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THE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME: A STUDY OF GLOBAL CHANGE (IGBP)
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Beyond the Endless Frontier

Chris Rapley, Executive Director, IGBP

In 1947 Vannevar Bush provided United States President Roosevelt with a report which shaped attitudes towards scientific research in the USA and many other nations for the next four decades. 'Science - The Endless Frontier' made the following recommendations:

" (i) The health, prosperity, and security of a nation in the modern world depend on new knowledge that can be obtained only through basic scientific research.

" (ii) A proper concern of Government is to promote the flow of new scientific knowledge and to develop scientific talent in a nation's youth.

" (iii) The agency of the government responsible for attending to this concern should have:

- stability in funding
- an understanding of the peculiarities of scientific research...
- a recognition that freedom of inquiry must be preserved, with control of policy, personnel, and the method and scope of research left to the institutions in which

it is carried out (but with ultimate responsibility remaining with ...government)

" (iv) Science can be effective in the national welfare only as a member of a team. Scientific progress is a necessary but not sufficient condition for ensuring that welfare."

The principles encapsulated in the 'Endless Frontier' stood the test of time. Those nations which adopted strategies based on them experienced unprecedented improvements in health, quality of life, and material well-being, with science playing a key role.

However, attitudes towards science are changing, and Bush's principles are under attack. An implicit faith in the value of basic research is being replaced by a "cost-benefit" approach, in which researchers are required to justify in advance the likely economic returns on public investment in their work. This has some validity when dealing with applied research, but it ig-

nores or even denies the "peculiar nature" and underpinning role of basic research. Budgets are far from stable, resulting in uncertainty, disruption, and reduced rate of progress. More invidious is a trend towards politically motivated interference with the research agenda. All scientists should worry when global warming is publicly disclaimed by political figures as "at best ...unproven, and at worst ... *liberal claptrap*".

So how does this affect the IGBP? Our overarching aim is to provide a sound scientific basis for a future sustainable world. The magnitude and complexity of the task demands substantial stable funding over at least another decade, in order to allow the initial Core Projects and Framework Activities to complete their work. This will require a conviction on the part of the governments and agencies supporting the programme that the objectives are realistic and that there will be an appropriate pay off on their investment.

To maintain existing levels of funding

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for the IGBP, and to justify some urgently required increases, it is therefore imperative that the participants and supporters of the programme rally to its support. Much has been achieved, even at this relatively early stage, with substantial organisational strength having been established, and with major scientific results having been obtained. These must be articulated clearly, convincingly and widely. The IGBP *Global Change Newsletter* provides one platform for such material, and we encourage contributions.

The passing of an era may be regrettable, but there is good reason to be confident that by fully making known our existing successes, the "golden age" of the IGBP remains ahead.



From left to right: The Executive Directors of IGBP (Chris Rapley), the Human Dimensions of Global Environmental Change Programme (Ellen Wiegandt) and the World Climate Research Programme (Hartmut Grassl) at the IGBP Secretariat in Stockholm during the second of a newly established series of meetings aimed at ensuring close coordination between the three programmes.

First Open Science Meeting of Land-Use/Cover Change (LUCC)

Announcement and invitation to the LUCC Conference, hosted by the Royal Dutch Academy of Sciences, Trippenhuis, Amsterdam
January 29 - February 1, 1996

The IGBP and HDP announce the "Open Science Meeting" of the new approved core project/research programme on Land Use and Cover Change. The purpose of the meeting is to present and review the IGBP-HDP science plan and on-going research relevant to it. This will assist in outlining international and interdisciplinary collaboration on LUCC research.

LUCC is critically linked to the intersection of natural and human research on global environmental change. Changes in land cover contribute significantly to changes in the states of the biosphere and biogeochemical cycles. Such changes are driven by heterogeneous changes in land use and the continuation of those uses. Improved understanding of the dynamics of LUCC provide a means to project the impacts of land use and the consequent

land-cover changes and to assess possible responses to global environmental change. The IGBP and HDP have established a science plan (outlined in the next pages) for an interdisciplinary and international collaborative effort among the natural and human sciences to improve understanding of the critical linkages among global change, land cover and use sustainability, and the human and biophysical causes of change.

The First Open Science Meeting will present this plan to the community concerned and will launch a sustained programme of research on the subject. The meeting will have a series of presentations on the different research foci and activities of LUCC's science plan, as well as discussions by leading authorities and breakout sessions. Poster sessions on current research projects, and national and international activities relevant to LUCC, will be held on the following subjects: (i) assessments of the forces that impinge upon land managers and their land-use responses; (ii) studies of regional dynamics of land cover and use as gleaned from remotely sensed imagery and associated modeling activities; (iii) integrated models of use and cover; and (iv) LUCC classification and data issues.

For further information about the meeting, arrangements, and poster sessions, please contact Dr. D. Skole (until September 1995) or Dr. L. Fresco or Dr. R. Leemans (after September 1995):

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Thoughts on linking the physical and human sciences in the study of global environmental change

"A pragmatic approach is needed, perhaps centring on the identification of common problems that overlap the interests of the two realms and that allow each to pursue its favoured approaches as long as they can be brought to bear on the common problem. The study of global land-use change offers an example."

Billie L. Turner II, in: *Research & Exploration*, Spring 1991: 133-135

Linking the natural and the social sciences

The Land Use/Cover Change Core Project of the IGBP

Land-Use/Cover Change (LUCC) has been approved as a new Core Project of the IGBP, the first joint effort with the Human Dimensions of Global Environmental Change Programme (HDP), which also has approved LUCC as its first "research programme". It marks the end of the first phase of incorporating the social sciences into the IGBP, begun in 1990 with an agreement between the IGBP and the International Council for Social Sciences, represented by the HDP.

LUCC aims to improve understanding of (i) the human and biophysical forces that change land use and, hence, land cover and (ii) the environmental and social impacts of this change. It is directed in this mission by five major science questions:

1. How has land cover been changed by human use over the last 300 years?
2. What are the major human causes of land-use change in different geographical and historical contexts?
3. How will changes in land use affect land cover in the next 50-100 years?
4. How do immediate human and biophysical dynamics affect the sustainability of specific types of land uses?
5. How might changes in climate and global biogeochemistry affect both land use and land cover?

Investigating these questions requires research progress towards the following goals:

- Improvement of the data and data-based estimates for the major land covers and the changes in these covers for the last 300 years, with increasing spatial and temporal resolution for the last 100 and 50 years, respectively. (Questions 1 and 5)
- Determination of the spatial scale and pace of changes in the major land uses and covers, including cover conversion and modification. (Questions 1 and 3-5)
- Empirical identification of the major driving forces (exogenous variables) of land-use change as they relate to the land manager and use-system for critical land covers. (Questions 2-5)
- Empirical identification of the major

kinds of land-use/cover change dynamics operating throughout the world. (Questions 2-5)

- Refinement and development of new suites of geographically explicit land-use/cover models using both empirical-based diagnostic and behavioral-based regional approaches. (Questions 1 and 3-5)
- Refinement and development of new suites of prognostic land/use models capable of incorporating biophysical and climate impacts. (Questions 3-5)
- Determination of the sensitivity of such models for use in assessing future scenarios of land-use/cover drivers and conditions. (Questions 3-5)

To address these questions and research areas, LUCC establishes three research foci and two integrating activities.

Focus 1: Land-Use Dynamics-Comparative Case Study Analysis.

Land-use change must begin with the land managers that actually implement the changes in question. These land managers receive and interpret the signals from the complex array of factors in making their use decisions, even where their decisions are highly constrained.

Focus 1 seeks to identify the relationships among these signals, the land managers, and land uses for critical areas of the world: those contributing significantly to global systemic change (e.g., greenhouse gas emissions) and to global cumulative change (e.g., sustainability issues). Central in these relationships is the identification of the scalar linkages (spatial, temporal, and hierarchical) among the variables which will improve models seeking to link macro-signals (e.g., market) with local decisions. Systematic and comparative case studies will also be used to identify the typical patterns of land-use dynamics by critical areas throughout the world.

Focus 2: Land-Cover Dynamics-Direct Observation and Diagnostic Models.

The land uses undertaken by land managers have immediate and near-term land

cover impacts that are registered in ways that can be detected and monitored through satellite and other imagery. The resulting patterns of land-cover changes can be used to model near-term cover changes.

Focus 2 seeks to provide areal expression to the land-cover impacts of specific land-use dynamics through the use of remotely sensed imagery. The use-cover dynamics will be addressed by way of geographical information systems (GIS), permitting a range of spatially explicit analysis and outputs. Foremost among these, Focus 2 can be used to derive spatially explicit models of land-cover change that are useful for near-term projections of land-cover patterns.

Focus 3: Regional and Global Models-Framework for Integrative Assessments.

Ultimately, understanding the larger patterns of land-use/cover change requires integrated models linking multi-scalar forces, including biophysical ones, to which the land managers are responsive to the land-use and -cover outcomes.

Focus 3 seeks to improve upon existing and create new integrated LUCC models capable of being nested or coupled to the continental and global scales while maintaining geographic specificity. These models, in turn, can be used to project land-use/cover patterns over the longer term. It is equally important that they can be used to assess scenarios of different combinations of conditions, especially policy affecting land managers. This exercise also requires that models be subjected to sensitivity analysis.

The Integrating Activities address (i) Data and Classification, and (ii) Scalar Dynamics

The LUCC Science Plan will be published in the IGBP report series for presentation at the Fourth Scientific Advisory Council for the IGBP in Beijing, in October of this year.

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International Global Atmospheric Chemistry Project

Activities on Atmospheric Aerosols and on Rice Cultivation

Atmospheric Aerosols and their Effects on Climate: a new IGAC Focus

The International Global Atmospheric Chemistry (IGAC) Project was designed to address the growing international concern over the rapid changes observed in the Earth's atmosphere during the past few decades and their potential impact on human activities. IGAC is a joint project of the IGBP and the Commission on Atmospheric Chemistry and Global Pollution, a Commission of the International Association of Meteorology and Atmospheric Sciences, both of which are parts of the International Council of Scientific Unions (ICSU). IGAC was accepted in 1989 as one of the first Core Projects of the IGBP.

The long-term aim of IGAC is to develop models that integrate relevant biospheric and atmospheric processes for a wide suite of atmospheric species, contributing to a predictive capability for the atmosphere and Earth system as a whole under conditions of global change. IGAC is structured as five regional Foci (Marine, Tropical, Polar, Boreal, Mid-latitude), a Global Focus, and a Fundamental Focus. Each Focus consists of a number of Activities which comprise achievable endeavours addressing the major IGAC goals and objectives.

Early this year Ronald Prinn, Chair of the IGAC Scientific Steering Committee, and Peter Hobbs, Chair of the Scientific Steering Committee for the International Global Aerosol Programme (IGAP) announced the merging of IGAP with IGAC to form a new IGAC Focus on Atmospheric Aerosols. This merger will enhance significantly the important ongoing studies of atmospheric aerosol budgets, processes, and effects, and better link them to studies of the relevant gas phase chemistry and biospheric, geospheric, and anthropogenic processes.

1. The initial principal objective of the Aerosol Focus will be "To improve

understanding of the role of atmospheric aerosols in climate forcing and in the production of changes in the global climate and geospheric-biospheric processes".

2. The Merger Panel that was created on this occasion will oversee and develop the implementation plan for the new Aerosol Focus through at least October 1995. At that time the Panel will report on its activities to the IGAC-SSC, which will then consider whether continuance of the Panel is desirable.

