

# GLOBAL CHANGE NEWSLETTER

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The International Geosphere-Biosphere Programme: A Study of Global Change (IGBP)  
of the International Council of Scientific Unions

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## The Second Scientific Advisory Council Meeting for the IGBP

3-7 September 1990, La Villette, Paris, France

The Scientific Advisory Council (SAC) advises on the scientific contents of the International Geosphere-Biosphere Programme, assesses its results and makes recommendations for the general policies of the Scientific Committee (SC) of the IGBP.

SAC is composed of representatives of National IGBP Committees, and scientists nominated by members of the International Council of Scientific Unions (ICSU) in all categories of membership. In addition, observers from other organizations, such as major UN bodies, are invited to attend SAC meetings. The SAC meets every two years under the chair-

manship of the ICSU President.

SAC I was held in Stockholm in October 1988. The French Ministry for Science and Technology hosted SAC II, which was appropriately held at the international conference center in the Cité des Sciences et de l'Industrie, a new science park at La Villette in Paris.

The principle activity of SAC II was to review and to give advice on the scientific research plan as presented in IGBP Report 12 "The Initial Core Projects". This publication marks the end of the initial planning phase and the transition, after three years, into the research phase to attain the IGBP objective as decided on by



*Dr. Hubert Curien, French Minister for Research and Technology, welcomed the delegates to the Second Scientific Advisory Council on September 3, at the International Conference Centre in the Cité des Sciences et de l'Industrie, Parc de la Villette, Paris.*

*"The Programme of the IGBP and the questions it addresses deserve particular attention. It is a great scientific adventure in that it is the largest international programme ever conceived; never has such an effort to globalize concepts and to set in motion so many united forces been undertaken. The programme is an entirely new challenge to scientists who are or will be devoted to it; never have they been more strongly solicited by social and economic forces rapidly to give irrefutable results on a group of themes as complex and as diversified."*

the ICSU 21st General Assembly (Berne 1986). An outline of the IGBP Core Projects was presented in Global Change NewsLetter No. 3, published early this year.

Several nations have offered generous assistance to enable a forceful development of the IGBP Core Projects. In particular, offers have been accepted to establish Core Project Offices for:

- International Global Atmospheric Chemistry Project (IGAC) Boston, MA, USA

- Joint Global Ocean Flux Study (JGOFS), Kiel, Germany
- Biospheric Aspects of the Hydrological Cycle (BAHC), Berlin, Germany
- Global Change and Terrestrial Ecosystems (GCTE), Canberra, Australia
- Past Global Changes (PAGES), Berne, Switzerland
- Data and Information Systems (DIS) Paris, France (co-sponsored by the USA)

In addition, a Core Project Planning office will be established for the Global

Ocean Euphotic Zone Study (GOEZO) in Wormley, UK.

The Scientific Advisory Council also noted the appointments by the ICSU Executive Board of the new IGBP Scientific Committee, taking office as of 8 September 1990.

Below follow the recommendations of SAC II, followed by the reports from the working groups on the Core Projects and the implementation and funding policy for the research programme.

## Recommendations of SAC II

The IGBP Scientific Advisory Council held its second meeting in Paris, 3-7 September 1990. The meeting was attended by members of ICSU, members of the Special Committee for the IGBP and representatives from 38 National Committees for the IGBP, as well as by representatives from 28 ICSU Unions, Interdisciplinary Bodies and Associates, and 15 International Organizations. The meeting had for its consideration IGBP Report 12, The Initial Core Projects. In addition, reports from National Committees and international organizations were distributed at the meeting. Four discussion groups prepared reports on the proposals for the initial projects, Data and Information Systems, Regional Research Centers, and the IGBP implementation strategy. The Scientific Committee for the IGBP should study all these reports at its forthcoming meetings in order to develop a coherent scientific programme based on the IGBP objective and underlying themes.

### 1. General Recommendations

• The Scientific Advisory Council notes that the publication of the research plan marks the end of the initial planning phase for the IGBP and the transition to implementation of research that addresses the IGBP objective "to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth system, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human activities."

• The Scientific Advisory Council further notes that the recommendations made at the First Scientific Advisory Council held in Stockholm, 24-28 October 1988, had been given due consideration by the Special Committee and had, wherever possible, been used in formulating the proposals presented to the Council in Paris.

• It is apparent that, taken as a whole, the proposed research plan enjoys a wide measure of support. The Second Advisory Council, accordingly recommends that Report 12 be accepted by the Scientific Committee as the basis for initiating the

research efforts of the IGBP, subject to consideration by the Committee of the following specific recommendations.

### 2. Specific recommendations

#### A. Established Core Projects

The establishment and continuing activities in relation to IGAC, JGOFS, BAHC, GCTE and PAGES were noted and supported. In addition, it recommends:

- that, recognizing that some overlap will occur between IGBP core projects and between these projects and other international programmes, and that in some cases the overlaps will be beneficial and others wasteful, the Scientific Committee should consider ways to manage such overlaps to the benefit of the IGBP and to minimize unnecessary duplication of scientific efforts and wastage of resources. The Scientific Committee should, therefore, continue to develop close working relationships with the WCRP and, when appropriate, to develop joint projects.

#### B. Proposed Projects

The need for the proposed projects STIB, GAIM and LOICZ was accepted in principle. It is recommended:

- that the Scientific Committee establish a Planning Committee to develop a science plan for STIB as soon as possible;
- that detailed planning is needed before LOICZ can be launched and that a Planning Committee should be established as soon as possible to advise the Scientific Committee on further developments; and
- that the central importance of GAIM for the entire IGBP effort to predict global change on the scale of decades to centuries be reiterated and the planning of detailed proposals be intensified.

#### C. Potential Projects

The preliminary proposals relating to GOEZO and GCEC were noted. It is recommended:

- that plans for GOEZO should be developed further with a wider scientific community and in consultation with SCOR; and
- that the development of GCEC await

the outcome of the SCOPE/IUBS/MAB study.

#### D. Key Activities

The Scientific Advisory Council notes the progress made in relation to DIS and recommends:

- that it is essential to ensure continuous long-term observations from space and the Earth's surface in order to develop adequate time series of important parameters and that mechanisms be developed for collecting, processing and disseminating the information; and
- that all countries have unhindered access to IGBP-related data at minimal cost. The Council notes the progress made concerning RRCs and recommends:
- The establishment of RRCs and associated networks for regionally-directed global change research;
- that it be accepted that RRCs will provide an important means of involving scientists from developing countries in IGBP work and in training activities; and
- that RRCs should be adapted to regional needs, as advised by the scientists of the regions.

#### E. Implementation and Funding

The Scientific Advisory Council recommends:

- that the IGBP maintain established links to governments, for example through the IPCC, and develop other appropriate means to communicate its findings to decision makers;
- that the Scientific Committee develop close working relationships with IGFA to ensure coordination between the planning and funding of Core Projects;
- that it be accepted that national research efforts contributing to the IGBP need not necessarily be costly and that significant contributions can be made through well-planned, low-budget national research activities;
- that the Scientific Committee continue its efforts to raise additional funds for scientists of developing countries to participate in IGBP activities; and
- that the coordinating activities of the

Stockholm Secretariat be maintained at an appropriate level in the future.

#### F. Other Important Matters

The Scientific Advisory Council *recommends*:

- that, noting the number of National

Committees having already integrated the human sciences into their global change activities and that a number of the already established Core Projects require a dynamic understanding of the human sources of global change, a working group be established jointly with the ISSC to ex-

plore the development of a project on land-use change; and

- that in order to enhance the flow of young scientists into the IGBP, national efforts should be directed to maintain and enhance environmental education programmes.

## Reports of SAC II Discussion Groups

### I Report of the Discussion Group on IGAC, STIB, JGOFS, GOEZO AND LOICZ

The participants posed a number of specific scientific questions to the conveners of each of the Core Projects. Only the broader subjects raised are recorded in this report.

#### *International Global Atmospheric Chemistry Project (IGAC) - An Established Core Project*

The importance of establishing an observational programme in the tropical atmosphere was noted. IGAC should place special emphasis on the establishment of observation stations in the tropics. It was recommended that the Scientific Steering Committee for IGAC, in consultation with other Core Projects, should seek to establish a network of observation stations in the tropics.

#### *Stratosphere-Troposphere Interactions and the Biosphere (STIB) - A Proposed Core Project*

STIB also requires stratospheric and tropospheric measurement programmes in the tropical and marine atmospheres. The importance of the relationship between the WCRP and STIB was stressed. The degree to which each of these programmes will address questions of stratosphere-troposphere interactions needs to be clarified. While STIB is not presently considering the biological consequences of the UV-B radiation, the data on UV from the STIB project will be of interest to other Core Projects. Biologists should be invited to participate in the planning of this component of the STIB project. It was recommended that the SC-IGBP should establish a Planning Committee for STIB as a matter of urgency.

#### *Joint Global Ocean Flux Study (JGOFS) - An Established Core Project*

Several participants provided information on specific programmes in marginal seas which might be included in JGOFS. While the project has concentrated on

open-ocean studies thus far, this issue is under discussion and is awaiting the further development of LOICZ. The discussion group recommended that the Scientific Steering Committee for JGOFS should interact with the proposed planning committee of LOICZ to consider the need for experiments in marginal seas.

