 907
Administrative Expenses:	
General office expenses	316 815
Total Expenditure	2 031 797
Operating Assets to 2003	271 290

Expenditure 2002



IGBP Databases

Introduction

Much of the information about IGBP (people, publications, graphics etc) is stored in databases at the IGBP Secretariat. Extensive work has gone into the development and maintenance of these databases and they are a fundamental resource for the programme.

The following databases are maintained by the IGBP Secretariat:

Meetings List: This database includes meetings posted in the IGBP Newsletter and the IGBP web site.

Library: An internal library of books and journals stocked at the IGBP Secretariat.

Publications: A listing of all books, special journal editions and synthesis and overview papers that are specifically the result of an activity that has been sponsored or co-sponsored by IGBP or one of its Projects.

Main database: A list of names, contact details and roles of people in the IGBP Network. It is used for the mailing of reports, IGBP Newsletters, Science Series, etc. Also used in the construction of the IGBP Directory and tracking people related to IGBP and its Projects.

Graphics database (web/internal): The IGBP web image archive is a selection of images used in IGBP products, which have been selected for easy access by the IGBP community. This is still in its early stages of development, but will increase significantly

over the next year. The internal database is a more comprehensive selection of images accessible by the IGBP Secretariat.

Congress database: A temporary relational database dealing with the participation and logistics of the 3rd IGBP Congress being held in Banff, Canada 2003. This helps pull together information received from different groups and handled by different people. It helps ensure accuracy and finding the most up-to-date information.

IGBP Scientific Committee and Secretariat Staff

IGBP Secretariat staff

The IGBP Secretariat coordinates the central activities of the Programme, under the leadership of the Executive Director, with a current staff of ten persons. The Secretariat implements the decisions of the Scientific Committee of the IGBP, works with the Core Projects to provide support to the overall research effort, raises funds for IGBP activities, communicates IGBP research to a wide variety of audiences, liaises with partner organisations, and administers the IGBP central budget.

The IGBP Secretariat is hosted by the Royal Swedish Academy of Sciences in Stockholm.

A number of people joined the Secretariat in 2002 on fixed contracts to work on specific projects or fill in for staff on leave. From mid March Clare Bradshaw replaced Susannah Elliott who took 10 months maternity leave. Petra Nilsson and Anna Bastås provided much needed graphic design support during February to April and September to December. From September Sofia Roger worked part-time in order to accommodate a study leave programme. Some of her duties were taken over by Suzanne Nash. Angelina Sanderson began in March, providing editorial support for the production of the IGBP Synthesis Volume.



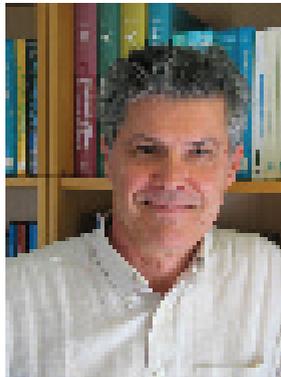
John Bellamy
Graphics Designer



Wendy Broadgate
Deputy Director Natural Sciences



Susannah Elliott
Science Communicator



João Morais
Deputy Director Social Sciences



Suzanne Nash
Acting Information Coordinator



Sofia Roger
Information Coordinator



Will Steffen
Executive Director



Angelina Sanderson
Acting Science Editor



Clemencia Widlund
Administrative Officer



Charlotte Wilson Boss
Database Coordinator



Elise Wännman
Director for Finances

IGBP Scientific Committee (2003)

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*Max Planck Institute for Meteorologie
Hamburg*
GERMANY

Paul Crutzen - Vice Chair
*Max-Planck-Institute for Chemistry
Mainz*
GERMANY

Seth Krishnaswami - Treasurer
*OCE-CS Area
Ahmedabad*
INDIA

ICSU APPOINTED MEMBERS

Zhisheng An
*Chinese Academy of Sciences
Shan'xi Province*
CHINA

Dagoberto Arcos
*Fishery Research Institute
Talcahuano*
CHILE

Takashi Kohyama
*Hokkaido University
Sapporo*
JAPAN

Sandra Lavorel
*Université Joseph Fourier
Montpellier*
FRANCE

Karin Lochte
*Universität Kiel
Kiel*
GERMANY

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*Faculty of Science, University of Nairobi-
Nairobi*
KENYA

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*Institute of Biological Sciences, Århus
University
Århus N*
DENMARK

