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THE INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME: A STUDY OF GLOBAL CHANGE (IGBP) OF THE INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

Ecological Complexity and Ecosystem Function The Effects of Global Change

UTLÄNAS EJ
FÖRE DEN
94-09-15

The aim of the Global Change and Terrestrial Ecosystems (GCTE) Core Project has been to assess the effects of global change on the function and structure of ecosystems, and how these changes feed back to the atmosphere and the physical climate system. The drivers of global change, which are changes in land use, atmospheric composition, and climate, also directly affect ecological complexity which in turn affects ecosystem function (Figure 1). The objective of GCTE's recently launched Focus 4, Global Change and Ecological Complexity, is to assess the effects of global change on the relationship between ecological complexity and ecosystem function.

Ecological complexity represents biological diversity in a broad sense, including not only species diversity but diversity of ecosystems, landscapes, as well as genetic diversity within species. In addition, ecological complexity covers diversity of functional pathways and interactions. We can

envision systems with similar diversity, but contrasting complexity as a result of different organisation. Ecosystem function represents the collection of processes including primary production, decomposition and nutrient cycling and their interactions.

The drivers of global change affect the functioning of ecosystems, and in turn changes in ecosystem function affect the atmosphere and the climate systems. For example, elevated CO₂ affects the functioning of ecosystems from grasslands to forests. In addition, global change results in alterations in the species composition and/or the composition of functional types. The new focus concentrates on the effects of global change on the relationship between ecological complexity and ecosystem function. Rapid changes in land-use patterns in conjunction with large increases in the use of fossil fuels result in changes in the atmosphere which affect ecosystems directly and indirectly through chang-

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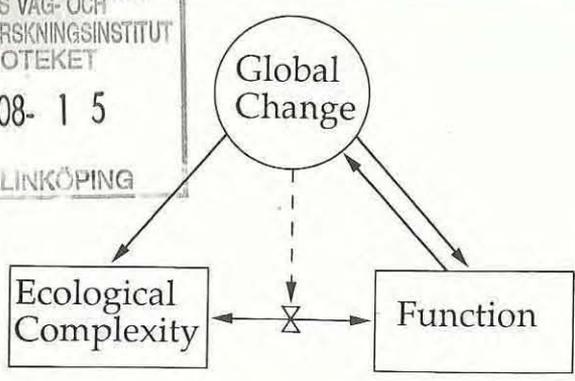


Figure 1. The drivers of global change, which are changes in land use, atmospheric composition, and climate, also directly affect ecological complexity, which in turn affects ecosystem function.

es in climate. These human driven alterations of the biosphere also significantly alter the complexity of ecosystems. Are these changes in complexity going to accelerate the current trends of change in the functioning of ecosystems? Are the effects on carbon, nutrient, and water cycles going to be amplified in a simpler, less complex world?

Ecologists are intrigued by the diversity of organisms that inhabit the Earth and therefore have studied the mechanisms that may account for this wealth of diversity. At this point, there is evidence supporting several available hypotheses, which explain diversity as a function of ecosystem properties. However, less effort has been concentrated in understanding the effects of ecological complexity (or of changes in ecological complexity) on ecosystem function.

SCOPE (the Scientific Committee on Problems of the Environment) is just finishing a project led by H. Mooney which synthesizes our current understanding of the effects of biodiversity on ecosystem function (Schulze and Mooney 1993). This project (one of the components of the *Diversitas* programme) consisted of a series of parallel workshops held around the globe for different biomes, and a final synthesis conference which identified similarities and differences among biomes. The reports from each biome and the cross biome comparisons helped identify gaps in our understanding. There is a close connection between the SCOPE project being concluded and the starting GCTE Focus 4 Global Change and Ecological Complexity. The SCOPE project synthesised our knowledge and identified gaps which are the base of the research project which will be carried out by the new Focus 4. This is another example of the complementarity of SCOPE and IGBP, two programmes of the ICSU family. SCOPE excellently synthesises current knowledge, which IGBP can use to guide its research programmes.

The SCOPE project joined together with IUBS and UNESCO in the *Diversitas* programme to approach the problem of the loss of biodiversity, including not only ecosystem function, but also an analysis of the origin and maintenance of diversity, as well as monitoring of diversity. As these programmes developed, UNEP launched the Global Biodiversity Assessment. This Assessment, which parallels two previous and successful endeavours, the Ozone and the Climate Change Assessments, includes two sections describing the state of our knowledge regarding the relationship between biodiversity and ecosystem function.