#### *Global Ocean Euphotic Zone Study (GOEZO) - A Potential Core Project*

Concern was expressed about the level and detail of marine biology in the project. It was agreed that considerable consultation will be required with the biological oceanographic community as the development of plans for GOEZO proceeds. It was recommended that the SC-IGBP should take steps to develop the GOEZO project in consultation with SCOR. At an early stage in the development of more detailed plans for GOEZO, consideration must be given to the incorporation of an appropriate biological component in the project.

#### *Land-Ocean Interactions in the Coastal Zone (LOICZ) - A Proposed Core Project*

It was recognized that LOICZ, while complex, will be of great interest to all coastal states and provides a special opportunity for the involvement of the developing countries in the IGBP. Considerable scientific research on the coastal zone is being carried out at national, regional and global levels and involves many scientists and national and international organizations.

Concern was expressed at how much of this effort should be coordinated by an IGBP Core Project, as well as the extent to which the Core Project should be involved in site-specific studies of relevance to particular countries. The Project was not viewed as an integration of all ongoing coastal zone research, but rather a more focused attempt to examine coastal science issues of global significance common to most coastal states. It was stressed that a Planning Committee should quickly establish the most important common issues to be addressed on coastal studies in consultation with national IGBP committees and other international and regional

groups involved in coastal zone research. It was recommended that a Planning Committee for LOICZ should be established as a matter of urgency, with consideration being given to other active coastal zone research groups (e.g., SCOR, IGCP, COMAR, UNEP).

#### *General Comments:*

• Many Core Projects have common interests in measurements being taken at similar locations. There is a need to examine the commonalities of the observational programmes of the various Core Projects and to ensure that efforts are made to combine support facilities at observing stations to assist the measurement programmes.

Recommendation: That planning activities of the Core Projects involving measurement programmes be coordinated to ensure that where possible there is joint use of facilities such as land-based observing stations and research vessels.

• A need was identified for many countries to be involved in the experimental programmes of the Core Projects. Representatives from developing countries were concerned that they be involved in various experimental activities and it was agreed that the role of the SC-IGBP in facilitating such arrangements needs to be explored.

Recommendation: The science plans for the Core Projects should recognize the importance of involving scientists from developing countries as participants in specific research activities.

• Concern was expressed that there are still many issues of significance to IGBP which have not been identified as part of any existing Core Project (such as the problems of large inland lakes and seas). There are also cases of important overlap between projects where an issue of importance to two projects (such as biogeochemical processes in continental shelf and slope areas, a topic of relevance to both JGOFS and LOICZ) may be in danger of being neglected by both.

Recommendation: The SC-IGBP should recognize the existence of overlapping interests between projects and of issues of global significance which may have been neglected by Core Projects and to ensure the continued consultation and discussion of these matters.

## II Report of the Discussion Group on BAHC, GCTE, GCEC, PAGES and GAIM

### *Biospheric Aspects of the Hydrological Cycle (BAHC) - An Established Core Project*

Discussions are ongoing with WCRP concerning the nature of the linkage between BAHC and GEWEX. A joint working group has already been established on the major field experiments, e.g., for HAPEX type large-scale experiments (WCRP) and ISLSCP type smaller-scale experiments (IGBP). This may lead to even closer connections between BAHC and GEWEX as an outcome of ongoing efforts to streamline the organizational structure.

A major problem in BAHC from the perspective of modelling concerns the disparity in space and time scales between the General Circulations Models, the Land Surface Process Models, and the models of Ecosystem Dynamics. Both climate model and statistical weather forcing (or climate of the past) are needed as input to models of ecosystem dynamics.

A number of questions were raised concerning the role of vegetation in evapotranspiration. This influence may of course be studied in the context of today's climate, but it is important to understand how this might change in response to a change in climate. Such changes may have important consequences for run-off for example. It was suggested that palaeo-data might have a role to play as isotopic ratios will change in response to changes in stomatal resistance.

A good deal of discussion took place on the issue of the nature of the changes that are to be expected under a change of climate regime. Rather than smooth changes in vegetation type in a given region, the response will consist of a sequence of abrupt changes as critical environmental variables are exceeded. In order to make such responses "predictable" it is necessary to understand the way in which the probability distribution of extreme events changes in response to changing climate. It may be possible to verify the required models of abrupt transition by using palaeo-data and observed surface gradients.

Issues were raised concerning site-selection criteria for ISLSCP and HAPEX type field experiments. Site selection for SIFE (the Boreal Forest Experiment) has been completed and the experiment will be conducted on a transect from southern to northern Manitoba in Canada.

### *Global Change and Terrestrial Ecosystems (GCTE) - An Established Core Project*

The importance of major field experiments in this project was strongly highlighted (e.g., of the HAPEX - ISLSCP type). Discussions are ongoing concerning large-

scale transects - one of which is the geobiosphere traverse of the Americas that contemplates a pole-to-pole investigation along the west coast (and adjacent oceans) of South America, Central America, and North America. During the discussion of GCTE, Soviet scientists presented a proposal for a transect of similar scale called the Asian Ecological Meridian, a project that has been discussed and supported during several USSR - USA meetings.

It was pointed out that agricultural ecosystems need to be fully integrated into the main line of activities.

In connection with the intellectual focus of GCTE, it was suggested that the "second order" effects of changing climate on terrestrial ecosystems through changes in the incidence of pests and diseases (rather than directly) could be of major importance.

### *Past Global Changes (PAGES) - An Established Core Project*

There is very little data available on palaeo-environments in tropical lowlands and that this should perhaps be pursued in the form of an enlistment programme to identify persons interested in these areas and to begin to develop strategies for filling this important gap.

The interrelations between the PAGES project and the developing IUGS activity in global change were discussed. IUGS is awaiting the full development of the PAGES planning effort before finalizing its own programme, but intends to focus on time-scales longer than those taken to define Stream 1 (0-2000 yr BP) and Stream 2 (late Quaternary glacial cycles) of the PAGES research plan. Excellent coordination exists with INQUA.

One of the main products of PAGES will be palaeo-maps of past environmental conditions for specific times (perhaps times of extreme climate) that may be employed for purposes of model validation - of the same type as that previously produced in the context of the CLIMAP and COHMAP programmes.

### *Global Change and Ecological Complexity (GCEC) - A Potential Core Project*

It was suggested that this project was still too unfocused to warrant adoption as a Core Project. SCOPE currently is running a two-year project in this area and its activity may help to define the focus for a large-scale IGBP initiative. If this phase of activity were successful, the GCEC Activity might best be absorbed as a fourth stream under GCTE, but links to IUBS will be important.

### *Global Analysis, Interpretation and Modelling (GAIM) - A Proposed Core Project*

The issue was raised as to whether it was wise for the IGBP to be overly dependent on existing ocean-atmosphere numerical

technology and whether we should begin to promote serious work on new techniques with which "nesting" (an important issue in IGBP) might be more easily accomplished.

It was pointed out that the computational requirement for Global Environment Models were considerably higher than those for existing atmosphere-ocean GCMs. Very large investments in hardware will be required.

## III Report of the Discussion Group on DIS and RRC

### *Data and Information Systems (DIS)*

The meeting approved and supported the achievements accomplished so far. It was stressed that all countries should have access to the data and the cost of obtaining the data should be kept to a minimum.

The meeting recommended that the IGBP should maintain close contact with space research and the data community. The need to coordinate the Data Information Systems and the RRCs, or else to merge them, was stressed.

The decision to establish a DIS office, thus facilitating data coordination, was greatly appreciated. The establishment of data directories at various locations around the world and connected by communication network is a very positive step and should continue to expand.

The clarification of several issues was discussed, e.g., space and time resolution of the data sets; ways to proceed from the biomass index to a calculation of evapotranspiration; the role of major transects and interdisciplinary observation sites; establishing a global data base for the study of land-cover change. A suggestion was made to establish a reference level of the state of the environment.

### *Regional Research Centres (RRC)*

The great majority of participants recognized the importance of RRCs for the implementation of the IGBP. It was felt that scientists from developing countries should be more involved in the IGBP. Moreover, the RRCs should be one of the main mechanisms for achieving this.

In this connection it was also stressed that training and other ways to increase the capabilities of the developing countries' scientists are top priority areas for the RRCs. An RRC should be seen as a centre for coordinating and catalyzing the research activities in the region, e.g., networks for different projects, observatories, data bases, etc.

For the purpose of locating RRCs, it was suggested that the world be divided in accordance with the United Nations geographical regions. The scientific programmes of the RRCs should be formulated in terms of major regional environ-

mental problems which would then be matched with the IGBP scientific priorities.

It was accepted that RRCs should be established at the earliest opportunity. The structure and modes of operation need not be uniform and can be elaborated and refined in the process of creating the RRC. Selection of sites for RRCs should be made through regional consultations among the countries concerned. Existing institutions and expertise should be engaged.

It was suggested that each RRC has both a Scientific and a Steering (management) Committee. The former would be composed of scientists from the region, and the latter of the donors and governments/scientists.