3. The initial structure of the Aerosol Focus for consideration by the Merger Panel will be as follows:

Activity 1: Aerosol Formation and Evolution

Goals: (i) To understand the spatial-temporal distribution of chemical and physical aerosol properties, and (ii) to understand the physical and chemical factors that produce aerosol particles and control their evolution and physical, biological, and chemical properties.

Activity 2: Direct Radiative Forcing.

This will be divided into two Tasks: Remote Sensing and In-Situ Optical Properties.

Goals: (i) To relate optical properties (e.g., single-scattering albedo, asymmetry parameter, and optical depth) to the physical and chemical properties of the aerosols and atmosphere; (ii) to measure the solar and infrared radiation fields to directly obtain radiation budgets and to remotely sense aerosol optical properties; (iii) to measure radiative flux profiles, heating rates, and aerosol forcing, and (iv) to construct integrated data sets of aerosol properties, surface radiation budgets, radiative forcing at the top of the atmosphere, and vertical distributions of radiative heating and cooling rates.

Activity 3: Indirect Aerosol Radiative Forcing

Goals: To understand (i) the relationship between the physical and chemical properties of aerosols and the microphysical and radiative properties of the clouds that form them, and (ii) the relationships between the physical and chemical properties of clouds and the properties of aerosols that are processed or formed by clouds.

Activity 4: Stratospheric Aerosols

Goal: To quantify the sources, abundances, and sinks of stratospheric aerosols and to assess their role in stratospheric chemistry and climate forcing.

4. A workshop entitled *Atmospheric Aerosols: A New IGAC Focus* was held during the week of 10-14 July 1995 at the XXI General Assembly of the International Union of Geodesy and Geophysics in Boulder, Colorado, USA, to brief the international community on the new IGAC Focus, and to invite involvement in its detailed planning and implementation.

The foundation has now been laid for a comprehensive international research programme that incorporates physical, chemical, and biospheric studies to investigate the life cycle of aerosols and their effects on climate.

Ronald Prinn, MIT, Cambridge, MA, USA and Peter Hobbs, University of Washington, Seattle, WA, USA.

Mitigation of Methane Emissions from Irrigated Rice Agriculture

The total annual global source strength of atmospheric methane, an important greenhouse gas, is estimated to be 500 teragrams, with anthropogenic sources accounting for 340 teragrams. With an estimated sink strength of 460 teragrams per year, the annual increase of atmospheric methane is 40 teragrams. Methane emissions from flooded rice cultivation is currently estimated to be 60 teragrams per year; among the larger sources worldwide.

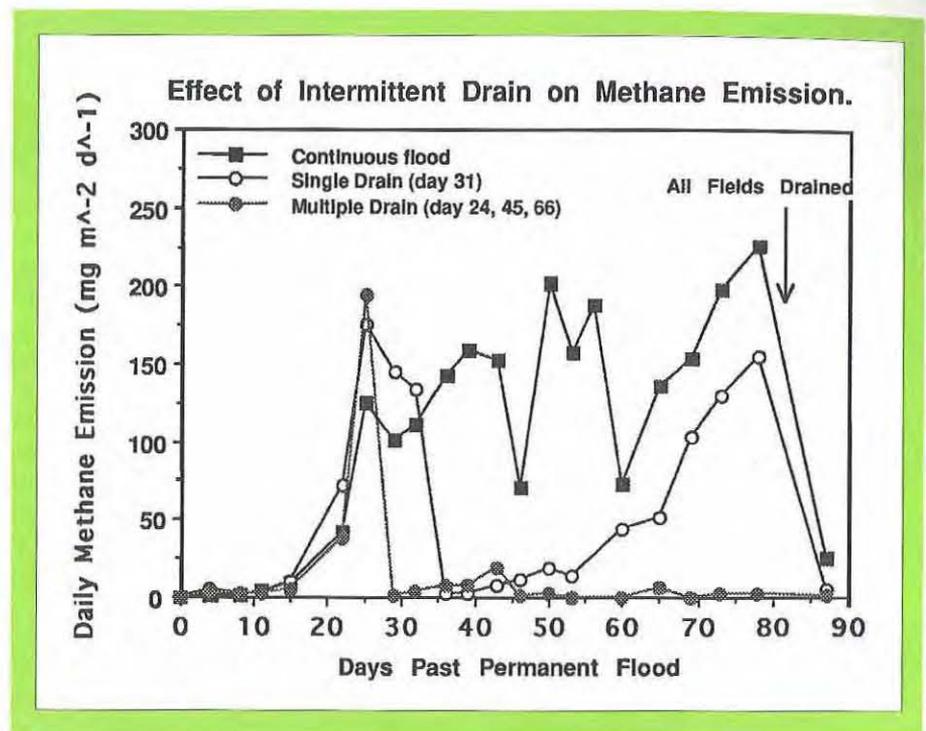
To meet the rice supply needs of growing populations, rice cultivation will continue to increase at or beyond its current rate. It is estimated, for example, that the world's annual rice production must increase from a 1990 value of 518 million

tons to 761 million tons by 2020 - a 47% increase - just to maintain current nutritional levels. Because arable land is highly limited in major rice growing areas, increased production has to be achieved mainly by intensifying cropping (i.e. two or three crops per year) rather than expanding the area of rice cultivation. Irrigated rice will continue to dominate production. Irrigated rice land now comprises about half the total harvested area but contributes more than two-thirds of the total grain production. With present agronomic practices, this will lead to increased methane emissions.

Because rice agriculture is one of the few sources of methane emission where management of the system is possible, it has become a critical focus of mitigation efforts. However, because rice is also the world's most important wetland crop and the primary caloric source of a large fraction of the world's population, mitigation efforts must be based on sound agricultural practices as well as good scientific judgement.

A primary mitigation 'switch' of the production and emission of methane is the presence of oxygen in the environment surrounding rice production. Removal of oxygen is normally through consumption by soil bacteria. The presence of the flood water impedes the diffusion of oxygen from the atmosphere into the soil and thus keeps it anoxic. It has been observed that a single drain of the flood water at the end of the vegetative stage allowed the soil to be reoxidized, reducing the seasonal methane emission by nearly 50%. Repeated drains every three or four weeks throughout the rice growing season, reduced seasonal methane emission by 88% without affecting grain yield (see figure). Methane emission reductions of approximately 50% were observed in intermittently drained plots when compared with continuously flooded Japanese rice paddies.

An important contributor to variations in observed methane emissions and a strong candidate for mitigation is the use of different rice cultivars. There are currently some 80,000 different rice cultivars available through the germplasm bank at the International Rice Research Institute in the Philippines and others are being sought. Most of these were developed for specific areas of the world and many are in current use. Yet, very few methane emission studies have considered cultivar differences. Methane emissions from eight different cultivars grown under similar conditions near New Delhi, India, differed by as much as an order of magnitude. A study of five



rice cultivar in irrigated fields near Beijing, China, indicated that methane emission during the tilling-flowering stage varied by a factor of two. A preliminary study using ten cultivars showed seasonal methane emissions ranging from 18.2 to 41.0 g m⁻². All three studies show a significant variation in methane emission that is solely dependent on cultivar choice. Selection by individual farmers could thus greatly influence regional and global estimates of methane emission from rice fields.

The wide variation of traits and related emission rates among cultivars opens the possibility for the choice of existing cultivars and the breeding of new cultivar as a method for mitigation of methane emission. However, the relationships between different cultivar characteristics and methane emission have yet to be elucidated. Some cultivars may have more or less efficient conduits for the removal of methane from the soil through the rice plant, others may deposit different amounts of organic matter in the soil during the growing season or may differ in the ability to transfer oxygen to the surrounding environment, thus altering the redox potential of the soil system or modifying the bacterial response of the rhizosphere. In other cultivars, differential allocation of translocatable carbon may even promote higher grain yield in preference to root processes and eventual methane production and emission.

The reported effects of different mineral fertiliser applications on methane emission are inconsistent. Researchers concluded that the type and method of application

strongly influenced methane emission rates. Some studies observed increased methane emissions with increased urea application, or reported large increase in emission after fertilisation with ammonium sulphate, while other studies show a decrease. Several scientists found that methane emission rates are affected by the method of fertiliser application. Many agree that the application of organic matter to rice paddies strongly increases methane emission rates over that from mineral fertilisation. Emission rates are dependent on amount, kind, and prior treatment of the organic components.

Current research efforts clearly indicate that realisable options are available to mitigate methane emissions from flooded rice fields. Successful implementation of these options will depend upon the collective acceptance by the rice farmers of Asia and the rest of the world. In order for that to happen, research results must be able to demonstrate that: (1) grain yield will not be decreased and may be increased by a particular mitigation practice, (2) that by adopting recommended mitigation practices the farmer will benefit through better water utilisation, reduction of labour, or a decrease in production costs, and (3) the rice cultivars that lead to reduced methane emission are those desired by local consumers.

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CH₄ Flux Measurement Standardization Experiment

As a result of planning meetings held last year at the International Rice Research Institute, Los Banos, Philippines, and in Tsukuba, Japan, IGAC's Rice Cultivation and Trace Gas Exchange (RICE) Activity Coordinating Committee proposes a retrospective analysis of the role of rice production on increasing atmospheric assessment of rice fields as a global source of atmospheric methane.

In order to carry out this proposal, the RICE Committee recommends a large global campaign to measure methane (and possibly N₂O) emissions from rice agriculture using a common standardized experimental approach. The RICE Committee invites all active research groups to participate in this campaign as part of their ongoing measurement programmes. The campaign will apply only to one field trial and should not be thought of as replacing the specific measurement programme of participating research groups. The global measuring campaign does not commit a research group to a new programme, but is

meant as a supplementary activity to allow for intercomparison of the ongoing research results of all participating groups.

This campaign should have a latitudinal approach as well as a country approach. Over 200 laboratories in all major rice growing regions of the world have been invited to participate. A detailed protocol, contained in a pamphlet entitled "Global Measurement Standardization of Methane Emissions from Irrigated Rice Cultivation" has been sent to each of these laboratories. Laboratories agreeing to participate are encouraged to conduct certain standardized emission measurements companion to their own individual experiments in order to obtain control flux measurements that will insure the intercomparability and intercalibration of extended data sets that may be generated.

The data from this program will be used to develop predictive process-level models of methane emissions and to link remotely sensed data on variables such as biomass, leaf area index, temperature and water depth to methane emission rates. Both the predicted values of methane emission and the values derived from remote sensing can then be incorporated into geographic information systems (GIS) to provide predictions of the effects of changes in rice cultivation on trace gas production, and to extrapolate methane emissions from core sites to regional and global scales.

It is anticipated from previous experimental studies that a data set of companion measurements will need to be taken along with seasonal methane flux measurements to accomplish these goals. The proposed standardization programme consists of a specified experimental plan for seasonal flux measurements along with specific accompanying data on location and climate, soil, water management, plant characteristics, fertiliser treatment, and a detailed cropping calendar. These data are considered to represent the minimum data set needed to characterise seasonal emission measurements for inclusion in a global survey aimed at resulting in a global assessment of atmospheric methane source values from irrigated rice fields.

The project will comprise a complete year of field data collection. Publication of the results will be the responsibility of individual research groups. The collective data set will be standardised for general use, and archived for general distribution on the internet by the US Trace Gas Network (TRAGNET). This network is part of the worldwide programme being established under the auspices of IGAC's Activity on Trace Gas Exchange: Mid-Latitude Ecosystems and Atmosphere.

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CLIMATE '95 BERLIN

The Climate Exhibition took place from April 4 -7, 1995, on occasion of the UN Convention on Climate Change Conference of the Parties. The German National IGBP Secretariat in Berlin was granted space within the exhibition hall to set up an International corner that comprised presentations from IIASA, WMO, WHO, and other multinational organizations.