A broad range of models addressing the

relationship between ecological complexity and ecosystem function have been suggested. At one end are models proposing that each species plays a unique role in the functioning of ecosystems, and therefore deletion of any species results in a change in ecosystem function. At the other end, some models consider that most species are redundant and that changes in ecological complexity should not result in changes in function (Vitousek and Hooper 1993).

A recently developed model relates previous diversity-function models with rank dominance models. The effects on ecosystem function depend not only on changes in complexity, but also on how these changes occur, and which species are added or deleted. The model suggests a way of identifying those species which will have maximum effect on ecosystem processes.

Experiments scattered over the world provide evidence to support or reject the different diversity-function models. These include a range of studies from field to controlled environment conditions (McNaughton 1993, Naeem *et al* 1994). Primary production and its relationship to plant species diversity has been one of the best studied relationships. For example, in the Serengeti grasslands, removals of grasses with different contributions to total productivity show the limits of ecosystems to compensate for the deletion of different species (McNaughton 1983). Experimental removal of species which contributed very little to production in the intact grassland resulted in total compensation by the remaining species, and no changes in total production. Removal of intermediate species resulted in production being only partially compensated. Finally, removal of dominant species resulted in a significant decrease in production.

Ecological complexity may affect not only average ecosystem functioning but also the system response to extreme conditions. The diversity-stability hypothesis suggests that perturbations will result in a larger change in ecosystem function in simple systems than in diverse systems. In the USA tall grass prairie, species diversity determines the ability of the ecosystem to withstand and recover from severe drought (Tilman and Downing 1994). The least diverse experimental units showed a larger reduction in biomass during an extreme drought than the most diverse, and they recovered more slowly than the richest plots.

GCTE's Focus 4 will address problems which are best solved collectively. It will avoid tasks which can be accomplished individually by investigators or groups, and

will concentrate on those experiments which yield more than the sum of individual experiments. Examples of this kind of activity are networks of experiments or workshops with specific objectives.

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Dr. Sala is a member of the Scientific Committee for the IGBP, and the Scientific Steering Committee for GCTE, where he is Focus 4 leader. He has recently worked at Stanford on an ecosystem model that would judge the impact of a species by how abundant it is compared to other members of the same functional group. The above paper presents the major thrust of his presentation at the First GCTE Science Conference held at Woods Hole, Massachusetts, 23-27 May 1994. The invited papers from this conference, giving a thematic overview, will be published in the recently created IGBP book series, and the contributed papers to the conference will be published in a special edition of *Global Ecology and Biogeography Letters*.

Biosphere-Atmosphere Field Experiment in Amazonia

LAMBADA/BATERISTA/AMBIACE (LBA)

In June 1992, at its third meeting in Greenbelt, Maryland (USA), the Joint WCRP (World Climate Research Programme)/IGBP Working Group on Land-Surface Experiments, where IGBP was represented by the BAHC Core Project (Biospheric Aspects of the Hydrological Cycle) and the WCRP by GEWEX/ISLSCP (Global Energy and Water Cycle Experiment/International Satellite Land-Surface Climatology Project), suggested to plan and prepare a large-scale land surface experiment in Amazonia in the time frame 1997-1999. Meanwhile, the scientific plan has been further developed under the leadership of Professor Carlos Nobre from the Brazilian National Space Research Institute.

The main goals of the biosphere-atmosphere field experiment in Amazonia are to answer the following questions:

(i) How does Amazonia currently function as a regional entity? The question addresses interactions with the Earth system in the form of exchanges of energy, water, carbon and other trace gases via atmospheric and river systems.

(ii) How will human-induced change alter the function of the Amazon region? The question addresses modifications within Amazonia associated with replacing tropical forest with mixed replacement vegetation, and on indirect modification of the vegetation gradient in areas surrounding Amazonia.

To answer these questions, an experiment consisting of three linked field activities is being proposed: LAMBADA (the long-term monitoring, large-scale regional component) and BATERISTA and AMBIACE (process-oriented field studies).

The Large-scale Atmospheric Moisture Balance of Amazonia using Data Assimilation (LAMBADA) would set in place a radiosonde network around and within the Amazon basin; precipitation, hydrography and surface meteorological networks within the basin; long-term monitoring stations of CO₂ and trace gases in at least six research sites within the basin; and a comprehensive satellite remote sensing programme. The field observation phase of LAMBADA would continue for approximately two years, probably in the 1997-1998 time frame. In conjunction with meteorological

fields provided by a mesoscale model 4-dimensional data assimilation (4DDA) scheme, LAMBADA would provide the data that would permit quantification of the energy, moisture and carbon budgets of the region and their dependence on the large-scale atmospheric circulation.