The group stressed the need for a wide network of regional institutions related to each RRC. The establishment of an isolated centre might lead to a minimum of cooperation in the area. Therefore, when a centre is to be established, measures to integrate it in an effective network should be taken.

The RRC should serve the purpose of supporting and strengthening monitoring and experimentation sites, and, accordingly, intercalibration with instruments.

The staff of the RRC should be selected from the best available expertise in the region to ensure a high standard of excellence.

The group stressed that centralized efforts for funding and international support should be made available only to RRCs in developing countries.

Representatives from several countries offered to establish Regional Research Centres in the following regions:

- RRCs for Antarctica in Christchurch, New Zealand and Ushuaya, Argentina
- French national centre in Toulouse on interactions between biosphere, atmosphere and land use in arid zones, with networks in North Africa, Southern Europe and the Sahel
- Regional centres in China using existing networks with 30 years of research and very rich proxy data on climate
- RRC in Ensenada, Mexico, mainly on oceanography and sea/land interactions
- RRC in Israel, presently a desert research centre in the Negev, in cooperation with Egypt's desert development centre
- RRC in Ireland
- RRC in Italy

It was pointed out that this list is not exhaustive and that many more ideas and suggestions are in circulation among scientists. Suggestions should be sent to the Chairman of the Working Group on RRC and to the IGBP Executive Director, giving details of offers (building, facilities, access, financing, etc.)

The group encouraged the group meeting in Bellagio in December to take into account the above remarks and recommendations.

## IV Report of the Discussion Group on Implementation Strategy and Financing of Research

### *The meeting had three areas of concern:*

- 1) The use of national contributions to the IGBP.
- 2) The provision of research funding.
- 3) The financing of IGBP projects in developing countries.

1) The role of the Stockholm Secretariat was reviewed, and the need to provide adequate funding to ensure the maintenance of its planning and coordinating role. Detailed breakdowns of the budget were made available to the meeting.

The responsibilities of the different levels in the new programme structure were clarified.

Overall programme direction and co-ordination will be provided by the Scientific Committee and implemented by the Secretariat. The Secretariat will also be responsible for facilitating planning of new Established Core Projects, coordination between Projects, and overseeing the Regional Research Centres.

Scientific planning and coordination within Core Projects is the responsibility of the Core Project Office and Core Project Scientific Steering Committee. Foci will be determined and key Activities identified. Tasks contributing towards these activities and foci would be proposed and undertaken by individual groups of scientists and accepted according to local research project evaluation procedures.

2) The strategy for research funding was clarified:

Research within the Core Projects is funded through the normal research channels by means of direct agreements between researchers and funding agencies. The Secretariat or Core Project Offices do not handle research funding.

It is the responsibility of the Secretariat to obtain commitments from the countries participating in the IGBP and from other scientific agencies to fund the activities of the Secretariat and the Scientific Committee as well as Scientific Steering Committee meetings.

Support for Core Project Offices is provided by the host countries. Funds for their activities and planning meetings will be sought outside of core IGBP funding through the Secretariat.

Funding for Regional Research Centres in developing countries will be coordinated by the Secretariat. RRCs in industrialized countries should be funded mainly by those countries.

It is recommended that the funding and implementation strategy as outlined above be accepted as providing cost-effective, flexible support for the IGBP.

However, concern was expressed at:

- the shortfall in funding for the activities of the Secretariat
- the vulnerability of the Secretariat and its essential functions to funding fluctuations. This vulnerability could increase as Core Projects become established and absorb more funds from participating countries.

3) Because of time constraints, full discussion of the problems of developing countries was not possible. However, it was noted that it is important that developing countries should be involved in IGBP research projects in a truly cooperative way. The tendency of scientists from developed countries to undertake research in the Third World, and to take their data and conclusions back to their base without making this available to the host country is very much resented.

The following recommendations are proposed:

The IGBP must maintain the high quality of its science in order to attract the necessary funding. It must also develop a high profile in relation to international scientific agencies and to governments. Heads of major scientific funding agencies should be encouraged to attend the prestigious biannual Scientific Advisory Council meetings.

A strategy should be devised to maintain the interest of funding bodies in the progress of the IGBP. The ongoing work of the Core Projects could be used, with regular publication of activity results.

Care should be taken that as the Core Projects develop, the scientific community continues to interact with funding agencies in a coordinated and integrated manner.

The accountability for funds should be addressed at all levels. The value of the biannual SAC reports and the need for management committees for RRCs is stressed.

Every effort should be made to encourage National Committees to ensure that their financial contribution to the Programme is at a level proportional to their involvement in Global Change research.

It should be made clear that participation in the IGBP is not necessarily costly, and that significant contributions can be made by well-planned, low budget local research programmes.

A contingency fund should be established to give the Secretariat flexibility for rapid action when necessary. This fund should also be used to stimulate research where necessary, to ensure balance in core Projects if national funding is unobtainable.

# Membership of the Scientific Committee for the IGBP

*Chairman*

Prof. James J. McCarthy, Museum of Comparative Zoology, Harvard University, 26 Oxford Street, Cambridge, MA 02138, U.S.A.

Professor of Biological Oceanography; Director of the Museum of Comparative Zoology, Harvard University. Research interests include nutrient cycles in the sea, and processes that regulate marine production.

*Vice-Chairmen*

Prof. Bert Bolin, Kvarnåsvägen 6, S-184 51 Österskär, Sweden.

Former Professor of Meteorology at the University of Stockholm, Sweden Director of the International Meteorological Institute in Stockholm. Research in the fields of dynamical meteorology and numerical weather forecasting, atmospheric chemistry, biogeochemistry.

Dr. John A. Eddy, Director, Office for Interdisciplinary Earth Studies, UCAR, P.O. Box 3000, Boulder, CO 80307, U.S.A.

Co-Chair, Scientific Steering Committee on Past Global Changes (PAGES); President of the Commission on the History of Astronomy of the IAU. Research interests include solar physics, the history of solar behavior and of climate and the history of astronomy and archaeoastronomy.

Dr. Robert W. Stewart, 4249 Thornhill Crescent, Victoria, BC V8N 3G6, Canada.

Former Professor of Physics and Oceanography, University of British Columbia; President of the Alberta Research Council and Interim Director of the Centre for Earth and Ocean Research, University of Victoria. Research in plasma physics, underwater acoustics, turbulence (laboratory, ocean and atmospheric), boundary layer meteorology, air-sea interaction, physical oceanography, sea-level variation.

*Treasurer*

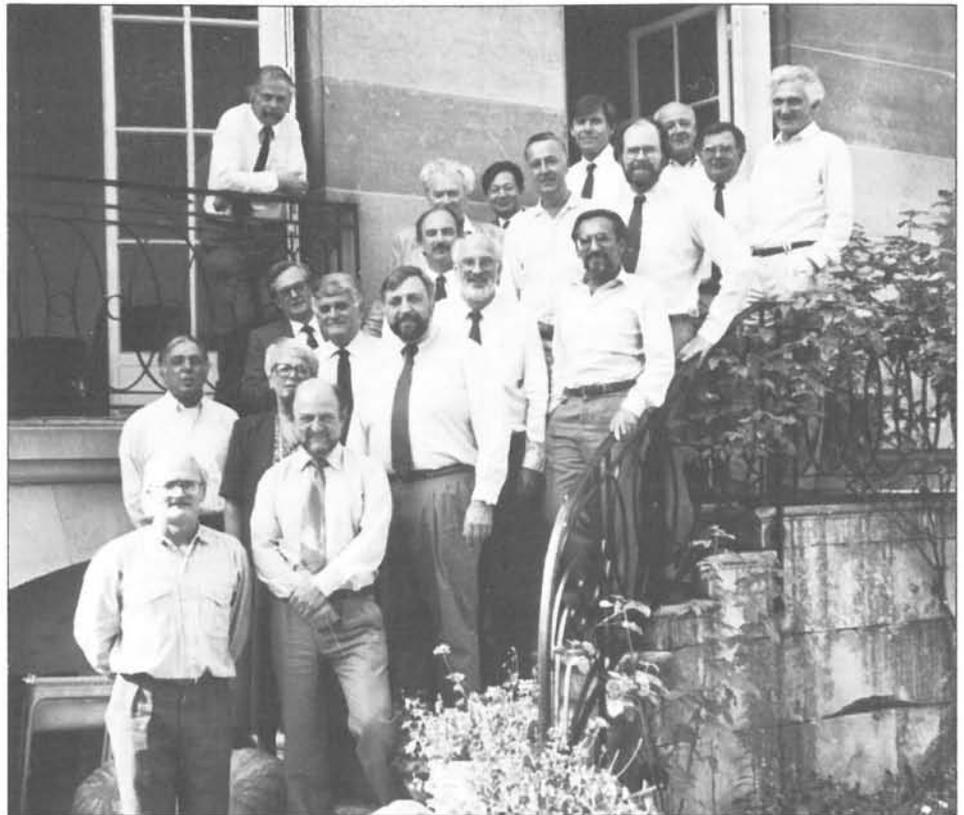
Prof. Peter S. Liss, University of East Anglia, School of Environmental Sciences, Norwich NR4 7TJ, UK.