The centrepiece, literally, was Phillip Williamson's exhibit on ICSU displaying the IGBP, WCRP and HDP, with painted panels and three-dimensional images giving an easily understood picture of the different aspects of Global Change.

Dr. Sabine Lütke-meier of the German IGBP Secretariat led the project and met the public. In addition, IGBP was also present as part of a group exhibit displaying the research activities of Berlin Universities.

FLUXNET: CO₂ flux monitoring network

Establishing a network of long-term flux measurement sites is determined necessary by the international scientific community. Three international bodies of scientists under the auspices of the IGBP, the Core Projects on Biospheric Aspects of the Hydrological Cycle (BAHC), Global Change and Terrestrial Ecosystems (GCTE), and the International Global Atmospheric Chemistry Project (IGAC), met to study strategies for CO₂ Flux Modelling at a joint workshop convened by Dennis Baldocchi and Riccardo Valentini in Italy in the spring of this year.

Between 5 and 9 March, 1995, an international multi-disciplinary group of 78 scientists (micrometeorologists, ecophysiologicals, biogeochemists, and biospheric modellers) from 19 countries assembled at La Thuile, Italy to report on experiments ranging from the arctic tundra to tropical rain forests. They discussed strategies for monitoring and modelling CO₂ and water vapour fluxes over terrestrial ecosystems, with a view to forming a global flux measuring network. The meeting was sponsored by US Department of the Environment, National Oceanic and Atmospheric Administration, and National Air and Space Administration, the Italian regional government of D'Aosta and the BAHC Core Project Office.

During the week discussions focused on:

- 1) the current state of continuous measuring of carbon dioxide and water vapour fluxes;
- 2) the problems and pitfalls associated with making long term flux measurements;
- 3) alternative methods for assessing ecosystem carbon dioxide and water vapour fluxes;
- 4) how direct and continuous carbon dioxide and water vapour flux measurements could be of use to the ecological and biogeochemical modelling communities, and;
- 5) if, how, and where to proceed with the establishment of a network of long term flux measurement sites.

Science Background

Our understanding of the global carbon budget based on knowledge of anthropogenic and natural sources and sinks of carbon, and the role of the terrestrial biosphere in global CO₂ fluxes is incomplete. First, only half of the anthropogenic CO₂ remains in the atmosphere and we do not know with

confidence whether the missing half of the emitted CO₂ is being sequestered in the deep oceans, in soils or in plant biomass, or what factors are modulating the annual increment of atmospheric CO₂. Second, global carbon budget analyses are unable to simulate latitudinal variations in atmospheric CO₂ and year to year variations in the annual amplitude of CO₂. Our current knowledge of regional and global carbon budgets stems primarily from long-term monitoring of CO₂ concentrations at a very limited number of sites. The workshop evaluated a strategy for creating a co-ordinated world-wide network of flux measurements in widely varying ecosystems and climates. This can lead to an independent global database which allows to quantify the fraction of anthropogenic CO₂ which is taken up by terrestrial ecosystems. Various methods of assessing carbon and water vapour fluxes were discussed at the workshop, including tower and aeroplane mounted micrometeorological techniques, leaf and soil chambers, sap flow and the use of natural isotopes.

Only a combination of methods can overcome limitations of individual techniques. The primary method to be adopted for a future global flux network is eddy covariance, measuring trace gas flux densities directly between biosphere and atmosphere from towers (measurements from small aircraft will be used, where available). This involves the near-instantaneous measurement of momentum and gas concentration (of CO₂, water vapour) of eddies (parcels of air) within and above the plant canopy, and exchanges between the canopy and the boundary layer. The method uses fast infrared gas analysers and sonic anemometers, providing real-time data acquisition and processing. The integration of the CO₂ fluxes yields an estimate of net flux into (or out of) the above and below-ground plant community (i.e. the whole system). Estimates of carbon gain in two deciduous forests suggest that between 2.2 and 5.8 tonnes of carbon per hectare may be sequestered annually.

These values exceed those usually quoted in literature (based on studies of

plant growth) and currently used in modelling studies. The continuous climatic controls and triggers of key ecosystem processes must be represented correctly in models for biomes. The non-growing season activity is important, because soil carbon decomposition occurs all year around, even in cold climates under snow packs. Understanding the terrestrial carbon cycle consequences of interannual climate variability, from ENSO events to Mt. Pinatubo anomalies, requires continuous ecosystem analysis, and models that have been demonstrated to be accurate over a wide array of conditions throughout the year.

Until now, there have been few studies in which modellers and experimentalists have fully collaborated. Only an integrated modelling and measuring approach can address contemporary problems associated with understanding biogeochemical fluxes, using a hierarchy of modelling approaches and scaling from the leaf, to the canopy, and upwards to the landscape, region or globe. Global terrestrial carbon models have progressed from simple aggregate budget calculations to relatively mechanistic models including key processes of photosynthesis, respiration and decomposition, specific to given biome types. Major large scale experiments have been run in a number of biomes to build understanding and tools for spatial scaling. The Hydrological-Atmospheric Pilot Experiment, the first International Satellite Land-Surface Climatology Project (ISLSCP) field experiment, the European International Project on Climate and Hydrological Interactions between Vegetation, Atmosphere, and Land Surfaces, the Oregon Transect Terrestrial Ecosystem Research, and Boreal Ecosystems Atmosphere Study (BOREAS) and BAHC have all had the common objective of developing energy budget techniques and remote sensing to spatially upscale terrestrial surface processes to regional landscapes.

Because of the large resource requirements for these projects, continuous measurements for multiple years are not common. Consequently, scaling in the temporal domain has not progressed as well as in the spatial domain. Continuous datasets of CO₂ fluxes and related variables over multiple years in different biomes are rare. New micrometeorological technologies have re-

cently been perfected that allow continuous flux measurements, and a few sites have begun this data collection. Relative to the high cost of the spatial scaling studies, these continuous flux studies are modest in financial requirement. Since these continuous time CO₂ flux datasets have immense value for global carbon and climate modelling, continuous flux measurements should be encouraged in an array of biomes and climates world-wide. These data are critical for validation and testing carbon balance simulation models. An organised flux network with standard measurement and data presentation protocols, and an active centralised archive, would make them available to the wider global change science community most quickly.

Although the primary science justification offered here is carbon balance-related, hydrologic balances are also of high importance, and will be an integral component of flux network measurements (as they were previously in the large-scale experiments). No carbon flux dynamics can be interpreted without the accompanying hydrological fluxes. Quantity and quality aspects of regional water resources are becoming increasingly important in global change science in its own right. The non-growing season is just as critical for hydrologic balances as it is for the carbon cycle. Continuous measurements of terrestrial hydrologic balance and evapotranspiration, and vegetation (carbon cycle) controls will contribute equally to producing better global hydrologic models.

Implementation ideas

By the end of the workshop, it was clearly established that long term flux measurements were both necessary and feasible in a variety of ecosystems. Areas were identified in boreal, temperate, Mediterranean and tropical forests, grasslands and wetlands on four continents (North and South America, Europe and Australia) where flux measuring sites were already planned or in operation.

From this plans were developed for the establishment of networks of existing and new sites to cover most ecosystems of interest for solving the global carbon balance equation. BAHC, IGAC and GCTE will seek sponsorship for a Steering Committee to provide quality control of existing and potential sites, to make procedural decisions on network data access and to confer on other details of operation.

Essential activities of this Steering Committee will include: (1) designing an instrument and model intercalibration plan, (2) standardising units, (3) choosing sensor locations, (4) developing uniform software

for raw data processing, (5) assessing procedures for missing data, and other actions for data quality assurance. A standard minimum protocol including a minimum set of reported variables is required for a flux network to allow comparisons amongst biomes/sites, and for ease of use of multiple data sets by other scientists and modellers. Continuous measurements for at least one year and archiving in the flux network data centre should be requirements for network sites. This minimum data set philosophy is meant to keep the costs and personnel requirements of operating a site low, encouraging as many sites globally as possible, particularly in developing countries. Advanced micrometeorological research sites that transmit only a subset of their data to the flux network may provide the test bed for instrumentation advances, intercalibrations, and personnel training for the standard sites.

A forthcoming issue of the international journal *Global Change Biology* will publish selected papers from the Workshop.

References:

- Baldocchi, D.D., B.B. Hicks and T.P. Meyers. (1988). Measuring biosphere atmosphere exchanges of biologically related gases with micrometeorological methods. *Ecology* 69:1331-1340.
Wofsy, S.C., M.L. Goulden, J.W. Munger, S.M. Fan, P.S. Bakwin, B.C. Daube, S.L. Bassow and F.A. Bazzaz. (1993). Net exchange of CO₂ in a mid-latitude forest. *Science* 260: 1314-1317.

Compiled by the BAHC Core Project Office from workshop reports

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BAHC First Science Conference

During the first week of April this year IGBP Core Project Biospheric Aspects of the Hydrological Cycle (BAHC) held its First Science Conference in Hamburg, Germany. The conference was jointly organised with the European Geophysical Society (EGS), in the framework of its XX General Assembly. This four-day conference was one of the main events in the short history of BAHC. The programme proved to be so scientifically attractive that over 350 abstracts were received from scientists from more than 40 countries. Each day featured one of the four foci of the BAHC research agenda:

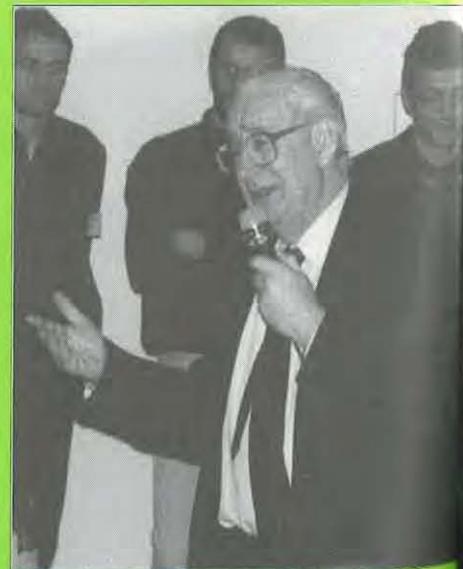
Focus 1: Development, testing, validation of 1 dimensional soil-vegetation atmosphere transfer models

Focus 2: Regional scale studies of land-surface properties and fluxes: experiments, interpretation and modelling

Focus 3: Diversity of biosphere-hydrosphere interactions: temporal and spatial variability

Focus 4: The Weather Generator Project

A fifth day, jointly organised by BAHC and the International Satellite Land-Surface Climatology Project (a component of the Global Energy and Water Cycle Experiment) provided an overview of two large-scale experiments in the boreal biome: the Boreal Ecosystems Atmosphere Study (BOREAS) and the Northern Hemisphere Climate Processes Experiment.



Jim Dooge, President of ICSU, at the BAHC Science Conference

To promote further interaction between the scientific, organisational and funding communities, two other events were part of the programme. A reception hosted by BAHC provided an opportunity for informal exchanges among colleagues and friends. The Panel Discussion allowed for a more formal, critical assessment of the BAHC science agenda.

The current status of BAHC's foci can be summarised as follows:

(i) Many soil-vegetation-atmosphere transfer models have been developed for equally as many field situations, and they cover the full range of relevant bio-physiological, atmospheric and soil physical processes. A refocussing may be needed from model development to rigorous testing and validation on coordinated, global and long-term datasets.