The Biosphere-Atmosphere Transfers and Ecological Research In situ Studies (BATERISTA) is proposed as a co-ordinated set of process studies aimed at better understanding the micro-meteorological, ecophysiological and biogeochemical controls on the exchange of energy, moisture, trace gas and momentum between the atmosphere and the vegetated land surface. The BATERISTA studies would also provide opportunities for the validation of remote sensing techniques and provide a framework for associated ecological studies. As proposed, six research areas located in different ecoclimatic regions of the Amazon basin and surrounding regions are to be equipped with arrays of surface sampling equipment, flux towers and other hardware. Three of the research areas are to be the axis of an ecological gradient transect study.

The Amazon Ecology and Atmospheric Chemistry Experiment (AMBIACE) is proposed as a study of the influence of the intact forest and of the consequences of

forest conversion, agricultural practices and abandonment, and secondary succession, on regional and global biochemistry and atmospheric chemistry, focusing on ecosystems carbon dynamics, on atmospheric greenhouse gases (CH₄, N₂O, CO₂) and on the oxidising potential of the atmosphere (O₃, CO, NMH, NO_x). Flux tower and aircraft gas concentration measurements, and satellite observations of land-use patterns will provide the basis to integrate measurements of fluxes at scales ranging from meters to kilometers in the Amazon basin. These data will be complemented with ecological monitoring studies along transects of climate and land-cover and land-use changes.

Planning Workshops

During the period 8-11 September 1993 a LAMBADA/BATERISTA Workshop was held at the Brazilian Space Research Institute (INPE) in São José dos Campos, Brazil. More than 60 scientists from a number of countries (Bolivia, Colombia, France, Germany, Holland, Peru, UK, USA, and Venezuela) and from international programmes (IGBP, WCRP with GEWEX and ISLSCP) attended the meeting.

The Workshop was opened by the Deputy Minister for Science and Technology



Satellite view of Brazilian Amazonia, showing the river, forested and deforested areas

for Brazil, Prof. Luiz Bevilacqua. The first part of the Workshop consisted of a series of review presentations on the major ongoing field experiments in Amazonia. These are: ABRACOS (Anglo-Brazilian Amazonian Climate Observational Study), ABLE (Amazon Boundary Layer Experiment), HYTRECS (Hydrology of Tropical Ecosystems), TRACE-A (Transport and Atmospheric Chemistry near the Equator-Atlantic), CAMREX (Carbon in the Amazon River Experiment), Forest Fires, SHIFT (Studies on Human Impact on Forests and Flood Plain in the Tropics), FPB (Flor-Past Brazil), presentations of related research conducted in other Amazonian countries (Venezuela, Colombia, Peru and Bolivia) and planned European Community participation. In the second part, presentations and discussions were carried out in two areas where large uncertainties remain: hydrology/hydrogeo-chemistry and the carbon cycle of Amazonia. Subsequent working groups addressed specific questions of the LAMBADA and BATERISTA components, and questions associated with logistical and organisational aspects.

The importance of the proposed research and the international, interagency and interdisciplinary nature of LBA was unanimously recognised by the participants. As a result of the meeting a 'Preliminary Science Plan' was defined and an organisational structure to implement the experiment was outlined.

Following this Workshop, a meeting of American and Brazilian scientists held in Brasilia, Brazil, 27-29 September 1993 discussed in greater detail the atmospheric chemistry and ecological components of the experiment (AMBIACE). Ways to integrate the individual components were further discussed in a meeting in Washington, DC, 17-18 March 1994 between American, European and Brazilian scientists and agency officials. A strategy of integrating the three components was outlined.

A need for focused workshops in many of the research areas emerged from the meetings. A first one took place at CENA (Centro de Energia Nuclear na Agricultura) at Piracicaba, Brazil, 9-11 May 1994, to discuss tropical ecology, and another one is planned to take place in Brazil in November 1994, focusing on hydrology.

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The GCTE Wheat Network

Crop Networks

Within the Agriculture, Forestry and Soils area (Focus 3) of GCTE, a series of crop networks is forming a major mechanism for integrating modelling and experimentation on global change impact on crop production. The networks, which are designed to be highly interactive and to maximise the exchange of models and datasets, address two objectives:

- To refine and adapt current crop production models for use in global change studies in a wide variety of conditions
- To design and undertake experiments to provide an improved mechanistic understanding of the impacts of global change on crop production.