Mary C. Scholes
*University of the Witwatersrand
Johannesburg*
SOUTH AFRICA

Sybil Seitzinger
*Rutgers, The State University of New
Jersey
Brunswick*
USA

IGBP PROJECT CHAIRS

Timothy Bates - co-Chair, IGAC
*NOAA/Pacific Marine Environmental
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Seattle*
USA

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*The College of William and Mary, VIMS
Gloucester Point*
USA

Sandro Fuzzi - co-Chair, IGAC
*Institute for Atmospheric and Oceanic
Sciences, National Research Council
Bologna*
ITALY

Sulochana Gadgil - co-Chair, START
*Indian Institute of Science
Bangalore*
INDIA

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Université Catholique de Louvain
Belgium
BELGIUM

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Texel
THE NETHERLANDS

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University of East Anglia
Norwich
UK

Shaw Liu - co-Chair, IGAC
Academia Sinica
Taiwan
TAIWAN, R.O.C.

Vera Markgraf - Chair, PAGES
University of Colorado at Boulder
Boulder
USA

Graeme Pearman - co-Chair,
START
CSIRO, Atmospheric Research
Aspendale
AUSTRALIA

Louis Pitelka - Chair, GCTE
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Max Planck Inst. for Biogeochemistry
(MPI)
Jena
GERMANY

H. John Schellnhuber - co-Chair,
GAIM
School of Environmental Sciences, University of East Anglia
Norwich
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Francisco Werner - Chair, GLOBEC
University of North Carolina
Chapel Hill
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Alfred-Wegener-Institut
Bremerhaven
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Ecole Normale Supérieure
Paris
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Coleen Vogel - Chair, IHDP
University of Witwatersrand
Johannesburg
SOUTH AFRICA

Note that the following people served on the SC-IGBP until the end of 2002:

Robert Wasson
(Vice-Chair, Australia)

Rodolfo Dirzo (Mexico)

Victor Gorshkov (Russia)

Pamela Matson (USA)

Michel Maybeck (France)

Carlos Nobre (Brazil)

Roger Harris (Former Chair of GLOBEC SSC, UK)

Pavel Kabat (Former Chair of BAHC SSC, Germany)

Thomas Pedersen (Former Chair of PAGES SSC, Canada)

A Glossary of Acronyms

APN	Asia-Pacific Network for Global Change Research
BAHC	Biospheric Aspects of the Hydrological Cycle
CGIAR	Consultative Group on International Agricultural Research
CNES	Centre National d'Etudes Spatiales
CoML	Census of Marine Life
DIVERSITAS	An International Programme on Biodiversity Science
ESA	European Space Agency
ESSP	Earth System Science Partnership
FAO	Food and Agriculture Organization
GAIM	Global Analysis, Integration and Modelling
GCP	Global Carbon Project
GCTE	Global Change and Terrestrial Ecosystems
GECAFS	Global Environmental Change and Food Systems
GLOBEC	Global Ocean Ecosystem Dynamics
IAI	Inter-American Institute for Global Change Research
ICSU	International Council for Science
IGAC	International Global Atmospheric Chemistry
IGBP	International Geosphere-Biosphere Programme
IGCO	Integrated Global Carbon Observation theme
IGOS	Integrated Global Observing Strategy
IHDP	International Human Dimensions Programme on Global Environmental Change
IOC	Intergovernmental Oceanographic Commission (of UNESCO)
IPCC	Intergovernmental Panel on Climate Change
JGOFS	Joint Global Ocean Flux Study
GWSP	Global Water Systems Project
LOICZ	Land-Ocean Interactions in the Coastal Zone
LUCC	Land-Use and Land-Cover Change
MISTRA	Foundation for Strategic Environmental Research (SWEDEN)
NASA	National Aeronautics and Space Administration (USA)
NSF	National Science Foundation (USA)
NWO	Netherlands Organisation for Scientific Research
PAGES	Past Global Changes
PICES	North Pacific Marine Science Organisation
SCOR	Scientific Committee on Oceanic Research
Sida	Swedish International Development Cooperation Agency
SOLAS	Surface Ocean - Lower Atmosphere Study
START	Global Change System for Analysis, Research and Training
UNESCO	United Nations Educational Scientific and Cultural Organisation
WCRP	World Climate Research Programme
WMO	World Meteorological Organisation