(ii) Past and recent regional studies suggest that vegetation parameters can be aggregated over a landscape by 'simple' rules, in contrast to soil parameters and topography. A discrepancy between meso-scale circulation effects which are present in models but absent in observations remains to be solved. A renewal of interest in below ground processes, together with an extension of temporal scales may be required. BAHC large-scale experiments are planned for the Amazon and the tundras, regions which are particularly sensitive to climate change.

(iii) Recent developments in global, dynamic vegetation modelling show a strong two-way interaction between climate and vegetation patterns, as well as a sensitivity of the latter to soil-water redirection. There is now a need for fully bi-directional coupled models of climate, vegetation and hydrology, that include anthropogenic forcings.

(iv) Dynamic and stochastic downscaling of large scale weather is well developed, but further work is required in applying stochastic methods across different regions and applications. Both dynamic and stochastic downscaling could profit from intercomparisons on standardised data sets that are now being compiled. The work on downscaling for weather generator development and data set collection has focused on temperate climates, and the next step is to focus on arid, semi-arid, and tropical climates.

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The IGBP 1994 Central Budget

During 1994, the total income of the IGBP central budget was a record USD1.5m. Contributions were received from 44 Nations (also a record), from ICSU, the CEC, and from the Dutch Electricity Generating Board. Figure 1 is a league table of contributing nations, in order of magnitude of contribution.

Total expenditure during the same period was USD1.4m. This covered the costs of all scientific planning meetings (51%), the operational costs of the Secretariat (43%), and publications (6%). Figure 2 displays the expenditure in these broad categories as a pie chart.

We are extremely grateful to all those individuals who worked hard and tirelessly on our behalf to ensure our central support during difficult financial times.

1	Russia	16	Argentina	31	Indonesia
2	USA	17	Norway	32	Singapore
3	Sweden	18	Canada	33	Egypt
4	Germany	19	China, Beijing	34	Sri Lanka
5	Japan	20	Austria	35	India
6	France	21	Denmark	36	Thailand
7	UK	22	Finland	37	Philippines
8	Italy	23	Czech Republic	38	Romania
9	Brazil	24	Hungary	39	Bangladesh
10	Belgium	25	Israel	40	Columbia
11	Spain	26	Poland	41	Estonia
12	Netherlands	27	South Africa	42	Kenya
13	Australia	28	Ireland	43	Togo
14	Switzerland	29	Slovak Republic	44	Jamaica
15	China, Taipei	30	Bulgaria		

Table 1: Nations contributing to the IGBP 1994 central budget, in order of magnitude

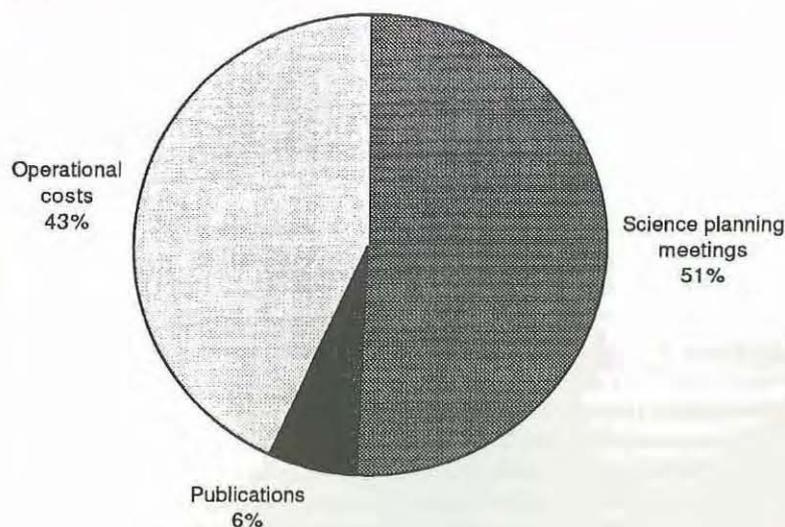
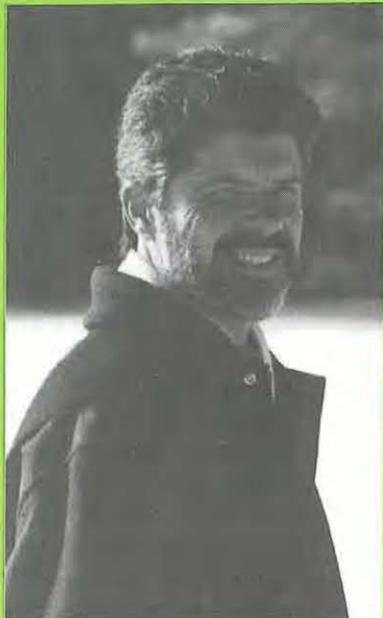


Table II:
IGBP 1994 Central budget expenditure in broad categories

People

At the IGBP Secretariat



João Morais

João Morais is the new Programme Officer for Social Sciences at the IGBP Secretariat in Stockholm, starting on 1 June, 1995. He comes to us from the Tropical Research Institute (ICT) in Lisbon, Portugal, where he has worked since 1988. In addition to his position at the ICT as Principal Researcher, Morais is Professor of "Methodology of the Social Sciences" at the Universidade Lusófona de Humanidades e Tecnologias (Portuguese University for the Humanities and Technology) in Lisbon, and Director of the University's African History Study Centre.

Prof. João Morais was born in Mozambique. He studied History at Lourenço Marques University (now Maputo University), where he started and directed the Department of Archaeology and Anthropology. He later received his PhD in Archaeology from Oxford University in the UK. His academic interests are in African archaeology, early farming systems, past global changes and environmental archaeology (issues on technological evolution and environmental change), and interaction processes in natural and social sciences.

In his new role, Prof. Morais will address issues on the links between the natural and the social sciences in the study of global change. The tasks ahead involve

work with the newly created Core Project on Land-Use and Land-Cover Change, and with research programmes in concert with the Human Dimensions of Global Environmental Change Programme, and the European Community's ENRICH project (European Network on Research in Global Change). Another task is collaboration with the Core Project on Land-Ocean Interactions in the Coastal Zone (LOICZ) on Economic and Social Impacts on Coastal Systems, Focus 4 of the LOICZ science plan. Professor Morais writes:

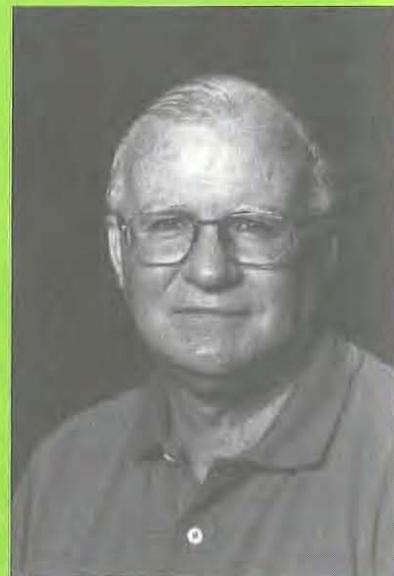
I am particularly happy with the fact that there is a growing awareness of the role of science in understanding and changing our world. Everyone is being affected one way or the other by global processes such as climate change, and one positive feedback is that there is a major engagement from public opinion to decision making in searching for solutions. The role of science is to provide some of those answers to the best of our knowledge.

In this challenging context, it is apparent that the frontiers of science are being tested with present-day strains: as processes have to be addressed globally, science has to be universally integrated. Local, regional and international organisations have to fully interact and collaborate to design and carry out research projects that should lead to solutions to urgent socio-economic and cultural problems occurring worldwide. Public opinion demands that science becomes "humanised", useful and more perceptible, and communities are pressing for higher standards of living and security. Policy making calls for fast answers and a quick return on investments made in science, something which scientists cannot promise either in timing nor in certainty.

The nature of the current change process is not different from changes affecting societies in the past: only the scale - now global - has changed. We have been engaged since the dawn of time in finding creative solutions to our problems and responses to our doubts. This process has cut across biological, spatial and cultural differences, as well as methodological ones. It is based on a "trial and error" approach in which a few new answers arise from a considerable number of questions. Science has therefore a better chance of success if built upon systemic and diversified networks intersecting the natural and the social, the basic and the applied, the quantitative and the qualitative. This shift of attitude will eventually take us to an approach whereby knowledge will be articulated between scientists, institutions and the

public at large, creatively participating in searching for better choices. I very much look forward to assisting the commitment for an integrated and collaborative scientific effort put together by the IGBP. I am encouraged that Social and Natural Science interaction is part of the IGBP agenda and that it is being carried within the Core Projects themselves in cooperation with a growing number of other international and regional initiatives, namely the Human Dimension Programme (HDP) and the European Network for Research in Global Change.

Honours



Billie Lee Turner II

Billie Lee Turner, II of Clark University's George Perkins Marsh Institute and Graduate School of Geography was recently elected to membership in the prestigious US National Academy of Sciences. Turner's election recognises his distinguished achievements in original research in archaeology, agriculture and land use, and global environmental change. Turner said he was honoured at his election to the academy, which required broad-based support from a number of other disciplines: "I am flattered that my research contributions are considered deserving of academy recognition," Turner said. He noted with thanks the influence of his colleagues in the Graduate School of Geography and the George Perkins Marsh Institute at Clark.

The Institute, which Turner directs, is dedicated to the study of the relationship between people and their environment and has been deeply involved in helping to establish the IGBP-HDP Core Project/Research Programme on LUCC (Land-Use/Cover Change). Turner is completing a year's sabbatical as a Fellow of the Center for Advanced Studies in the Behavioral Sciences in Stanford, California, USA.

The National Academy of Sciences is dedicated to furthering science and its use for the general welfare. The Academy was established in 1863 by a congressional act signed by Abraham Lincoln. It is called upon to act as official adviser to the federal government upon request, on any matter of science or technology.

Professor Turner was also awarded Honors for Scholarship by the Association of American Geographers in March, 1995 "for path-breaking scholarship on Mayan civilisation and cultural ecology, leadership in research on the human dimensions of global change, and distinguished contributions to the global change literature exemplified by 'The Earth as Transformed by Human Action.'"

Awards

Jean-Claude Duplessy, Director of the Centre des Faibles Radioactivités, Chairman of the French Scientific Committee for the IGBP, and member of the PAGES Scientific Steering Committee, was awarded the Milutin Milankovitch Medal 1995 by the European Geophysical Society at its 20th General Assembly in Hamburg in April of this year. The testimonial was given "in recognition of his outstanding contributions to isotopic geochemistry for



Jean-Claude Duplessy

the reconstruction of palaeo-oceanic circulations".

Dr. Duplessy studied physics and geology at the Ecole Normal Supérieure in Paris. He received the Agrégation de Physique in 1967, and submitted his doctoral thesis on "The geochemistry of carbon stable isotope in the sea" at the University of Paris in 1972.

He began his research at the Centre des Faibles Radioactivités (a joint laboratory of the Centre National de la Recherche Scientifique and the Centre des Etudes Nucléaires) by analysing speleothems in order to estimate the past air temperature at the surface of the continents. He then shifted his interest and used the variations of the isotopic composition of carbon and oxygen in planktonic and benthic foraminiferal shells to study broad aspects of marine palaeoclimatology and palaeoceanography. His research has given insight to variations in the monsoon intensity under glacial conditions, first evidences of changes in both the global deep water circulation and the location of major convection areas in the North Atlantic Ocean during the last climatic cycle, and made advances in the utilisation of Accelerator Mass Spectrometry carbon-14 dating to measure the rate of temperature change during the abrupt climatic changes of the last deglaciation.