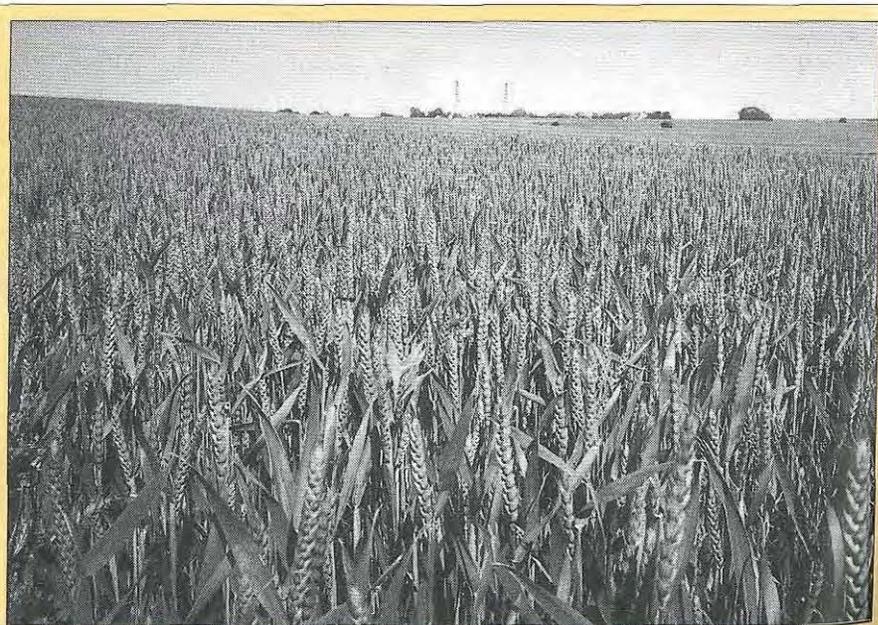
The GCTE Wheat Network has gained considerable momentum since its launch at an international workshop in Saskatoon in July 1992, and is now recognised as a contribution to GCTE Core Research. Currently 23 scientists are formally included, contributing some 36 datasets strictly pertinent for model development, and 15 of the most popular wheat models. Using the Network's models, Network members undertook a major model comparison at a workshop held in Lunteren, The Netherlands, in November 1993. This produced some very unexpected results.

The Lunteren Workshop

Two sets of 30-year mean meteorological data were distributed to modellers in advance of the workshop. One set was for a winter wheat growing season (European data), and the other for spring wheat (North American data). The 30-year mean data were used to provide 'smoothed' datasets, because data from a given season may have been unusual, thereby complicating the comparison. One consequence of this was that no real crop data were available, so the models were only compared one against another. Modellers were asked to fit genetic coefficients so as to simulate a common phenological time course.

For both 'crops' modellers were asked to assume optimum fertilisation and irrigation as well as optimum pest management (i.e. to simulate 'potential yield'). Plant population density was prescribed at 300 per square metre, with a row width of 20 cm. Requested output included total above-ground dry weight and grain weight at maturity.

Each model in this comparison had been validated satisfactorily for the environment for which it was designed. The emphasis of this exercise was not therefore to repeat this validation, but to establish the transferability of each model. The preconception was that all models would



Wheat fields in Denmark

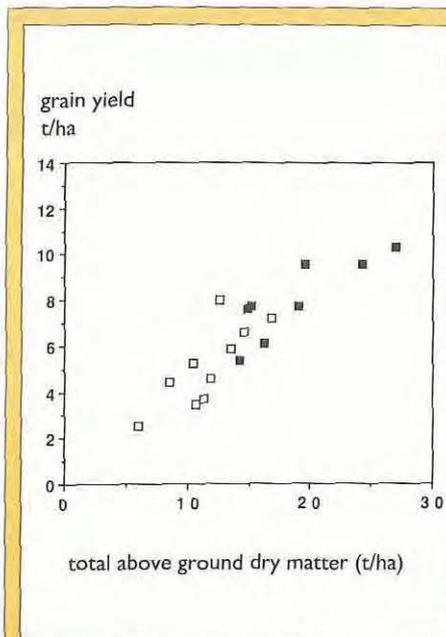


Figure 1. Scatter plot of simulated yield against simulated biomass for the North American Site \square and for the European Site \blacksquare