Environmental Chemist. Professor in the School of Environmental Sciences; Chair, U.K. IGBP Working Group. Research in the field of ocean/atmosphere chemistry, in particular air-sea gas exchange.

*Executive Director*

Prof. Thomas Rosswall, IGBP Secretariat, the Royal Swedish Academy of Sciences, Box 50005, S-104 05 Stockholm, Sweden.

Professor at the Department of Water



*First Meeting of the newly appointed Scientific Committee for the IGBP, 8 September 1990, at ICSU Headquarters, Paris, France.*

*Left to right. Top row (window): Bernt Zeitzechel. Top row, stairs: Genady Golubev, Pierre Morel (WCRP), Richard Peltier, Vladimir Kotlyakov. 2nd row, Robert Stewart, Congbin Fu, Thomas Rosswall, James McCarthy. 3rd row: Peter Liss, Hans Oeschger, Hassan Virji (IGBP Secretariat). 4th row: Hans-Jürgen Bolle, John Eddy, Jerry Melillo. 5th row: S. Ichtiague Rasool, Marie-Lise Chanin, José Sarukhan, and last row: Brian Walker.*

*Absent during this part of the meeting were: Bert Bolin, Gordon McBean, Ronald Prinn, Sunesh K. Sinha.*

in Environment and Society, University of Linköping, Sweden; Past Secretary General of SCOPE (Scientific Committee on Problems of the Environment) of ICSU. Research in the fields of microbial ecology and biogeochemical cycles, especially nitrogen.

*Members*

Prof. Hans-Jürgen Bolle, Institut für Meteorologie, Freie Universität Berlin, Dietrich-Schäfer-Weg 6-10, D-1000 Berlin 41, Germany.

Chair, Scientific Steering Committee, Biospheric Aspects of the Hydrological Cycle (BAHC); Professor of Meteorology. Meteorologist, with research area in the application of remote sensing data for climate research.

Dr. Marie-Lise Chanin, Service d'Aéronomie du CNRS, B.P. 3, F-91371, Verrières-le-Buisson Cedex, France.

Chair, Core Project Planning Committee on Stratosphere-Troposphere Interactions and the Biosphere (STIB); Director of Research on aeronomy at the French National Centre of Scientific Research. Research fields include aeronomy of the upper atmosphere, physics and dynamics of the middle atmosphere and solar induced atmospheric variability.

Prof. Congbin Fu, Institute of Atmospheric Physics, Academia Sinica, Beijing 100011, China.

Professor in Meteorology; Director of Climate Research Laboratory, Institute of Atmospheric Physics, Chinese Academy of Sciences. Research in the fields of physical and dynamic climatology, climatic change, air-sea interaction and climate-vegetation interaction.

Prof. Genady N. Golubev, Faculty of Geography, Moscow State University, Leninskie gory, 119 808 Moscow, U.S.S.R.

Chair, Standing Committee on Regional Research Centres (RRC). Geographer, hydrologist; Professor and Head of Department of Physical Geography of the World and Geocology. Research interests include global environmental problems, water resources assessment and management, and system aspects of natural resources use and environmental management.

Prof. Vladimir M. **Kotlyakov**, Director, Institute of Geography, USSR Academy of Sciences, Staromonetny per. 29, Moscow 109017, U.S.S.R.

Geographer and glaciologist; President of the International Commission on Snow and Ice, research on the present-day regime and the past of the environment in polar and high mountain regions, problems of interaction of society and nature.

Prof. Gordon A. **McBean**, Atmospheric Sciences Programme, University of British Columbia, Department of Geography, Vancouver, B.C. V6T 1W5, Canada.

Chair, Joint Scientific Committee for the WCRP; Professor of Atmospheric Science, research on atmosphere-ocean interaction, role of storms in climate, and oceanic heat and water balances.

Prof. Jerry M. **Melillo**, Marine Biological Laboratory, Woods Hole, MA 02543, U.S.A.

Terrestrial Ecologist; Co-director of the Ecosystems Center; Principal Investigator of research projects in boreal, temperate and tropical ecosystems. Research fields include biogeochemistry and ecological modelling.

Prof. Hans **Oeschger**, Institute of Physics,

University of Bern, Sidlerstrasse 5, CH-3012 Bern, Switzerland.

Chair, Scientific Steering Committee on Past Global Changes (PAGES); Professor of Physics at the University of Berne; Director of the Department of Nuclear Geophysics. Principal Investigator of glaciology research projects in Greenland and Antarctica. Research on Earth system studies: radioisotope analyses, natural system modelling.

Prof. W. Richard **Peltier**, Department of Physics, University of Toronto, Toronto, Ontario M5S 1A, Canada.

Professor of Physics; Research in the area of geophysical fluid dynamics and the dynamics and evolution of the planetary interior and surface, especially mantle convection and palaeoclimatic change.

Prof. Ronald G. **Prinn**, Room 54-1312, Massachusetts Institute of Technology, Cambridge, MA 02139, U.S.A.

Chair, Scientific Steering Committee for the International Global Atmospheric Chemistry Project (IGAC); Professor of Meteorology, MIT Department of Earth, Atmospheric and Planetary Sciences; Director, MIT Center for Global Change Science. Research involves the chemistry, dynamics, and physics of the atmospheres of the Earth and other planets and the chemical evolution of atmospheres.

Dr. S. Ichtaque **Rasool**, Université de Paris 6, Tour 26, 4ème Etage, 4 Place Jussieu, F-75230 Paris Cedex 05, France.

Chair, Standing Committee on Data and Information Systems (DIS); Chief Scientist for Global Studies, NASA. Research on thermal structures of planetary at-

mospheres of Jupiter, Mars, Venus and the planet Earth.

Dr. José **Sarukhan**, Universidad Nacional Autónoma de México, Torre de Rectoría, 6o Piso, Ciudad Universitaria, 04510 México, D. F., México.

Rector of the National University of Mexico; Tropical plant ecologist with emphasis in population and ecosystem approaches.

Prof. Suresh K. **Sinha**, Professor of Eminence, Water Technology Center, Indian Agricultural Research Institute, New Delhi 110 012, India.

Plant Physiologist; Research on the impact of climate change on agriculture, drought resistance in crops, plant biochemistry, physiological genetics, physiological and biochemical basis of yield.

Dr. Brian H. **Walker**, Division of Wildlife and Ecology, CSIRO, P.O. Box 84, Lyneham, ACT 2602, Australia.

Chair, Scientific Steering Committee for Global Change and Terrestrial Ecosystems (GCTE); Chief, CSIRO Division of Wildlife and Ecology, previously Professor of Botany; ecologist with particular research interest in the dynamics of tropical savannas.

Prof. Bernt **Zeitzschel**, Institut für Meereskunde, Universität Kiel, Düsternbrooker Weg 20, D-2300 Kiel, Germany.

Chair, Scientific Steering Committee, Joint Global Ocean Flux Study (JGOFS); Professor of Biological Oceanography; Director of the Department of Marine Planktology in the Institut für Meereskunde at Kiel University. Research interests include processes that regulate the particle flux in the ocean.

## Meeting of the International Group of Funding Agencies for Global Change Research 4-6 July 1990, Bonn, Germany

Coordination of resource provision for research related to global change -- socio-economic, human dimensions, and natural science -- was the subject of a series of meetings which took place in Bonn, 4-6 July 1990. It was decided that the international group of funding agencies for global change research which had first met in January 1990 in

Washington, parallel with the first meeting of the National Committees for the IGBP, would become an informal working group, referred to as the "International Group of Funding Agencies for Global Change Research" (IGFA). This group will then serve as a forum for information exchange among national funding agencies on national and international

global change research, including funding requirements, education and training, and involvement of Third World countries.

The next meeting will be held in London 4-6 February 1991 in conjunction with the second meeting of National IGBP Committees.

# IGBP Regional Meetings

## IGBP in South America

Regional IGBP meetings are important to further strengthen involvement in the IGBP and promote regional cooperation. A number of such meetings are being planned and the first for South America was held at the Instituto de Pesquisas Espaciais (INPE), São José dos Campos, Brazil, from 5 to 9 March 1990. The meeting was attended by 35 scientists representing eight Latin American Countries. It was hosted by the Brazilian National Committee for the IGBP and INPE and sponsored by Unesco, OAS and TWAS. The objectives of the workshop were to:

- Review current global change issues in relation to South American ecosystems and important processes of special relevance to the region
- Review proposals for IGBP core projects and South American priorities for collaboration
- Review the concept of Global Change Regional Research Centres in a South American context
- Propose further measures to stimulate regional collaboration in the IGBP and with other relevant research programmes (e.g., Unesco: MAB, IOC, IHP, IGCP)

Working groups were set up to address four scientific areas of global change research: (i) Past global changes, (ii) Climate change and terrestrial ecosystems, (iii) The role of ocean processes in global change, and (iv) Land transformation and global change processes. These groups produced reports with detailed recommendations, which will be published shortly in the IGBP Report Series.