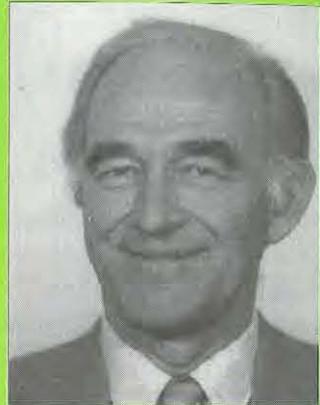
Blue Planet Prize

The prestigious Blue Planet Prizes of the non-profit Japanese Asahi Glass Foundation, were awarded this year to Maurice Strong and Bert Bolin.

The Asahi Glass Foundation was established in 1934 to provide financial assistance to researchers at public and private universities in Japan and abroad. The first Blue Planet prizes (two are awarded each year) for environmental issues were given in 1992. Both of the 1995 award winners are names familiar to the global change science community.

Bert Bolin is Director of the International Meteorological Institute, and Chairman of the Intergovernmental Panel on Climate Change (IPCC). His research is in the fields of dynamical, meteorology numerical weather forecasting, atmospheric chemistry, and biogeochemistry. He has long been advisor to the Swedish Government in matters of the environment.

Professor Bolin was one of the earliest leaders of the IGBP with his chairmanship of the *ad hoc* planning committee which



Bert Bolin

studied the prospects for founding IGBP during 1984-86. His willingness to commit his time and energy to the tasks of the initial Special Committee and its successor in 1990, the Scientific Committee for the IGBP, ensured that senior and seasoned leadership were available to guide the development of the programme at the early, critical stages.



Maurice Strong

Maurice Strong, 1995 recipient of the Blue Planet Prize, is Chairman of the Earth Council. Dr. Strong was the organiser of and driving force behind the first United Nations Conference on the Environment, held in Stockholm in 1972. He was later Chairman of the follow-up United Nations Conference on the Environment and Development in Rio in 1992.

Regional Research Networks

The European Community conducted a regional seminar for the former eastern bloc states, a regional workshop of the Global Change System for Analysis, Research and Training (START) focused on the needs of northern Africa, the Southeast Asian component of START introduces itself, and the Inter-American Institute for Global Change Research introduces its new Director

The European Network for Research in Global Change

The ENRICH Office of the European Commission organised a seminar in Budapest in September of last year at the invitation of, and in collaboration with, the Hungarian Ministry for the Environment and Regional Policy. The Regional Seminar, held at the Novotel Conference Centre in Budapest, was opened by the Hungarian Minister for the Environment and Regional Policy, Mr. F. Baja, and the Director General of The European Commission's Joint Research Centre, M. Jean-Pierre Contzen. In their welcome address, both confirmed the need for developing close east-west co-operation in the area of global change research.

The participants at the seminar included representatives from ten countries of Central and Eastern Europe and the former Soviet Union (Belarus, Bulgaria, Czech Republic, Hungary, Latvia, Lithuania, Poland, Romania, Russia, Ukraine), international programmes on global change research (World Climate Research Programme, the Human Dimensions of Global Environmental Change Programme, the IGBP, represented by Chris Rapley, Executive Director, and START), mem-

bers of the ENRICH Council, and representatives from the European Commission's services.

The objective of the seminar was to explore the possibilities of collaboration between the scientific communities and institutions of central and eastern Europe and the former Soviet Union, and those of the European Union/European Free Trade Association countries and the European Commission in the field of global change.

The seminar considered two main aspects, operational and scientific. Regarding the operational aspects, the seminar identified the needs for several actions. There was a consensus that emergence of multinational research projects (involving east-west collaboration) should be ensured through the identification of themes focusing on global issues. The preservation of existing long-term observational datasets was noted to be of utmost importance. There is also the need to ensure access to these and other databases, and to international scientific publications. It was recommended that ENRICH should provide help towards partner-search, both from different countries and different disciplines, considering the importance of interdisciplinary approach.

Many groups in the regions concerned will require support towards proper preparation and writing of research proposals. The need for having a coherence in the deadlines for the call for proposals of dif-

ferent EC programmes was stressed. There is a need also to raise the awareness of the importance of global change research at the level of the governments and funding agencies in the regions. The ENRICH Liaison Officers will make efforts in this respect. One of the main issues to be addressed is the improvement of communication links, e.g. setting up and use of e-mail networks. In addition, the urgent need of issuing an ENRICH newsletter with special issues for the various regions was stressed. It was felt that one of the important tasks of ENRICH should be to bring people together by, for instance, organising focused thematic workshops. Although ENRICH does not intend to write or rewrite a scientific agenda, possible scientific themes for co-operation with western Europe were identified with a view to providing joint contributions to the international programmes. These themes should include the following:

- Ecosystem research (interalia wetlands, tundra, forests)
- Land use sustainability (soils, desertification/erosion)
- Coastal zones and river systems (Baltic, Balkan, Danube)
- Arctic research
- Climate change modelling (utilising, or example, ECSN mechanism)
- Human dimensions research, in particular considering the economies in transition in the regions concerned

The seminar recommended that only those issues be addressed which are (i) global in nature and expected to have global impacts, (ii) global in nature but having possibly regional impacts, and (iii) regional in nature having possible global impacts. The proceedings of the regional seminar (including the position papers from the ten central and eastern European and former Soviet Union countries) will be published by the Hungarian Ministry for the Environment and Regional Policy in August of this year. For further information please contact:

Anver Ghazi, Head, ENRICH Office, European Commission, Rue de la Loi 200, B-1049 Brussels, Belgium. Fax: (+32-2) 295 0146.



LANDSAT image of Danube valley near the Hungarian border.

Desertification, Deforestation and Vegetation Change in Africa.

The Northern Africa Regional Committee for START (NAFCOM) workshop on desertification and vegetation change in Africa was held in the historical city of Yamoussoukro (renowned for its basilica and palace) in the Ivory Coast during December 1994. It followed immediately after a workshop at the same location of the International Global Atmospheric Chemistry Project (IGAC) activity on Deposition of Biogeochemically Important Trace Species (DEBITS). It was hosted by the IGBP National Committee for the Ivory Coast, and was attended by 25 scientists from universities and research institutions in the northern African region.

The purpose of the workshop was to develop a research agenda and implementation plans for the study of "Desertification, Deforestation and Vegetation Change: Impacts on and from Climate Change and Climate-driven Land Cover Change, including Biomass Burning" that was identified by African scientific community as a priority during the "Africa and Global Change" Workshop held in Niamey, Niger, in November. (see IGBP Reports No. 29 on the Niamey conference, and No. 31 "African Savannas and the Global Atmosphere, Research Agenda"). The other objective was to review state of the knowledge of land use/land cover change and its impacts on the climate of the region.

The workshop participants noted in particular for northern Africa the contributions to atmospheric chemistry made by biomass burning and desertification (soil dust). They decided to form an IGAC-DEBITS Steering Committee for Africa to initiate a network of measurements of dry and wet deposition fluxes of important chemical species (especially sulphur and nitrogen) at regionally representative sites in Africa in order to identify the relative contributions of natural and anthropogenic sources to the deposition fluxes in the region. These objectives will be addressed by an initial measurement programme comprising (i) rainwater sampling for chemical analysis, (ii) measurement of SO₂ and NO₂ concentrations from which to infer dry deposition fluxes, and (iii) collection of bulk aerosol samples for chemical analysis

from which to estimate dry deposition fluxes.

The African scientific community recognises the regional and global importance of anthropogenic emissions to the atmosphere of reactive nitrogen and sulphur, leading to (i) atmospheric acidity and acid deposition resulting in adverse effects upon plant, soil and water systems, (ii) elevated levels of aerosol haze, thought to have a significant forcing on regional and global climate, and (iii) other related effects, e.g. a role of emissions in increasing levels of tropospheric ozone.

The future direction of atmospheric deposition research in Africa includes bi-annual science meetings to present the results and review the status of the project, and maintaining close links with other national and international agencies, such as the World Meteorological Organisation, IGBP IGAC, The World Climate Research Programme, etc., which are involved in the estimation of atmospheric deposition.

For more information contact:

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SARCS The Southeast Asian Component of START

The Southeast Asian region of the Global Change System for Analysis, Research and Training (START), part of the tropical Asian monsoon area, is one of the initial regions prioritised for the establishment of the START network. The Southeast Asia Regional Committee for START (SARCS), formed to facilitate the establishment of the START network in this region, comprises representatives (IGBP National Chairs) from Australia, Brunei, China-Taipei, Indonesia, Malaysia, Philippines, Singapore, Thailand and Vietnam. The Chair of the committee for 1995-1996 is Prof. Twesukdi Piyakarnchana, from Thailand, and the Vice-Chair is Dr. Nguyen Huu Ninh, from Vietnam. SARCS, with advice from its Scientific Advisory Panel, works to promote activities aimed at developing, synthesising and interpreting regional data sets of key variables related to global change, thereby enabling indigenous analysis and the incorporation of these

data sets into global-scale modelling efforts.

The four primary objectives of the SARCS region are:

1. To improve estimates of greenhouse gas flux, especially in relation to changes in land use and land cover;
2. To integrate natural-social science assessments of changes in the coastal zones of the SARCS region;
3. To develop regional databases for use in global warming studies; and
4. To establish a regional research network for global change research, and lay the foundation for the creation of a regional research centre.

Activities that have been undertaken by the region to accomplish these objectives include pilot studies, data collection and inventories, workshops, training courses and fellowships. These activities of SARCS have been largely carried out in close collaboration with the relevant framework activities and core projects of the IGBP which address global atmospheric chemistry, land use and land-cover change, terrestrial ecosystems, land-ocean interactions in the coastal zone, and data and information systems. Representation of the IGBP and the Human Dimensions of Global Environmental Change Programme in SARCS has also served to ensure that linkages are established between the region, and international efforts.

Initial funding for SARCS activities was received from the Global Environment Facility, via the United Nations Development Fund, as part of a package of support for three START regions, international planning and co-ordination. In addition, SARCS has also obtained funding from other donors, as well as contributions from participating governments, notably Thailand where the SARCS Secretariat is located.

Beginning in mid-1993, a large proportion of the activities of SARCS was dedicated to studies related to the emission of greenhouse gases, and the impacts of land cover change on a regional and global scale. Recently, SARCS, in collaboration with the IGBP Core Project on Land-Ocean Interactions in the Coastal Zone, and the Netherlands Foundation for the Advancement of Tropical Research, has embarked on activities addressing the integration of natural and social science aspects of coastal zone research on the Southeast Asian region. Activities under the individual objectives of SARCS are scheduled to continue until 1999, and possibly beyond the year 2000, if funding is available.

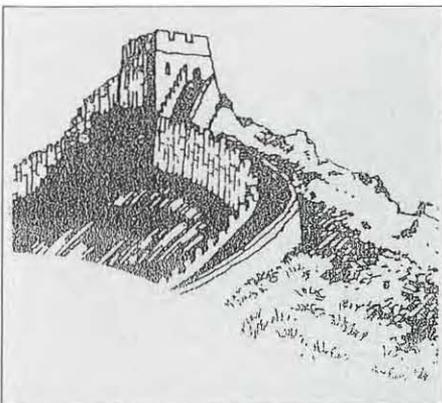
One of the more immediate tasks ahead

for SARCS in 1995 is the full establishment of a regional research centre at the Institute of Environmental Research, Chulalongkorn University, Bangkok, Thailand. The commencement of this task was the relocation of the SARCS Secretariat from its interim location at National University of Singapore (Industry and Technology Relations Office), to the planned location of the regional research centre at Chulalongkorn University on 1 June 1994.