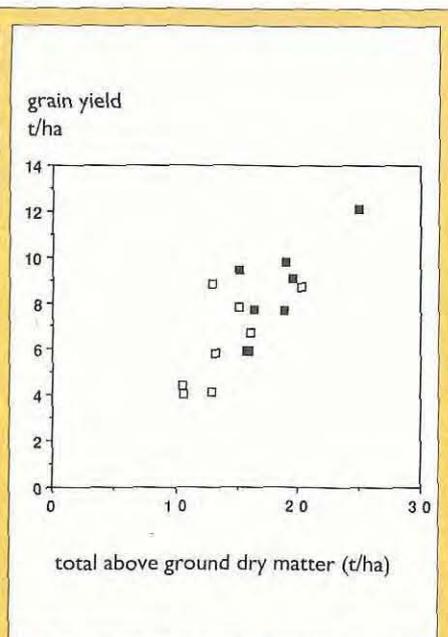


Figure 2. Scatter plot of simulated yield, as in figure 1, but with the same imposed time course for Leaf Area Index in all models.

produce comparable output. Contrary to this expectation, however, the variability of the models' results was surprisingly large, even though the dates of emergence, of bloom, and of maturity were prescribed. Figure 1 shows a scatter plot of grain yield against total dry matter for ten models for the North American site, and for eight models for the European site. If the models all performed similarly, the two sets of points should have been two tightly clustered clouds, one for the North American site, and one for the European site. What caused the observed divergence?

Models contain many feedbacks, making it difficult to trace the precise causes of deviation. From experience gained in modelling crop growth it is, however, known that a major feedback route occurs through growth of leaf area. Once leaf area in early growth is overestimated, its high value will tend to be amplified through greater photosynthesis. For this reason, it was decided to force the models by imposing the same prescribed time course of leaf area index to all models. This artificial move enabled exclusion of morphological model differences (specific leaf area, leaf area formation, tillering, leaf appearance) so that nothing but functional model differences (light interception, photosynthesis, respiration) were retained. Figure 2 gives the results of this approach. Clearly some improvement (c. 20% reduction in variability of total above ground dry matter) production was achieved, although many differences remain. One possible

reason is further internal model feedbacks, which may have caused unintended imbalances (leaf area ratio, nitrogen content, etc.). A further interesting point is that there was no apparent relationship be-

tween model output and model complexity.

Given that the exercise was not conducted with real datasets, the workshop participants were not in a position to judge which model was closest to the real world, and indeed it was not the intention to do so. The goal was to improve our understanding of why the models behave as they do, and the modellers can draw their conclusions accordingly. This exercise showed that much work has still to be done, both in modelling and experimental areas. "Real" datasets will next be used to refine models, while the models will be used to design further experiments that will produce datasets that can in turn be used to test the models' robustness to components of global change. Although this iterative process has only just begun, we believe it will assist the prediction of crop responses to global change.

GCTE is also establishing world-wide networks for rice, cassava, potato, maize and groundnut. For further information about the Wheat or other networks, please contact John Ingram, the GCTE Focus 3 Officer. Dept. of Plant Sciences, University of Oxford, South Parks Rd., Oxford OX1 3RB, UK, Fax: (+44 865) 275 060, Internet: ingram@vax.ox.ac.uk

At the IGBP Secretariat

The implementation of IGBP has brought with it an increase in the number of national committees, of inter-core project activities, of publications, of searching for funds, and of scientific positions to fill for two to three-year periods, to name only a few. This has in turn brought with it both more responsibility and a larger work load on all, from the Core Project Offices to the staff at the Secretariat.

In view of this, Elise Wänmann has recently been named Deputy Director for Administration to correspond to her broad range of administrative responsibilities. From May for a period of six months, with funding from a UNDP grant, Dawn Minto, a financial consultant with British Rail Engineering Limited before coming to Sweden, will assist Elise. Starting in June, through a grant from the Swedish government for an initial period of four months, Adam Czulinski, from the Royal Universi-

ty of Technology in Stockholm, will assist Suzanne Nash, Information Officer, with cataloguing the library, and database management.

Other new arrivals replace Cynthia Deaves and Magdalena Kanger until 31 December, when June Barwick and Lisa Cronqvist return from maternity leave. Voi-Ping Thor, formerly Executive Secretary at Asea Brown Boveri, took over the job of Assistant to the Executive Director on 30 May, and Kristina Harris, who brings with her experience from the newspaper world, will join us on 15 July, when she will be responsible for the technical editing of reports and all that regards mailing.

In addition to our new Executive Director, Chris Rapley, the scientific staff includes, as mentioned in previous Newsletters, Neil Swanberg, Deputy Executive Director, and Risa Rosenberg, Programme Officer.