Some general recommendations will be included in the final report:

- There is poor recognition of the IGBP and the World Climate Research Programme (WCRP) at the national level, both within the academic community and in governmental bodies. It is essential that future meetings at the national and regional level are utilized to highlight the IGBP in general, and South American participation in IGBP core projects in particular.
- Specific regional projects should be developed as part of the international IGBP effort.
- Regional coordination must be improved and the national committees must play a crucial role in this context.
- Although global change research is a priority in many South American countries, the financial resources are very limited and it is essential to seek different avenues to increase funding available for such research.
- The establishment of a Global Change Regional Research Centre in the Amazon is a high priority.
- Technological cooperation is essential

both within the region and with other countries participating in IGBP research. In many cases equipment for advances chemical analyses are not easily available and supercomputers for global climate modelling are available in a few countries only.

- There is a need to develop scenarios of future climates in order to use these as a basis for assessments of future impacts on terrestrial and marine systems.
- There is a need to develop a directory of directories which can identify where data relevant to the pursuit of IGBP research is available.
- It is essential to improve the communication network within the region and between the region and the overall international effort. Existing teletail links need to be improved and the participating scientists must have access to such communication links.
- A regional newsletter should be developed. National Committees for the IGBP currently exist in the following South American countries: Argentina, Bolivia, Brazil, Chile, Colombia, Peru and Venezuela.

## IGBP in Africa

An IGBP planning meeting to discuss how to promote IGBP research in Africa was held in Lomé, Togo, on 13-14 March at the invitation of Professor K. F. Seddoh, Vice-Chancellor of the University of Benin. The meeting was sponsored by the IGBP, Unesco and the Commonwealth Science Council.

The objectives of the meeting were to: (i) discuss a plan for action with the aim to increase the participation of African scientists in the planning of research on the IGBP core projects, (ii) review the IGBP core projects and identify priorities for African research, (iii) review the activities of an ongoing survey of global change related research in Africa, which has been commissioned by the IGBP and the Commonwealth Science Council, (iv) review plans for a network of IGBP Global Change Research Centres and the proposal by President F. Mitterand to set up an Observatory for the Sahara and the Sahel, and (v) develop plans for an African regional workshop.

The following was discussed in relation to an IGBP implementation strategy for Africa:

- Encourage and facilitate the formation of IGBP committees in African countries. At present, committees have only been established in Egypt, Kenya, South Africa, Uganda, Zambia and Zimbabwe. National committees will be a crucial link between the national and international efforts. In countries where there are as yet no national committee, it is important to establish a correspondent, who should contact the appropriate scientific or governmental body to encourage the establishment of such a committee.
- A regional meeting will be held 22-26 July 1991 in Niamey, Niger to address the priorities for IGBP research in an African context. A small organizing committee for the meeting met in Niamey 9-10 July,



Participants at the ad hoc Meeting on African Participation in the IGBP Lomé, Togo, 13-14 March 1990. Top row, left to right: Dr. Pascal Affaton, Dr. K. S. Edjame, Dr. Jean-Louis Domergue, Prof. Isaac V. Nyambok, Dr. K. Koulekey, Dr. Shrikant Jagtap, Dr. Rindayi Chimonyo. Bottom row, left to right: Prof. W. B. Banage, Dr. Amadou Ndiaye, Prof. Thomas Rosswall, Prof. Komlavi F. Seddoh, Dr M.V.K. Sivakumar, Prof. Laban J. Ogallo, Dr K. A. Kekeh.

1990. The survey of African scientists involved in global change related research will be an important source of information to identify suitable participants.

For further information, please contact: Professor Thomas Rosswall, Executive Director, IGBP, Box 50005, The Royal Swedish Academy of Sciences, S-104 05 Stockholm, Sweden, tel: (+46-8) 16 64 48, fax: 16 64 05; or Dr. M. V. K. Sivakumar, ICRISAT Sahelian Center, P. O. Box 12404, Niamey, Niger, tel: (+227) 72 25 29, or 72 27 25, fax: (+227) 73 43 29.

### IGBP in Asia

An Asian Workshop on the IGBP will be held in New Delhi, from 11-15 February, 1991. The workshop is being organized primarily to familiarize the scientists of Asia about all aspects of the IGBP, the

importance of their participation in it, the scientific programmes relevant to individual countries and the region, and to encourage and enable the active participation of Asian scientists in the IGBP.

The scientific programme for the five day workshop will cover:

- Invited talks on the general framework and scientific programmes and approach of the IGBP,
- Presentations on IGBP related problems and programmes unique to the Asian region or of special concern (such as biomass burning; deforestation and its effects; sources and fluxes of methane production; the Asian monsoon; impact of sea-level rise in the Asian region; palaeoclimatic studies, etc.).
- Presentation of national plans and programmes for the IGBP,

• Identification of scientific objects and programmes where cooperation among Asian countries is desirable.

• Strategies for manpower training in the highly multi-disciplinary scientific content of the IGBP.

• Discussion sessions on items like information and communication, governmental support and funding, implications of long term commitment required, and location of IGBP Regional Research Centres.

The organizer of the workshop is Prof. R. R. Daniel, Chairman, National Committee of the IGBP for India, and the contact person is Dr. B. M Reddy, Chairman, Local Organizing Committee, Asian IGBP Workshop, National Physical Laboratory, Sir K. S. Krishnan Road, New Delhi 110 012, India. Tel: (+91-11) 58 76 57.

## Joint IGBP/WCRP Working Group on Land-Surface Experiments

The Global Energy and Water Cycle Experiment (GEWEX) is a major project of the World Climate Research Programme, with the objective of observing and modelling the global hydrological cycle and interactions of the atmosphere with the underlying land and ocean surfaces. In parallel, the Special Committee for the IGBP has established a Core Project on the Biospheric Aspects of the Hydrological Cycle (BAHC) aimed at understanding the linkages between biological and physical processes of the global hydrological cycle. Field experiments on various spatial scales will be essential for scientific progress required by both IGBP and WCRP, to study the one-dimensional and three-dimensional structures of atmospheric boundary-layer processes, the details of soil-vegetation processes and the effects of mesoscale inhomogeneities on land use and soil properties.

In order to promote inter-disciplinary cooperation in investigating simultaneously physical and biological aspects of land surface processes and to promote the organization of multi-disciplinary field studies, the SC-IGBP and JSC-WCRP have established a Joint IGBP/WCRP Working Group on Land-Surface Experiments. The specific terms of reference of the Working Group are:

(1) To advise the IGBP/BAHC and the WCRP/GEWEX on the optimal organization and international coordination of land-surface process field studies (especi-

ally those involving linkages between the atmospheric boundary layer, hydrology, vegetation and soils).

(2) To interact with the organizers of specific land-surface field experiments for the purpose of optimizing international efforts to study physical and biological processes of relevance to the IGBP/BAHC and the WCRP/GEWEX.

(3) To promote multi-disciplinary participation in these field experiments, to facilitate the exchange of information between various experiment teams, and to facilitate the access of experimental data and results to the scientific community at large.

The members of the Working Group are:

Dr. Jean-Claude André, Chair, Direction de la Météorologie Nationale, Etablissement d'Etudes et de Recherches de la Météorologie, Centre National de Recherche Météorologique, 42, avenue G. Coriolis, F-31057 Toulouse Cedex, France. Tel: (+33) 61 07 90 90, Fax: (+33) 61 07 96 00, E-mail: J.Andre (Omnet).

Prof. Hans-Jürgen Bolle, Institut für Meteorologie, Freie Universität Berlin, Dietrich-Schäfer-Weg 6-10, D-1000 Berlin 41, Federal Republic of Germany. Tel: (+49-30) 830 39 61, Fax: (+49-30) 793 17 85.

Dr. William J. Shuttleworth, Institute of Hydrology, Maclean Building, Crowmarsh Gifford, Wallingford, Oxfordshire OX10 8BB, United Kingdom. Tel: (+44-491) 388 00, Fax: (+44-491) 380 97.

Dr. Piers Sellers, NASA/GSFC Code 624, Hydrological Sciences Branch, Greenbelt, MD 20771, USA. Tel: (+1-301) 286 41 73, Telefax: (+1-301) 286 92 00.

Dr. Paul Jarvis, Department of Forestry and Natural Resources, Darwin Building, Mayfield Road, Edinburgh EH9 3JU, United Kingdom. Fax: (+44-31) 66 838 70.

Dr. Stephen W. Running, School of Forestry, University of Montana, Missoula, MT 59812, USA. Tel: (+1-406) 243 63 11, Fax: (+1-406) 243 45 10

Prof. Luiz C. Molion, UNITROP, Rua Rio Branco, Q. et C. 24, 69.053 Manaus, Amazonas, Brazil. Tel: (+55-92) 236 2535.

The first meeting of the Working Group was held at the Institute of Hydrology, Wallingford, U.K. on 24-26 January, 1990. The Working Group reviewed the status of HAPEX and ISLSCP-type field experiments conducted so far by various national/multi-national organizations and recommended a prioritized set of specific future experiments to be undertaken prior to they deployment of the Earth Observing System of satellites. The report of this meeting is available as a publications of the WCRP. The next meeting of the Working Group will be held in Baltimore, Md, USA, immediately following the spring 1991 AGU meeting.