Presently the SARCS Secretariat operates to co-ordinate the various activities of the programme. The establishment of the centre will involve an expansion of the role of the SARCS Secretariat to include, in addition to activity co-ordination, the functions of information dissemination, research and training, data and information system management, synthesis and modelling, and policy development, providing linkages to government authorities. Activities at the SARCS Secretariat/Regional research centre currently taking place include preparations for the instalment of work stations at the centre for regional and global networking, and preparations for a regional inventory of global change databases. Fulfilling the role of the centre is expected to be achieved over the next three years.

The SARCS Secretariat/Regional research centre is currently staffed by the Interim Technical Director, Jariya Boonjwat, the SARCS Project Manager, Beverly Goh and a small administrative unit. It is envisaged that the START/SARCS centre, in collaboration with other regional and international programmes on global environmental change, will play an important role in the expanding global change activities in the region, and contribute significantly to similar activities internationally.

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SAC IV, Beijing, 22-27 October 1995

New Director elected to the Inter- American Institute for Global Change Research

Armando Rabuffetti is the first director of the Inter-American Institute for Global Change Research (IAI). Dr. Rabuffetti was elected by the IAI Conference of the Parties at its second meeting in Rio de Janeiro, Brazil on April 28, 1995. Dr. Rabuffetti will assume his position in September 1995 at the IAI Directorate located at the Instituto Nacional de Pesquisas Espaciais (INPE) in Sao José dos Campos, São Paulo, Brazil.

Dr. Rabuffetti, a soil scientist, received his undergraduate degree from the University of Uruguay (1965), a M.Sc. in Agronomy from Iowa State University (1967), and a Ph.D. in Soil Science from North Carolina State University (1976).

He began his research and teaching career in 1964 as an undergraduate assistant in soil science at the Agronomy Faculty of the University of Uruguay, and became an Associate Professor in 1969 and Professor in 1978. From 1982-1985, he was the Dean of the Faculty of Agronomy. His research has been focused on fertiliser requirements of major cereal crops and pastures for different cropping systems.

Since 1986, Dr. Rabuffetti has been mostly involved in the organisation and administration of agriculture research. He first led the Task Force appointed by the Uruguayan government to design an institutional reorganisation of the agricultural research system aiming at the creation of an autonomous institute, the National Agriculture Research Institute (INIA), established in 1990. From 1990 to 1995, he has been the Director General of this Institute, with full responsibility for its general orientation, implementation and supervision and for its international technical co-operation and support.

His experience in the design and implementation of the National Agriculture Research Institution led him to serve as consultant to other countries and institutions on problems related to this area of management: Malawi, Africa, through the International Service for National Agricultural Research, and El Salvador, Central America, through the Inter-American Institute for Co-operation Agriculture. Pres-



Armando Rabuffetti

ently, he is a member of the Sustainable Agriculture Task Force of the Washington-based Consultative Group on International Agricultural Research (CGIAR), and a consultant to the CGIAR Technical Advisory Committee for a strip study on public policy, public management and international strengthening of CGIAR.

Dr. Rabuffetti has been able to devote 15% of his time to research in soil and crop management; he has been involved since 1993 in a project on "Cropping Systems for Sustainable Vegetable Production in Agriculture of Southern Uruguay."

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GLOBAL CHANGE NEWSLETTER

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The IGBP Report Series is an annexe to the Global Change NewsLetter

Publications

IGBP Report No. 33

Land-Ocean Interactions in the Coastal Zone. Implementation Plan (1995). Edited by J. C. Pernetta and J. D. Milliman. Stockholm: IGBP, 215 pp.

LOICZ is the component of the IGBP which focuses on the area of the Earth's surface where land, ocean and atmosphere meet and interact. The implementation plan describes the research, its activities and tasks, and the management and implementation requirements to achieve LOICZ's science goals. These are, to determine at regional and global scales: the nature of these dynamic interactions, how changes in various compartments of the Earth system are affecting coastal zones and altering their role in global cycles, to assess how future changes in these areas will affect their use by people, and to provide a sound scientific basis for future integrated management of coastal areas on a sustainable basis.

Write to: IGBP Secretariat, The Royal Swedish Academy of Sciences, Box 50005, S-104 05 Stockholm, Fax: (+46-8) 16 64 05, E-mail: sec@igbp.kva.se

Core Project Publications

IGBP-DIS

IGBP-DIS Working Papers

No. 10

A Global Database of Soil Properties: Proposal for Implementation, edited by R. J. Scholes (CSIR, South Africa), D. Skole (University of New Hampshire, USA), and J. S. Ingram (GCTE Focus 3 Associate Office, UK). January 1995, 33 pp.

No. 11

A First Step Towards a Reference ΔPCO_2 Map for the North Atlantic Ocean, edited by N. Lefèvre (LODYC, France). April 1995, 25 pp, includes diskette. No. 12

Global Primary Production Data Initiative project Description, edited by S. D. Prince (University of Maryland, USA), R. J. Olson (Oak Ridge National Laboratory, USA), G. Dedieu (CESBIO, France), G. Esser (Institute of Plant Ecology, Germany), and W. Cramer (Potsdam Institute for Climate Impact Research, Germany). April 1995, 38 pp.

Data and Information Systems. DIS Office, University Paris VI, Place Jussieu, F-75230 Paris Cedex 05m France. Fax: (+33-1) 44 27 61 71

GCTE

GCTE Report No. 3. GCTE Task 3.1.3: Global Change Impacts on Pastures and Rangelands. Implementation Plan. Edited by: Mark Stafford Smith, Bruce Campbell, Will Steffen, Steve Archer and Dennis Ojima. 59 pp.

Climate and Vegetation Change. The Influence of Changes in Climate and Carbon Dioxide on Biome Distribution. (1995). Interim report of the consortium led by Professor F. I. Woodward, December 1994. TIGER (Terrestrial Initiative in Global Environmental Research), Natural Environment Research Council, UK. 24 pp.

M. A. Beran, Institute of Hydrology, Crowmarsh Gifford, Oxfordshire OX10 8BB, UK, Fax: (+44-1491) 692 4320.

IGAC

IGACivities. Newsletter of the International Global Atmospheric Chemistry Project. Issue No. 1, June 1995.

IGAC Core Project Office, MIT, Bldg 24-409, Cambridge, MA 02139-4307, USA. Fax: (+1-617) 253 9887, E-mail: erobbins@mit.edu

Southeast Asia Regional Committee for START (SARCS)

SARCS Network News, Newsletter of the Regional Research Centre of Southeast Asia, Vol. 1, No. 1, January 1995.

Directory of Southeast Asian Scientists and Scientific Institutions Involved in Global Change Research, 1995. Edited by Orawan Siriratpiriya. SARCS Secretariat: Bangkok. 198 pp.

Beverly Goh, SARCS Secretariat, Institute of Environmental Research, Chulalongkorn University, Bangkok 10330, Thailand. Fax: (+66-2) 251 2952, E-mail: gohbp1@chulkn.chula.ac.th

National Publications

Finland

For the publications below, write to: The Academy of Finland, PO Box 57, FIN-05511 Helsinki, Finland. Fax: (+358-0) 7748 8299, E-mail: SILMU@aka.fi

The Finnish Research Programme on Climate Change: SILMU (1994). From

reconstructing past climate to studying the effects of possible future climatic changes. Helsinki: SILMU, 12 pp.

Carbon Balance of World's Forested Ecosystems: Towards a Global Assessment (1993). Report of the workshop held in Joensuu, Finland 11-15 May 1992, edited by M. Kanninen. Helsinki, SILMU, 308 pp. (Publications of the Academy of Finland 3/93)

The Finnish Research Programme on Climate Change. Second Progress Report (1994). Edited by M. Kanninen & P. Heikinheimo. Helsinki, SILMU, 308 pp. (Publications of the Academy of Finland 1/94)

Climate Variations in Europe. Proceedings of the European Workshop on Climate Variations held in Kirkkonummi (Majvik), Finland, 15-18 May, 1994, edited by Raino Heino. Helsinki: SILMU. Helsinki, SILMU, 308 pp. (Publications of the Academy of Finland 3/94)

France

Le Courrier de JGOFS-France, edited by Guy Jacques. Annual (1993 on-) Guy Jacques, Observatoire Océanologique, 66650 Banyuls-sur-mer, France. Fax: (+33) 68 88 16 99.

India

National Report on Indian Activities and Plans Related to International Geosphere-Biosphere Programme (IGBP), prepared by National Committee for IGBP, Indian National Science Academy (1994). Bangalore: Indian Science and Research Organisation, 160 pp.

Dr. M. K. Tiwari, ISRO Headquarters, Antariks Bhavan, New BEL Road, Bangalore 560 092, India.

ISRO-GBP in Action. Newsletter of the Geosphere Biosphere Programme of the Department of Space. No. 1, 1995.

Indian Space Research Organisation, Dept. of Space, ISRO-GBP Programme Office, 321 Antariksh Bhavan, ISRO Headquarters, Bangalore 560 094, India.

Japan

Global Fluxes of Carbon and its Related Substances in the Coastal Sea-Ocean-Atmosphere System. Proceedings of the 1994 Sapporo IGBP Symposium, 14-17 November 1994, Hokkaido, organized by the Japan National Committee for the IGBP. 558 pp.

Ken Ikehara, Marine Geology Department, Geological Survey of Japan, Higashi 1-1-3, Tsukuba, Ibaraki 305, Japan. Fax: (+81-298) 54 3533 or 3589

Monitoring Report on Global Environment, 1994. Center for Global Environmental Research, National Institute for Environmental Studies, Environment Agency of Japan. 40 p.

Monitoring Section, CGER, National Institute for Environmental Studies, 16-2 Onogawa, Tsukuba, Ibaraki 305, Japan. Fax: (+81-298) 58 2645, E-mail: cgermoni@nies.go.jp

Japanese JGOFS News Letter, edited by Isao Koike. No 1, October 1994. Isao Koike, Ocean Research Institute, University of Tokyo, Nakano, Tokyo 164, Japan. Fax: (+81-3) 5351 6461.

Malaysia

Global Change Research Directory Malaysia (1994). Edited by Lim Joo Tick & M. Subramaniam. National IGBP Committee of Malaysia, 61 p.

National Technical Committee for START Secretariat, Malaysia Meteorological Service, Jalan Sultan, 46667 Petaling Jaya, Selangor, Malaysia.

Netherlands

Towards Environmental Performance Indicators Based on the Notion of Environmental Space (1994). Report by Dr. R. Weterings, TNO Centre for Technology and Policy Studies, and Prof. dr. J. B. Opschoor, Free University, Rijswijk: RMNO, 138 pp. (Publikatie RMNO, 96).

RMNO, PO Box 5306, 2280 HH Rijswijk, The Netherlands, Fax: (+31-70) 336 4310.

Climate Research in the Netherlands (1995). National Research Programme on Global Air Pollution and Climate Change. Bilthoven: NRP, 58 pp.

NRP Programme Bureau, RIVM, PO Box 1, NL-3720 BA Bilthoven, The Netherlands. Fax: (+31) 3251 932.

Sweden

A Proposal for Strengthening Climate Modelling in Sweden, with an Overview of Swedish Climate Research Related to the World Climate Research Programme (WCRP). A Report issued by the Swedish National Committee for the IGBP and WCRP, September 1994. 48 pp. (Documenta, 59).

The Royal Swedish Academy of Sciences, Box 50005, S-104 05 Stockholm, Sweden.