Thomas Rosswall IGBP Executive Director Returns to Academia

When the International Geosphere-Biosphere Programme was launched, Sir John Kendrew, then President of the International Council of Scientific Unions, the parent organisation of the IGBP, wrote "The IGBP will certainly be the most ambitious, the most wide-ranging, and in its impacts on our understanding of the future possibilities for mankind, the most important project that ICSU has ever undertaken." Essential to success in launching such a vast interdisciplinary programme is the Executive Director. Now that Thomas Rosswall is leaving this post at the IGBP Secretariat in Stockholm to become Rector of the Swedish University of Agricultural Sciences in Uppsala, friends who have accompanied him in building the IGBP over the years express their appreciation of what he has achieved.

Building an international research programme

by James J. McCarthy

At the 1986 General Assembly of ICSU in Bern, the IGBP was launched. In due course a Special Committee was appointed, and I was asked to convene its first meeting in 1987. What form would the programme take? Some had argued at Bern that the preparatory documents had focused too much on the biosphere, others that the best approach for the IGBP was to be inclusive of all disciplines, and spatial and temporal domains - an umbrella structure large enough to cover the full spectrum of interdisciplinary science interests represented within ICSU. Still others argued that because the issues of global change are inextricably related to human behaviour both as drivers, and as sources for mitigating strategies, further development of the IGBP should await the emergence of a complementary companion effort from the social and human sciences.

The mandate from Bern was an immense challenge and responsibility: the scope of the programme, its disciplinary context, and its size would evolve under the direction of the special committee, initially a group of 18 scientists from 15 nations. The wisdom of the ICSU leaders who decided on committee membership

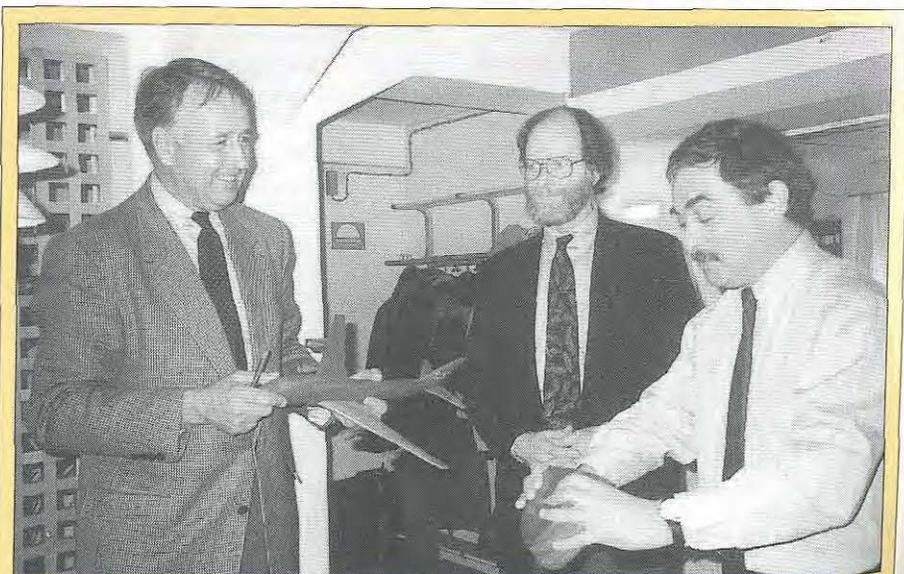
was perhaps most apparent in a decision of theirs, insuring that from deliberations of the special committee a programme would emerge: they selected Thomas Rosswall to design and build the implementing arm of the programme, the IGBP Secretariat.

I had known of Thomas through his publications on various aspects of the nitrogen cycle, but I had not met him prior to the Bern meeting. He was highly respected internationally for his research, his leadership in organising and conducting large studies under the auspices of the International Biological Programme and the Scientific Committee on Problems of the Environment, and his skills as editor and synthesiser. What thousands of scientists involved in the IGBP have also learned is that Thomas lives his work with passion, zeal, and energy that are nothing short of phenomenal. He put his heart and soul into the IGBP, and all who know the history of this programme could not imagine it having attained its present state without the insight, initiative and indefatigable efforts of Thomas.

Although there was no road map for the journey which began in Bern in 1986, there was no shortage of suggestions as to how we should proceed. We spent long hours debating how to best engage the creative talents and energies of the Special Committee.