# IGBP National Committees

National Committees for the International Geosphere-Biosphere Programme have been established in 46 countries.

The First Annual Meeting of National Committees for the IGBP was held on January 22-24, 1990, at the National Academy of Sciences, Washington, D.C.

The purpose of the meeting was to bring together the national committees for the IGBP to exchange views about their national plans, identify common interests and issues on which further collaboration between national committees could be pursued, and provide a forum for national committees to respond to and participate in the plans developed by the Special Committee for the IGBP.

The second meeting of representatives of IGBP National Committees will be held at the Royal Society in London, 4-6 February 1991.

Representatives of the International Group of funding Agencies for Global Change Research (IGFA) will be meeting at the Royal Society at the same time as the IGBP Group. At the IGBP meeting there will be sessions on progress within newly established and proposed core projects, results from the JGOFS North Atlantic Experiment, Regional Research Centres and the participation of developing countries in the IGBP (jointly with IGFA), global environmental research in the United Kingdom, and funding of the IGBP.

The areas covered by IGBP membership are marked in black in the above map; the Committees are listed below with the names of the Committee Chairperson(s).

## Argentina

Dr. Mario N. Nuñez, Departamento de Meteorología, Universidad de Buenos Aires, Pabellon 2 - Ciudad Universitaria, Buenos Aires 1428. Tel: (+54-1) 782 65 28, Telex: (33) 18694 ibuba ar, Fax: (+54-1) 311 05 16.

Dr. Osvaldo E. Sala, Departamento de Ecología, Universidad de Buenos Aires, Facultad de Agronomía, Av. San Martín 4453, Buenos Aires 1417, Tel: (+54-1) 52 09 03, Fax: (+54-1) 34 54 37.

## Australia

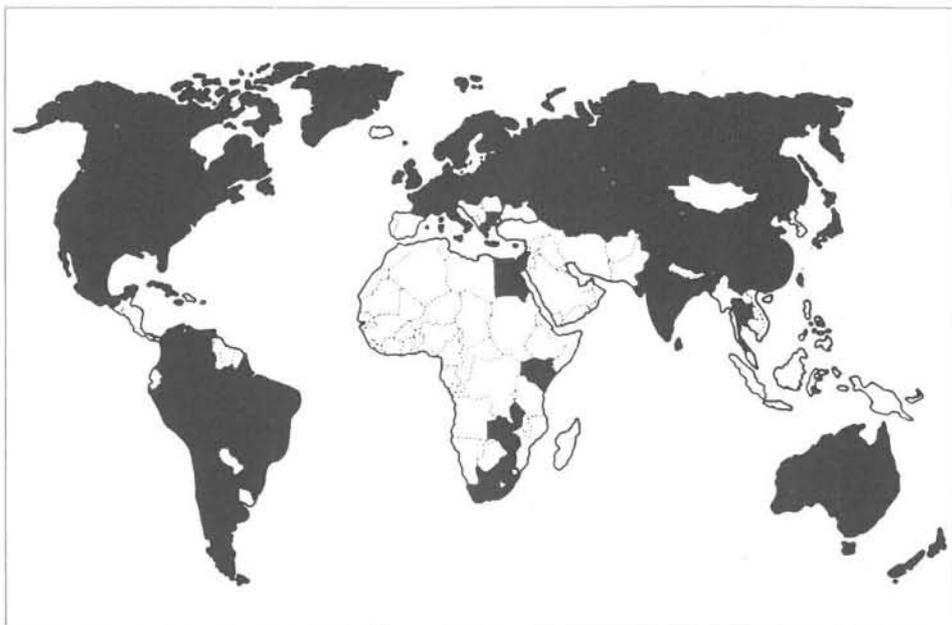
Prof. Bruce G. Thom, Department of Geography, Institute Building HO 3, University of Sydney, Sydney, New South Wales. Tel: (+61-2) 692 2886, Fax: (+61-2) 692 3644.

## Austria

Prof. Siegfried J. Bauer, Institut für Meteorologie und Geophysik, Universität Graz, Halbhärthgasse 1, A-8010 Graz. Tel: (+43-316) 380 52 56/55/61, Telex: (47) 31662 ubgraz A, Fax: (+43-316) 355 66.

## Bangladesh

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Present distribution of National IGBP Committees (October 1990)

## Belgium

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## Brazil

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### Ireland

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### USSR

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### Venezuela

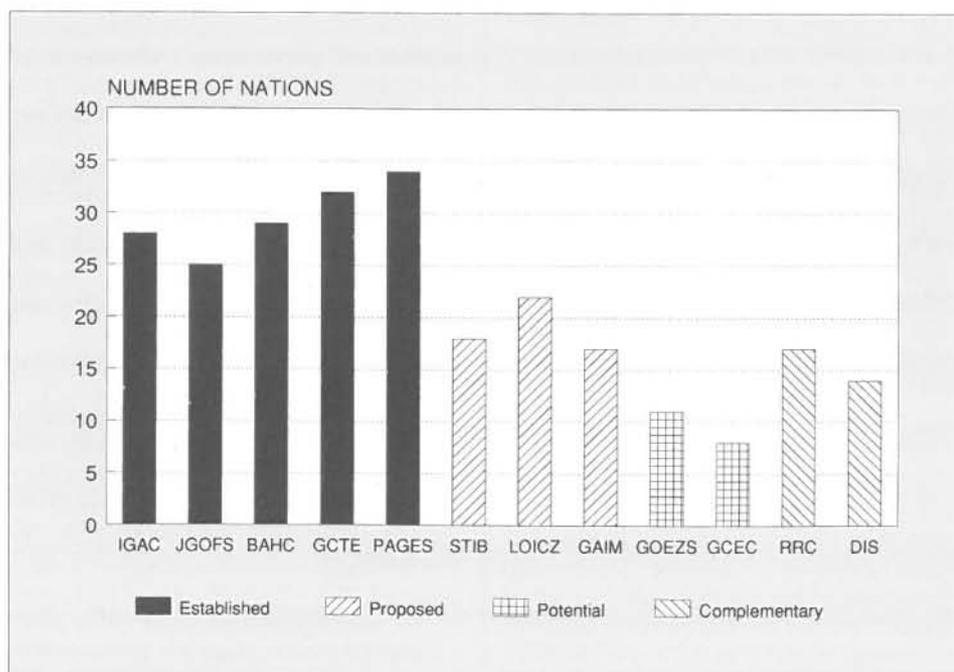
Prof. Federico Pannier, Academia de Ciencias Físicas, Matemáticas y Naturales, Apartado 1421, Caracas 1010A. Tel: (+58-2) 41 66 11 / 483 41 33, Telex: (31) 25205 cnit vc.

### Zambia

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### Zimbabwe

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Specifically expressed interest in IGBP Core Projects and complementary activities during the national reports to SAC II.

# Scientific Assessment of Climate Change

## IPCC Scientific Assessment

### Report from IPCC Working Group I

The Intergovernmental Panel on Climate Change (IPCC) was jointly established by the United Nations Environment Programme (UNEP) and the World Meteorological Organization (WMO) in 1988. Under the chairmanship of Professor Bert Bolin, the Panel was charged with:

- assessing the scientific information that is related to the various components of the climate change issue, such as emissions of major greenhouse gases and modification of the Earth's radiation balance resulting therefrom, and that is needed to enable the environmental and socio-economic consequences of climate change to be evaluated, and
- formulating realistic response strategies for the management of the climate change issue.

The Panel began its task by establishing three Working Groups to:

- assess available scientific information on climate change
- assess environmental and socio-economic impacts of climate change, and
- formulate response strategies.

It also established a Special Committee on the Participation of Developing Countries to promote, as quickly as possible, the full participation of developing countries in its activities.

Working Group I, under the chairmanship of Dr. John Houghton (Meteorological Office, Bracknell, UK), was charged with assessing the current scientific understanding of climate change. In this context the complementarity of the combined efforts of the WCRP and the IGBP is readily apparent. Whereas the first ten sections of the report assess present state of knowledge for the various aspects of the climate system, the eleventh and final section, entitled "Narrowing the Uncertainties: A Scientific Action Plan for Improved Prediction of Global Climate Change" is a description of the ongoing and planned projects of the WCRP and the IGBP. It lays out a timetable for a decade of well formulated research that is essential for addressing key unknowns and bringing increased precision to our quantitative understanding of climate processes. It calls attention to the fact that the WCRP and the IGBP plans are the result of many years of planning, and represent a consensus statement within

the international science community as to the most important questions to be addressed at this time. Governmental concern regarding climate change is increasing and the world-wide scientific community is prepared to commit to a comprehensive and timely suite of studies on this topic.

The full report of Working Group I, entitled *Climate Change, The IPCC Scientific Assessment*, edited by J. T. Houghton, G. J. Jenkins and J. J. Ephraums, was published by Cambridge University Press, Cambridge, UK, in 1990 (ISBN 0521 49360X Hardback, 0521 40720 6 Paperback).