Switzerland

Global Change Abstracts: The Swiss Contribution (1994). Edited by ProClim:

Forum for Climate and Global Change. Berne: Swiss Academy of Sciences, 33 pp. (GCA 95:1)
 Research and Monitoring of Climate and Global Change in Switzerland. Part I - Physical Climate System, by Anne Arquit-Niederberger. 1995. Final report of the Commission on Climate and Atmosphere Research in cooperation with ProClim. 49 pp.
 ProClim-Forum for Climate and Global Change, Bärenplatz 2, CH-3011 Berne, Switzerland. Fax: (+41-31) 312 55 37, E-mail: proclim@ubeclu.unibe.ch

USA

On the Full and Open Exchange of Scientific Data (1995), edited by the Committee on Geophysical and Environmental Data (Chair: F. Bretherton), Washington, D.C.: National Research Council, 21 pp.
 Anne Linn, Committee on Geophysical and Environmental Data, Board on Earth Sciences and Resources, National Research Council, 2101 Constitution Avenue, N.W., Washington, D.C. 10418, USA.

A Proposal to Launch a Seasonal-to-Interannual Climate Prediction Program. 1995. NOAA, 19 p.

National Oceanic and Atmospheric Administration, Office of Global Programs (NOAA/OGP), 1100 Wayne Avenue, Suite 1225, Silver Spring, MD 20910, USA. Fax: (+1-301) 427 2082.

Consequences: The Nature and Implications of Environmental Change (Quarterly). Spring 1995, Volume 1, No. 1. Edited by John A. Eddy. Saginaw Valley State University, 7400 Bay Road, University Center, MI 48710, USA. Fax: (+1-517) 652 8772, E-mail: jeddy@tardis.svsu.edu

Organisations

Commission of the European Communities

ELOISE. European Land-Ocean Interaction Studies Science Plan (1994). Report of an international workshop organised jointly by the Environment and MAST Programmes of DG XII of the European Commission, and the Netherlands Institute of Ecology, Centre for Estuarine and Marine Ecology. Edited by N. Cadée, J. Dronkers, C. Heip, J.-M. Martin and C. Nolan. Luxembourg: Office for Official Publications of the European Communities, ix, 52 pp.

Intergovernmental Panel on Climate Change (IPCC)

Climate Change 1994 (1995). Radiative Forcing of Climate Change, and An Evaluation of the IPCC IS92 Emission Scenarios, edited by J. T. Houghton, L. G. Meira Filho, J. Bruce, Hoesung Lee, B. A. Callander, E. Haites, N. Harris and K. Maskell. Reports of IPCC Working Groups I and III, forming part of the IPCC Special Report to the first session of the Conference of the Parties to the UN Framework Convention on Climate Change. Cambridge University Press, 339 pp.

CUP, The Pitt Building, Trumpington Street, Cambridge CB2 1RP, UK, or 40 West 20th Street, New York NY 10011-4211, USA.

International Association of Hydrological Sciences

For IAHS publications write to: IAHS Press, Institute of Hydrology, Wallingford OX10 8BB, UK, or Office of the Treasurer, IAHS, 2000 Florida Ave NW, Washington, DC 20009, USA

Snow and Ice Covers: Interactions with the Atmosphere and Ecosystems (1994). Edited by H. G. Jones, T. D. Davies, A. Ohmura & E. M. Morris. Wallingford, UK: IAHS Press, 498 pp. (IAHS Publication, 223).

Selected papers are presented from international symposia held at Yokohama, Japan, in July 1993, organised by the IAHS and the International Association of Meteorology and Atmospheric Sciences. The Symposium on "Snow Cover and its Interactions with Climate and Ecosystems" was jointly sponsored by the WCRP, the IGBP and UNESCO. The Symposium on "Processes of Mass Energy Exchange between the Atmosphere and Polar Surface" was sponsored by the Scientific Committee on Antarctic Research. The papers present a valuable study of the essential roles of snow and ice covers.

Variability in Stream Erosion and Sediment Transport (1994). Edited by L. J. Olive, R. J. Loughran & J. A. Kesby. Wallingford, UK: IAHS Press, 498 pp. (IAHS Publication, 224).

Proceedings of an international symposium held at Canberra, Australia, 12-16 December 1994, organised by the Department of Geography and Oceanography, University College, University of New South Wales, Australian Defence Force Academy, and the International Commission on Continental Erosion of the International Association of Hydrological Sciences. The chapters cover soil erosion, sediment transport and sediment tracers, flood plains and lake sedimentation, large basins and regional variation, small basins, human impacts, and research techniques.

IGBP Collaborators

Global data sets for the land from the AVHRR, edited by John R. Townshend. in: *International Journal of Remote Sensing*, vol. 15, no. 17, 20 November 1994, pp. 3315-3639.

The Advanced Very High Resolution Radiometer (AVHRR), one of the most important sensors for monitoring the terrestrial environment at resolutions of 1 km to very coarse resolutions of 15 km and greater, has led to the production of global data sets that are described here.

Taylor and Francis Ltd., 4 John Street, London WC1N 2ET, UK

The Ocean Observing System Development Panel. 1995. Scientific Design for the Common Module of the Global Ocean Observing System and the Global Climate Observing System: An Ocean Observing System for Climate. Department of Oceanography, Texas A&M University, College Station, Texas, 165 pp.

Write to Dr. Worth D. Nowlin Jr, Department of Oceanography, Texas A&M University, College Station, Texas 77843-3146, USA. Fax: (+1-409) 845 0888.

On the Web

URLs available in July 1995 to Web sites

Biospheric Aspects of the Hydrological Cycle (BAHC)
<http://www.pik-potsdam.de/bahc/>

Data and Information System (IGBP-DIS)
<http://xtreme.gsfc.nasa.gov/dis/>

International Global Atmospheric Chemistry Project (IGAC)
<http://web.mit.edu/igac/www/>

Joint Global Ocean Flux Study (JGOFS)
<http://www1.who.edu/>

Past Global Changes (PAGES)
<http://www.ngdc.noaa.gov/paleo/pages.html>

Global Analysis, Interpretation and Modelling (GAIM)
<http://pyramid.unh.edu/cscc/gaim>

European Network for Research in Global Change (ENRICH)

<http://www.enrich.hi.is/>



A provocative outdoor poster session at the Science Symposium for the Joint Global Ocean Flux Study, Villefranche, France, May 1995.

Invitation to Global Change and Ecological Complexity Workshop

24-27 September 1995, Minneapolis, Minnesota, USA
Development and Implementation of a Research Plan for
GCTE Focus 4

The purpose of the meeting is to develop an implementation plan for an international research effort to determine how global changes in environment and land use will alter the relationships between ecological complexity, ecosystem structure, and ecosystem function. We define ecological complexity as biodiversity occurring at scales ranging from genetic and species diversity to landscape diversity.

In the past there have been two largely independent concerns about global environmental change:

(1) changes in environment and ecosystem processes, and
(2) changes in biotic and landscape diversity. SCOPE (Scientific Committee on Problems of the Environment) has recently completed a synthesis of the current scientific understanding of the relationship between ecological complexity, ecosystem structure, and ecosystem function. This workshop is intended to develop the research programme that will fill the gaps in our understanding identified by the SCOPE project, and will draw together the two major strands of global change ecological research.

The workshop is open to all who wish to participate. However, we particularly encourage the participation of those individuals who are currently involved or plan research in this area.

The specific objectives of the workshop are to: i) summarize current hypotheses and develop new hypotheses concerning the complexity/structure/function relationship; ii) identify field

and laboratory experiments to test these hypotheses; iii) develop an implementation plan for the GCTE research programme that would best organize and promote these studies; iv) identify a network of scientists committed to conducting the research.

The development of an effective research programme will require the concerted effort of population, community, ecosystem and landscape ecologists, and of social and atmospheric scientists interested in predicting future changes in environment and land use. The programme requires the integration of observation, experimentation, and modelling.

The workshop will open with a few brief presentations and discussions of current hypotheses of the complexity/structure/function relationship. Working groups will then develop the ideas that will refine the Implementation Plan for Focus 4 of GCTE, Global Change and Ecological Complexity. The Implementation Plan will include the development of new concepts and hypotheses, and experiments to test them. This research effort will use all the available tools from field experiments to concept development and modelling. The experimental portion of Focus 4 will be developed jointly with the task on structure and function experiments within GCTE Focus 2 on Change in Ecosystem Structure.

Contact Nancy Larson by 8 September, 1995:

Nancy Larson, Department of Ecology, Evolution, and Behavior, 1987 Upper Buford Circle, University of Minnesota, St Paul, MN 55108, USA, Tel: 1-612-625-5740, Fax: 1-612-624-6777, Email: larson@lter.umn.edu

For more details on scientific aspects of the workshop, please contact:

Oswaldo Sala, Department of Ecology, Faculty of Agronomy, University of Buenos Aires, Av. San Martin 4453, Buenos Aires 1417, Argentina, Tel: 54-1-520-903, Fax: 54-1-334-8964, Email: osala@cnea.edu.ar

Pavid Tilman, Department of Ecology, Evolution, and Behavior, 1987 Upper Buford Circle, University of Minnesota, St Paul, MN 55108, USA, Tel: 1-612-625-5740, Fax: 1-612-624-6777, Email: tilman@cdr.lter.umn.edu

Will Steffen, GCTE Core Project Officer, CSIRO Division of Wildlife & Ecology, PO Box 84, Lyneham 2602, Australia, Tel: 61-6-242-1755, Fax: 61-6-241-2362, Email: wls@cbr.dwe.csiro.au

CALL FOR PAPERS

**Open Meeting on the IGBP Northern Eurasia Study
Tsukuba, Japan, 28 November - 1 December 1995**

The Environment Agency of Japan, the Japanese National Institute for Environmental Studies, and the IGBP are sponsoring an open meeting on the proposed IGBP Northern Eurasia Study. The unifying theme of the Study is the terrestrial carbon cycle in the Northern Eurasian region. The Study's most important overall objective is to determine how this cycle will be affected by global change, and how the consequent alterations to the cycle will feed back to further change.

The objectives of the Open Meeting are: (i) to introduce the prospectus for the Study, developed at an initial planning workshop held in Stockholm in November 1994, to the broader scientific community, and (ii) to get input from the broader community to improve and refine the science plan as outlined in the prospectus.

We invite papers from interested scientists to be presented at the Open Meeting. The four major themes of the meeting (relating to Northern Eurasia) are:

- water, energy and carbon exchange
- trace gas emissions

- ecosystem studies: impacts and feedbacks
- land-use/cover change

The papers should focus on the interactions and cross-links between these themes, and should address an aspect of the overall goal of the Study.

Abstracts should be one page or less in length, and should include a contact name, postal and email addresses, and telephone and fax numbers.