How could we insure that members worked as a single team rather than as representatives of disciplines or nations? How could we be responsive to the concerns of the many committee members, and insure that all of the contributions were fully valued? From these discussions I quickly learned that Thomas had other qualities that would in my opinion be as important as his scientific wherewithal in the development of the IGBP: he could stimulate and sustain a loyalty to purpose. He argued that in order to succeed, all the initial brainstorming and planning should be done by the Special Committee rather than ancillary groups created for one or another task. Only in this way would committee members become fully involved in educating and in being educated by fellow members, and thus share completely in ownership of the emerging programme. Moreover, Thomas convinced me that our manner should be as informal as possible, no titles but rather first names only, and no voting if we could get away with it. The objective was to set a tone whereby progress could be achieved by consensus, investing whatever time was required to attain this. Thomas was the navigator who directed the course of the IGBP.

Once a decision was made we saw another side of Thomas - the tough and driving Thomas. Once we had decided the



A private plane with the IGBP logo, symbolic of what the Executive Director could have used advantageously in building the IGBP, was given to him by the Scientific Committee at the IGBP Secretariat. Left to right: Thomas Rosswall, James J. McCarthy, and Peter Liss (Chair of the Scientific Committee) reading the dedication on the stand.

shape of a particular piece of the programme, Thomas was an inspiration to all. Outside of the meetings Thomas never asked time commitments from the members, all of whom were mere volunteers with at least one full time job elsewhere, if the task could be done by himself or the staff he assembled in the Secretariat. More symbolic of his style perhaps is the additional realisation that these requests he made of the Special Committee were not because he or the staff couldn't make the necessary time, but rather because in these instances he knew that he genuinely needed the input of the committee. In this way he kept the committee intimately involved and yet never feeling either that their contributions were other than essential or that their time had been other than well invested.

The finances of the IGBP are another area where Thomas' selfless devotion to the IGBP was abundantly evident. At the conclusion of the Bern meeting the IGBP had firm financial commitments from ICSU and Sweden, with the USA and a few other countries pledging early support. The consultative and consensus style of the planning would require many meetings, a core administrative staff would have to be assembled in Stockholm, and there would be numerous reports to prepare. Perhaps only Thomas realised what this would cost.

It became readily apparent in the early days of the programme that various national and intergovernmental contributions were not sufficient to match these needs. Some argued that the burst of initiatives launched with the first meeting of the Special Committee should be scaled back. Others had suggestions for raising funds beyond the voluntary contributions, all of which would have further taxed the time and energy of the overworked and understaffed Secretariat.

Thomas never wavered from his tenacious position that were we to proceed to develop the best possible programme, the national funding bodies would recognise the extraordinary potential for return on their investment, and the funding problem would be solved. The Special Committee fully backed this position, for one reason: confidence in Thomas. Critics were sputtering in various forms, including published columns, with accusations of fiscal irresponsibility, and the cumulative debt continued to increase. Members of the committee accepted the responsibility to proceed in spite of the fact that sufficient resources had yet to materialise. We concurred with Thomas that loss of momentum would impair, perhaps cripple, significant programme development. Yet we also recognised that regardless of how broadly we would insist

ownership in this responsibility, ultimately no one had more at stake personally in this decision than Thomas. Fortunately, an essential partner in the development of the IGBP, the Royal Swedish Academy of Sciences, which hosts the Secretariat, also shared the Special Committee's respect for Thomas' intuition. When one really needs a banker, one very much welcomes a friendly banker. The trust extended by the Academy as it carried the debt of the IGBP on its ledgers cannot be overstated as an important factor in the success of the IGBP.

The record proves Thomas correct. Slowly, but eventually, national and international funding bodies came to recognise that the small incremental investment to their various global change research programmes required to support the highly voluntary IGBP effort returned significant dividends to the investor. Thomas did not decide to leave the secretariat until the IGBP was solvent, its debt to the Academy fully repaid.

The IGBP today, with its six core projects and another at an advanced stage of planning, has an imprint of Thomas Rosswall that will endure for the life of the

programme. No person has been more influential, and had the executive director lacked any of Thomas' leadership and energy, a different IGBP would be the worse for it. Thomas never sought recognition for his efforts; he never in the slightest way upstaged the others.

The IGBP will miss Thomas' gentle but firm hand at the helm. We all knew that the time would come when the robustness of the programme would be tested by Thomas' departure. I am confident that the foundation he laid is strong and because of this, the programme will endure splendidly under new leadership. Thomas knows this better than any of us. Those very same qualities that he brought to the IGBP will serve any university well. We thank Thomas for all he brought to the IGBP, for many fine memories of science and intellectual pursuit at their finest, and we wish him every success in his new career.