Below is the Executive summary of the Policymakers' Summary of Working Group I:

### *We are certain of the following:*

- There is a natural greenhouse effect which already keeps the Earth warmer than it would otherwise be.
- Emissions resulting from human activities are substantially increasing the atmospheric concentrations of the greenhouse gases; carbon dioxide, methane, chlorofluorocarbons (CFCs) and nitrous oxide. These increases will enhance the greenhouse effect, resulting on the average in an additional warming of the Earth's surface. The main greenhouse gas, water vapor, will increase in response to global warming and further enhance it.

### *We calculate with confidence that:*

- Some gases are potentially more effective than others at changing climate, and their relative effectiveness can be estimated. Carbon dioxide has been responsible for over half the enhanced greenhouse effect in the past, and is likely to remain so in the future.
- The long-lived gases would require immediate reductions in emissions from human activities of over 60% to stabilize their concentrations at today's levels; methane would require a 15-20% reduction.

### *Based on current model results, we predict:*

- Under the IPCC Business-as-Usual (Scenario A) emissions of greenhouse gases, a rate of increase of global mean temperature during the next century of about 0.3°C per decade (with an uncertainty range of 0.2°C to 0.5°C per decade); this is greater than that seen over the past 10,000 years. This will result in a likely increase in global mean temperature of

about 1°C above the present value by 2025 and 3°C before the end of the next century. The rise will not be steady because of the influence of other factors.

- Under the other IPCC emission scenarios which assume progressively increasing levels of controls, rates of increase in global mean temperature of about 0.2°C per decade (Scenario B), just above 0.1°C per decade (Scenario C) and about 0.1°C per decade (Scenario D).

• That land surfaces warm more rapidly than the ocean, and high northern latitudes warm more than the global mean in winter.

• Regional climate changes different from the global mean, although our confidence in the prediction of the detail of regional changes is low. For example, temperature increases in southern Europe and central North America are predicted to be higher than the global mean, accompanied on average by reduced summer precipitation and soil moisture. There are less consistent predictions for the tropics and the southern hemisphere.

• Under the IPCC Business-as-Usual emissions scenario, an average rate of global mean sea level rise of about 6 cm per decade over the next century (with an uncertainty range of 3-10 cm per decade), mainly due to thermal expansion of the oceans and the melting of some land ice. The predicted rise is about 20 cm in global mean sea level by 2030, and 65 cm by the end of the next century. There will be significant regional variations.

There are many uncertainties in our predictions, particularly with regard to the timing, magnitude and regional patterns of climate change, due to our incomplete understanding of:

- Sources and sinks of greenhouse gases, which affect predictions of future concentrations;
- clouds, which strongly influence the magnitude of climate change;
- oceans, which influence the timing and patterns of climate change;
- polar ice sheets which affect predictions of sea-level rise.

These processes are already partially understood, and we are confident that the uncertainties can be reduced by further research. However, the complexity of the system means that we cannot rule out surprises.

### *Our judgement is that:*

- Global mean surface air temperature has increased by 0.3°C to 0.6°C over the last 100 years, with the five global mean warmest years being in the 1980s.

Over the same period, the global sea level has increased by 10-20 cm. These increases have not been smooth with time, nor uniform over the globe.

- The size of this warming is broadly consistent with predictions of climate models, but it is also of the same magnitude as natural climate variability. Thus the observed increase could be largely due to this natural variability; alternatively this variability and other human factors could have offset a still larger human-induced greenhouse warming. The unequivocal detection of the enhanced greenhouse effect from observations is not likely for a decade or more.

- There is not firm evidence that climate has become more variable over the last few decades. However, with an increase in the mean temperature, episodes of high temperatures will most likely become more frequent in the future, and cold episodes less frequent.

- Ecosystems affect climate, and will be affected by a changing climate and by increasing carbon dioxide concentrations. Rapid changes in climate will change the composition of ecosystems; some species will benefit while others will be unable to migrate or adapt fast enough and may become extinct. Enhanced levels of carbon dioxide may increase productivity and efficiency of water use by vegetation. The effect of warming on biological processes, although poorly understood, may increase the atmospheric concentrations of natural greenhouse gases.

#### *To improve our predictive capability, we need:*

- To **understand** better the various climate-related processes, particularly those associated with clouds, oceans and the carbon cycle.
- To **improve** the systematic observation of climate-related variables on a global basis, and further investigate changes which took place in the past.
- To **develop** improved models of the Earth's climate system.
- To **increase** support for national and international climate research activities, especially in developing countries.
- To **facilitate** international exchange of climate data.

### *The Scientific/ Technical Sessions of the Second World Climate Conference*

The Second World Climate Conference was convened in Geneva, Switzerland, from 29 October through 7 November, 1990, under the sponsorship of the World Meteorological Organization; the United Nations Environment Programme; the United Nations Educational, Scientific, and Cultural Organization and its Inter-

governmental Oceanographic Commission; The Food and Agriculture Organization; and the International Council of Scientific Unions. The scientific and technical sessions (29 October - 3 November) involved more than 700 participants from over 100 countries.

The Conference discussed the results of the first decade of work under the World Climate Programme (WCP), the First Assessment Report of the Intergovernmental Panel on Climate Change (August, 1990) and the development of the International Geosphere-Biosphere Programme (IGBP) and other relevant priorities, and programme structure for the future development of the World Climate Programme.

The complementarity of the WCRP and the IGBP in addressing the need to narrow the scientific uncertainties in the IPCC report was stressed repeatedly in the discussions and is also repeated in the conference statement.

The following excerpt from the conference statement addresses priorities for enhanced research and observational systems:

1. A consensus exists among scientists on the main aspects of climate change due to increasing greenhouse gases and aerosols, as summarized in the report of Working Group I of the IPCC. However, there is substantial scientific uncertainty in the details of projections of future climate change. Projections of future regional climate and climate impacts are much less certain than those on a global scale. These uncertainties can only be narrowed through research addressing the following priority areas:

- Clouds and the hydrological cycle;
- greenhouse gases and the global carbon and biogeochemical cycles;
- oceans: physical, chemical and biological aspects; and exchanges with the atmosphere;
- palaeo-climatic studies;
- polar ice sheets and sea ice;
- terrestrial ecosystems.

2. These subjects are being addressed by national programmes, the World Climate Research Programme and the International Geosphere-Biosphere Programme. Increased national support and substantially increased funding of these programmes is required if progress on the necessary time scale is to be made in reducing these uncertainties.

3. Present observational systems for monitoring the climate system are inadequate for operational and research purposes. They are deteriorating in both industrialized and developing regions. Of special concern is the inadequacy of observation systems in large parts of the southern hemisphere.

4. High priority must be placed on providing high-quality, long-term data for climate-related studies. Data should be

available at no more than the cost of reproduction and distribution. A full and open exchange of global and other data sets needed for climate-related studies is required.

5. There is an urgent need to create a Global Climate Observing System (GCOS) modelled on the World Weather Watch and the Integrated Global Ocean Service System, and including both space-based and surface-based observing components. GCOS should also include the data communications and other infrastructure necessary to support operational climate forecasting.

6. GCOS should be designed to meet the needs for:

- (a) Climate system monitoring, climate change detection and response monitoring, especially in terrestrial ecosystems;
- (b) data for application to national economic development, and;
- (c) research towards improved modelling and prediction of the climate system.

7. The main components of such a GCOS would be:

- (1) An improved World Weather Watch Programme;
- (2) the establishment of a global ocean observing system (GOOS) of physical, chemical and biological measurements;
- (3) the maintenance and enhancement of monitoring programmes of other key components of the climate system, such as the distribution of important atmospheric constituents (including the Global Atmosphere Watch), changes in terrestrial ecosystems, clouds and the hydrological cycle, the earth's radiation budget, ice sheets, and precipitation over the oceans.

8. The further development and implementation of the GCOS concept should be pursued with urgency by scientists, governments and international organizations. All countries must ensure a full and open exchange of the data sets needed for climate system research, process and impact studies, and modelling.

The following sections of the report are also of particular importance to the IGBP:

- Co-operation in international research.

1. The existing and planned research projects of the WCRP and the IGBP address the highest priority scientific issues related to the understanding and prediction of climate variability and change.

2. These programmes should be implemented completely and rigorously. It is particularly important that adequate funding, including long-term funding, be provided.

3. In view of the progress made in climate research, it is now timely to proceed to the detailed design of an operational global climate observing system, together with the data communications and other infrastructure needed to support operation-

nal climate forecasting. Governments should enter into early discussions aimed at international cooperation in operational climate forecasting and climate change research.

• Co-ordinated international activities.

1. The Conference endorsed the three streams of international activity:

(a) Continuing global measurement and research efforts through the WCP, IGBP, and other related international programmes;

(b) assessment functions of a continuing IPCC to support negotiation and administration of a Convention;

(c) development of a Convention on Climate Change for governmental action.

2. The UN Conference on Environmental and Development (Brazil 1992) provides a valuable opportunity to relate the above three themes to all the other environment/development issues and objectives being examined by the Conference. It is therefore essential that the three streams should interact effectively with UNCED.