Abstracts should be sent to:

Dr Gen Inoue, Head of Global Warming Research Team, National Institute for Environmental Studies, Japan Environment Agency, 16-2, Onogawa, Tsukuba, Ibaraki 305, JAPAN, Tel: 81-298-51-6111, Fax: 81-298-51-4732, Email: inouegen@nies.go.jp

DEADLINE FOR RECEIPT OF ABSTRACTS IS **20 OCTOBER 1995**

Open Science Meetings

9 August 1995, Berlin Germany

Palaeomonsoon Variations and Global Change During the Late Quaternary, in conjunction with the XIV International Congress of INQUA. *Stefan Kroepelin, Co-ordinator, INQUA-PAGES Palaeomonsoons Project, Free University of Berlin, Geolaboratory, Altensteinstrasse 19, D-14195, Berlin, Germany. Fax: (+49.30) 838 6263, E-mail: skroe@zedat.fu-berlin.de*

6-12 August 1995, Tampere, Finland

GCTE-BAHC Session at the International Union of Forestry Research Organisations XX World Congress. *Paul Jarvis, Institute of Ecology & Resource Management, Darwin Building, The King's Buildings, Mayfield Road, Edinburgh EH9 3JU, UK Tel: (+44-316) 505 426, Fax: (+44-316) 620 478*

14-18 August 1995, Moscow, Russia

IGU '95. Global Changes and Geography, including PAGES Multiproxy Mapping Session. *A. Velichko, Institute of Geography, Russian Academy of Sciences, Staromonetny 29, Moscow 109017, Russia. Tel: (+7 095) 238 02 9+8, Telex: (64) 411781 globe, Fax: (+7 095) 230 20 90*

20-22 September 1995, Geneva, Switzerland

Global Change, Local Challenge. Third Scientific Conference of the Human Dimensions of Global Environmental Change Programme (HDP), at the International Conference Center of Geneva. *HDP, 11A, av. de la Paix, CH-1202 Geneva, Switzerland. Tel: (+41-22) 733 2002; Fax: (+41-22) 733 3049, E-mail: HDP@hei.unige.ch*

22-23 September 1995, Maynooth, Ireland

Global Change and the Irish Environment. *John Sweeney, Irish Committee for IGBP, The Royal Irish Academy, 19 Dawson Street, Dublin 2, Ireland. Fax: (+353-1) 676 2346, E-mail: jsweeney@vax1.may.ie*

25-29 September 1995, Garmisch-Partenkirchen, Germany

First International Science Conference of Global Analysis, Interpretation and Modelling (GAIM). *German IGBP Secretariat, Institut für Meteorologie, Freie Universität Berlin, Carl-Heinrich-Becker-Weg 6-10, 12165 Berlin, Germany. Fax: (+49-30) 838 71217, E-mail: igbp@zedat.fu-berlin.de, or Dork Sahagian, Complex Systems Research Center, Institute for the Study of Earth Oceans and Space (EOS), Morse Hall, 39 College Rd., University of New Hampshire, Durham, NH 03824-3525, USA. Fax: (+1 603) 862 0188, E-mail: gaim@unh.edu, Web: http://lgaim.unh.edu/csrx/gaim*

9-14 October 1995, Beijing, China

WMO/IGAC Conference on the Measurement and Assessment of Atmospheric Composition Change. Third science conference of the International Global Atmospheric Chemistry Project (IGAC). *John Miller, Environment Division, AREP, World Meteorological Organisation, 41 Ave. Giuseppe Motta, CH-1211 Geneva 2, Switzerland. Fax: (+41-22) 740 0984, E-mail: john-milton.miller@itu.ch*

22 October 1995, Beijing, China

ICSU Global Change Forum on Earth System Research

23-27 October 1995, Beijing, China

SAC IV: The Fourth Scientific Advisory Council for the IGBP
IGBP Secretariat, Box 50005, S-104 05 Stockholm, Sweden. Fax: (+46-8) 16 64 05, E-mail: sec@igbp.kva.se.

29 January -1 February, 1996, Amsterdam, The Netherlands

First Open Science Meeting of Land Use and Cover Change (LUCC)
The Royal Dutch Academy of Sciences, Trippenhuis, Amsterdam
Louise Fresco & Rik Leemans, Department of Agronomy, P.O. Box 341, 6700 AH Wageningen, The Netherlands, Tel: (+31) 8370 83040, Fax: (+31) 8370 84575, E-mail: lucc@sec.agro.wau.nl

17-21 June 1996, Washington DC, USA.

GEWEX: Second International Scientific Conference on the Global Energy and Water Cycle, at the US National Academy of Sciences. Scientific Interests involve the climate feedback associated with clouds, radiation, and the hydrologic processes. Papers invited. *Contact: GEWEX Project Office, 409 Third Street SW, Suite 203, Washington, DC, 20024, USA.*

2-6 December 1996

First SPARC General Assembly (Stratospheric Processes and their Role in Climate). *David Karoly, SPARC 96, CRC for SH Meteorology, Bldg 70, Monash University, Clayton, VIC 3168, Australia. E-mail: sparc96@vortex.shm.monash.edu.au*

Fourth Scientific Advisory Council for the IGBP and ICSU Global Change Forum Beijing, 22-27 October 1995

The Chinese National Committee for the IGBP has graciously invited the highest body of the IGBP, the Scientific Advisory Council (SAC), to hold its fourth session in Beijing. The Council, composed of National IGBP and ICSU representatives, advises on the scientific contents of the programme, assesses its results, and makes recommendations. The topic of the Scientific Symposium on 23-25 October is

Natural and Anthropogenic Changes : Impacts on Global Biogeochemical Cycles

I Change: The Historical Perspective

Historical records of climate change *An Zhisheng (China)*
Land-use history *John Richards (USA)*

II Change in Land Use and Mobilisation Rates of Carbon, Oxygen, Nitrogen, Phosphorus, and Sulphur

Land use change *Rik Leemans (Netherlands)*
Biomass burning *Jean-Paul Malingreau (Italy)*
Industrial metabolism of Sulphur and Nitrogen *Fred Mackenzie (USA)*
Nutrient cycling of productivity in grasslands/forests *Zhang Xinshi*

III Effects of Changes for Biogeochemical Cycles

Carbon and Water Exchange *Detlef Schulze (Germany)*
Terrestrial Carbon Budget *David Skole (USA)*
Methane emissions from rice cultivation *H-U. Neue (Philippines)*
Sediment/nutrient transport to the coastal zone *Hu Dunxin (China)*
River basin hydrology *Charles Vörösmarty (USA)*
Carbon and nutrients in the ocean *CT Arthur Chen (China-Taipei)*

IV Overview of Asian Change and Global Change

Impacts of Global Change on Asia *Fu Congbin (China)*
Impact of Asia on Global Change *Berrien Morre (USA)*
Symposium Summary *Ye Duzheng (China)*

Poster sessions will be held on the late afternoons of Monday and Tuesday

to register for SAC IV

IGBP Secretariat, The Royal Swedish Academy of Sciences
Box 50005, S-104 05 Stockholm, Sweden
Tel: (+46-8) 16 64 46, Fax: (+46-8) 16 64 05
E-mail: sec@igbp.kva.se

SAC IV Agenda

22 October	ICSU Forum	Presentations on Earth System Research Panel on science and decision making
23-25 October	Scientific Symposium	Natural and Anthropogenic Changes: Impacts on Global Biogeochemical Cycles
26-27 October	SAC IV	Scientific Advisory Council: IGBP Evaluation

COURSES FOR LATIN AMERICAN SCIENTISTS

IGAC's Atmospheric Chemistry and Environmental Education in Global Change (ACE^{ED}) Activity, the InterAmerican Institute for Global Change Research (IAI), The Global Change System for Analysis, Research and Training (START), The American Geophysical Union (AGU), and the World Meteorological Organisation's Global Atmospheric Watch (GAW) will sponsor two week Advanced Study Short Courses for Latin American Scientists, given by members of ACE^{ED}'s Volunteer Teaching Corps.

Funds are expected to be available to cover partial travel and per diem costs for all participants.

To apply, please complete the form and send it to:

Caroline J. Gilman, American Geophysical Union, 2000 Florida Avenue, N.W.
Washington, DC 20009-1277, USA

Tel: (+1-202) 939 3220, Fax: (+1-202) 328 0566, E-mail: cgilman@kosmos.agu.org

PHOTOCHEMICAL AIR QUALITY MODELLING UNIVERSITY OF CHILE, SANTIAGO, CHILE 20-31 MAY 1996

- Fundamental process components of air quality simulation models
- Overview of operational approaches used in ozone air quality management
- Description and application of photochemical models
- Fundamentals, description, and applications of observationally-based modelling approaches

There will be space for 20 participants. The course will be conducted in English.

Application for AGU course on

PHOTOCHEMICAL AIR QUALITY MODELLING

University of Chile, Santiago, Chile
20-31 May 1996

Name

Address

Telephone

Fax

E-mail address

Highest academic degree

University/Institution

Year

Academic background (courses, thesis or dissertation title)

Professional Experience

Please Return this form by 15 November 1995 to

Caroline J. Gilman, American Geophysical Union, 2000 Florida Avenue, N.W.
Washington, DC 20009-1277, USA

Tel: (+1-202) 939 3220, Fax: (+1-202) 328 0566, E-mail: cgilman@kosmos.agu.org

Executive Officer BAHC Core Project Office

Biospheric Aspects of the Hydrological Cycle (BAHC) A Core Project of the International Geosphere-Biosphere Programme

The International Geosphere-Biosphere Programme (IGBP) invites applications for the position of Executive Officer of the Biospheric Aspects of the Hydrological Cycle Core Project Office (BAHC CPO), based in Potsdam, Germany.

The IGBP is a non-governmental international research programme, organised under the aegis of ICSU, dealing with the causes and effects of global environmental change. The IGBP, together with the World Climate Research Programme (WCRP) and the Human Dimensions of Global Environmental Change Programme (HDP) provides the focus for the international scientific effort needed to reduce uncertainties relating to natural and man-made global changes.

BAHC is one of the Core Projects of the IGBP. BAHC is an interdisciplinary project which was established to study the role of vegetation in hydrological interactions between land surfaces and the atmosphere. As such, it combines and integrates expertise over wide temporal and spatial scales in the fields of hydrology, ecology, soil science, meteorology, modelling and information systems. The project is now being implemented and has operational goals which address specific questions of interactions with physical processes. BAHC cooperates closely with other IGBP, WCRP, UNESCO and International Hydrological Programme (IHP) projects and programmes.

The Executive Officer heads the BAHC CPO and will

- Facilitate achievement of BAHC's mandate by the international scientific community
- Collaborate with other IGBP Core Projects and Framework Activities to achieve maximum integration
- Ensure effective links between BAHC and other relevant research programmes, especially WCRP, HDP, and IHP, as well as improvement of links to international socio-economic science groups
- Liaise with the IGBP Secretariat and the Scientific Committee for BAHC
- Supervises the scientific, administrative and financial staff of the Core Project Office (3 persons), with responsibility for budgeting, funding proposals, and in other administrative aspects of the programme, in cooperation with the host institute

The successful candidate will:

- Have a PhD and an international research reputation in a relevant natural science discipline (hydrology, ecology, geography, meteorology)
- Be knowledgeable about the international global change research effort
- Have experience of international scientific collaboration
- Be familiar with, and interested in, management tasks
- Be prepared to conduct travels to all parts of the world
- Have full command of written and spoken English: knowledge of German and other languages is an advantage.

The Executive Officer of the BAHC CPO, to be appointed until February 1997 (with possibility of renewal) will be an employee of the Potsdam Institute of Climate Impact Research (PIK). The Executive Officer of the BAHC CPO will be working under the directives of the BAHC Scientific Steering Committee, and will report to its Chair.

The position should be filled as soon as possible. The salary will be negotiable in the framework of BAT Ib/IIa (salary scale for public employees in Germany) and will take account of experience and qualifications of the candidate, and the costs and benefits of living in Germany.

A letter of application, including a curriculum vitae and the names of two referees, should be received no later than 30 September 1995. Send to:

Dr. Pavel Kabat, BAHC SSC Chair, Winand Staring Centre, P.O.Box 125, NL-6700 AC Wageningen, The Netherlands.
Tel.: (+31-8370) 74314 / 74200, Fax: (+31-8370) 24812, E-mail: kabat@staring.agro.nl, or

Dr. Alfred Becker, BAHC SSC Vice Chair, PIK, Telegrafenberg, D-14473 Potsdam, Germany. Tel.: (+49-331) 288-2541,
Fax: (+49-331) 288-2640, e-mail: becker@pik-potsdam.de