## Resolution from the General Assembly of the United Nations, approved on 17 December 1989

(A/C.2/44/L.40 Rev.1)

At the Forty-fourth session of the Second Committee of the United Nations General Assembly, under Agenda item 85, entitled "Protection of Global Climate for Present and Future Generations of Mankind", the General Assembly,

*Recognizing* the need for additional research and scientific studies into all sources, causes and effects of climate change, ..

*Recognizing* the need for international collaboration, with a view to adopting effective measures on the question of climate change, within a global framework, and taking into account the particular needs and development priorities of developing countries;

*Concerned* that the participation of the developing countries in the Intergovernmental Panel on Climate Change remains limited, and stressing the need for the Intergovernmental Panel on Climate Change, in view of its intergovernmental nature, to do all that it can to ensure adequate participation and governmental involvement in its activities in accordance with United Nations practice,

1. *Emphasizes* the need to address with urgency the question of climate change as reflected in the conclusions of various important international meetings

2. *Recommends* that Governments, with due consideration of the need for increa-

# IGBP and related meetings in 1991

## 14-15 January, UK

World Climate Research Programme Workshop on the Global Climate Observing System (GCOS)

## 4-6 February, London, UK

2nd Meeting of Chairpersons of National Committees for the IGBP

## 4-6 February, London, UK

3rd Meeting of the International Group of Funding Agencies (IGFA)

## 11-15 February, New Delhi, India

IGBP Regional Meeting for Asia

## 18-22 February, Brighton, UK

Global Change and Terrestrial Ecosystems (GCTE) Core Project Open Meeting

## February, Boston, USA

International Global Atmospheric Chemistry Project (IGAC) Scientific Steering Committee

## 28 Feb-1 March, Stony Brook, NY, USA

Stratosphere-Troposphere Interactions and the Biosphere (STIB) Core Project Planning Committee Meeting

## 11-13 March, Mainz, Germany

Past Global Changes (PAGES) Scientific Steering Committee Meeting

## 18-23 March, Bremen, Germany

ICSU-WMO Joint Scientific Committee for the World Climate Research Programme (WCRP)

## March, Plymouth, UIC

Land-Ocean Interactions in the Coastal Zone (LOICZ) Core Project Planning Committee Meeting

## April-June

Regional Research Centres (RRC) Standing Committee Meeting

## April-June

Global Ocean Euphotic Zone Study (GOEZO) Core Project Planning Committee Meeting

## April-June

Global Analysis, Interpretation and Modelling (GAIM) Core Project Planning Committee Meeting

## 7-10 May, Asilomar, California, USA

Global Change and Terrestrial Ecosystems (GCTE) Focus 1 Meeting

## 2-4 June, Baltimore, Md, USA

Meeting of Joint IGBP/WCRP Working Group on Land-Surface Experiments

## 10-14 June, (Japan or Austria)

Global Change and Terrestrial Ecosystems (GCTE) Focus 2 Meeting

## July-August, Strasbourg, France

IGBP-Data and Information Systems (DIS) Data Validation Meeting

## 22-26 July, Niamey, Niger

Regional IGBP Workshop for Africa

## 29-31 August, Tokyo, Japan

3rd IGBP Scientific Committee Meeting

## 9-13 September, Wageningen, Netherlands

Global Change and Terrestrial Ecosystems (GCTE) Focus 3 Meeting

## September-November

Dahlem Conference. Global Changes in the Perspective of the Past

sed scientific knowledge of the sources, causes and impact of climate change and of global, regional and local climates, continue and, wherever possible, increase their activities in support of the World Climate Programme and the International Geosphere-Biosphere Programme, including the monitoring of atmospheric composition and climate conditions, and further recommends that the international community support efforts by developing countries to participate in these scientific activities;

3. *Urges* Governments, in keeping with their national policies, priorities and regulations, and intergovernmental organizations to collaborate in making every possible effort to limit, reduce and prevent activities which could adversely affect climate, and calls upon non-governmental organizations, industry and other productive sectors to play their due role.

## GLOBAL CHANGE NEWSLETTER

Global Change (IGBP) Newsletter  
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## IGBP Reports

No. 1. The International Geosphere-Biosphere Programme: A Study of Global Change. Final Report of the Ad Hoc Planning Group, ICSU 21st General Assembly, Berne, Switzerland 14-19 September, 1986 (1986) (Out of print).

No. 2. A Document Prepared by the First Meeting of the Special Committee, ICSU Secretariat, Paris 16-19 July, 1987 (1987) (Out of print).

No. 3. A Report from the Second Meeting of the Special Committee, Harvard University, Cambridge, MA, USA 8-11 February, 1988 (1988) (Out of print).

No. 4. The International Geosphere-Biosphere Programme. A Study of Global Change (IGBP). A Plan for Action. A Report Prepared by the Special Committee for the IGBP for Discussion at the First Meeting of the Scientific Advisory Council for the IGBP, Stockholm, Sweden 24-28 October, 1988 (1988) (Out of print).

No. 5. Effects of Atmospheric and Climate Change on Terrestrial Ecosystems. Report of a Workshop Organized by the IGBP Coordinating Panel on Effects of Climate Change on Terrestrial Ecosystems at CSIRO, Division of Wildlife and Ecology, Canberra, Australia 29 February - 2 March, 1988. Compiled by B. H. Walker and R. D. Graetz (1989).

No. 6. Global Changes of the Past. Report of a Meeting of the IGBP Working Group on Techniques for Extracting Environmental Data of the Past held at the University of Berne, Switzerland 6-8 July, 1988. Compiled by H. Oeschger and J. A. Eddy (1989).

No. 7. A Report from the First Meeting of the Scientific Advisory Council for the IGBP. Volumes I and II (1989).

No. 8. Pilot Studies for Remote Sensing and Data Management. Report from Working Group Workshop held in Geneva, Switzerland 11-13 January 1989. Edited by S. I. Rasool and D. S. Ojima (1989).

No. 9. Southern Hemisphere Perspectives of Global Change. Scientific Issues, Research Needs and Proposed Activities. Report from a Workshop held in Mbabane, Swaziland 11-16 December, 1988. Edited by B. H. Walker and R. G. Dickson (1989).

No. 10. The Land-Atmosphere Interface. Report on a Combined Modelling Workshop of IGBP Coordinating Panels

3, 4, and 5. Brussels, Belgium, 8-11 June, 1989. Edited by S. J. Turner and B. H. Walker (1990).

No. 11. Proceedings of the Workshops of the Coordinating Panel on Effects of Global Change on Terrestrial Ecosystems. I. A Framework for Modelling the Effects of Climate and Atmospheric Change on Terrestrial Ecosystems, Woods Hole, USA, 15-17 April, 1989. Edited by B. H. Walker. II. Non-Modelling Research Requirements for Understanding, Predicting, and Monitoring Global Change, Canberra, 29-31 August 1989. Edited by B. H. Walker and S. J. Turner. III. The Impact of Global Change on Agriculture and Forestry, Yaoundé, 27 November-1 December, 1989. Edited by S. J. Turner, R. T. Prinsley, D. M. Stafford Smith, H. A. Nix and B. H. Walker (1990).

No. 12. The International Geosphere-Biosphere Programme: A Study of Global Change (IGBP). The Initial Core Projects (1990).

No. 13. Terrestrial Biosphere Exchange with Global Atmospheric Chemistry. Terrestrial Biosphere Perspective of the IGAC Project: Companion to the Dookie Report. Report on the Recommendations from the SCOPE/IGBP Workshop on Trace-Gas Exchange in a Global Perspective. Sigtuna, Sweden, 19-23 February, 1990. Edited by P. A. Matson and D. S. Ojima (1990).

No. 14. Coastal Ocean Fluxes and Resources. Report of a CP2 Ad Hoc Workshop, Tokyo, Japan, 19-22 September 1989. Edited by P. Holligan (1990).

## Related Reports

Global Change Regional Research Centres: Scientific Problems and Concept Developments. September 25-29, Warszawa. Seminar papers and IGBP WG2 Report. Edited by Alicja Breymer. Warszawa, Institute of Geography and Spatial Organization, Polish Academy of Sciences, 1989. 181 pp. (Conference Papers, 6).

The International Science Plan for the Joint Global Ocean Flux Study. 1990. Copies may be obtained from Ms. E. Tidmarsh, Executive Secretary, SCOR, Department of Oceanography, Dalhousie University, Halifax, Nova Scotia B3H 4J1, Canada.

The International Global Atmospheric Chemistry (IGAC) Programme. A Core Project of the International Geosphere-Biosphere Programme. Edited by Ian E. Glabally. IAMAP Commission on Atmospheric Chemistry and Global Pollution (Mordialloc, Victoria, Australia. 1989). 55pp.

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## IGBP Personnel

Dr. Hassan Virji, Deputy Executive Director of the IGBP, returned to the United States in September 1990, after 17 months on secondment from the US National Science Foundation, where he will resume work in the Geosciences Directorate.

Dr. Dennis Ojima, Programme Officer, also returned to the United States in September to the National Research Ecology Laboratory, University of Colorado, Fort Collins. He was with the Secretariat from April 1988.

Both were crucial to the development of the science plan as presented in Report 12. We are all extremely grateful to them for their energetic work and long hours, and the successful completion of the task they had come to the IGBP to accomplish.



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