James J. McCarthy, Director, Museum of Comparative Zoology, Harvard University.

Chair, Special Committee for the IGBP, 1987-1990.

Chair, Scientific Committee for the IGBP, 1990-1993; Past Chair, 1994.

What it takes, by Brian Walker

I find it hard to believe that Thomas is really going to do what he says (and what the Agricultural University fondly hopes he'll do) - stay home in Uppsala and run the University. There is of course no doubt that he can do it, and in an exemplary fashion. It's just that he is naturally adapted to an impossibly punishing programme of zooming around the world sorting out complicated scientific/political/managerial problems in overlapping multinational forums in several languages at once. He thrives on it. What most normal people would find intolerable, Thomas considers to be "fun". I know this because he told me so himself, at 2.00 am in a hotel room in Chiang Mai. I had been begging and pleading to be allowed to go to sleep, but Thomas was just warming up. There were weighty matters to be discussed and thrashed out: besides, he said, this was really fun and that after all was the main reason why he was involved in the IGBP. Remembering the look on his face and the enthusiasm in his voice as he broached the next item, I believed him. And that is why I find it hard to believe that he will settle for a tamer life.

Thomas' physical fortitude is matched by the breadth of his interests and his knowledge of the array of scientific subjects that underpin the IGBP. He has been a tower of strength, in all senses, during the critical development phase of the IGBP. So often in the early planning days of the old co-ordinating panels, Thomas' perspective of what

was needed unscrambled tortuous discussions and helped us find that task again. And if agreement couldn't be reached, his prowess as a debater coupled with his ability to outlast all opponents generally won the day!

If we base the selection criteria for Thomas' successor on the man himself, they will emphasise a catholic diet in science, an irritating ability to pick out carefully concealed weak points in research plans, the capacity to function continuously on about four hours of sleep, and a pineal gland that secretes melatonin on demand (no jet lag).

We will all miss you, Thomas; your wisdom, your helpfulness, your good humour and above all your unflagging, enthusiastic support for this great international research effort in which you have played such a pivotal role. I, for one, have learned a great deal from you, and I hope that your new role will allow you to meet often with your old friends. You were right, Thomas, it has been fun! And thanks to the stamp you put on it, it will continue to be both fun and an excellent scientific programme.

Brian Walker, Chair, Coordinating Panel on Effects of Climate Change on Terrestrial Ecosystems, and Member of Special Committee for the IGBP (1987-1990)

Chair, Scientific Steering Committee for GCTE (1990-1993; 1994-1996). Division of Wildlife and Ecology, Commonwealth Scientific and Industrial Research Organisation, Canberra, Australia

How it all began

by Thomas F. Malone

The seeds of the IGBP were planted in Stockholm in January 1983 at the meeting of the ICSU Executive Board. The point was made that "a central intellectual challenge of the next few decades is to deepen and strengthen our understanding of the interactions among the several parts of the geosphere and biosphere, including the anthropogenic impact on biological productivity." A decision was reached at that time to bring the issue of a major programme dedicated to illumination of the interaction of global physical, biological, and chemical systems on environment to the attention of the ICSU General Committee, scheduled to meet in Poland in June of that year. This was done, and the General Committee, in turn, proposed that an international symposium be convened at the General Assembly of ICSU in Ottawa in September. Dr. T. F. Malone and Dr. J. G. Roederer were invited to organise the symposium.

More than 400 scientists participated in two days of in-depth discussion of the wide-ranging set of issues that would need to be taken into account. A masterful overview and introduction was presented by Professor Bert Bolin. The sense of the symposium that there should be a major programme mounted by ICSU was presented in an eloquent address by Professor William S. Fyfe, Dean of Science, University of Western Ontario, Canada. The response was an enthusiastic endorsement of the proposal to establish an *ad hoc* Planning Group to report to the 21st ICSU General Assembly, in Bern two years later. The papers presented in Ottawa were edited and brought together in the path-breaking book *Global Change* (T. Malone & J. Roederer, 1985. Cambridge University Press)

Under the Chairmanship of Bert Bolin this planning committee met several times during 1984 and 1985 and presented the proposal in Bern, Switzerland at the ICSU General Assembly in September 1986. The proposal was approved and IGBP was born!

Professor James J. McCarthy of Harvard University was asked to chair a Special Committee to initiate the programme. A key question remained: How could an executive officer of sufficient stature, talent, energy and material competence be found to insure a dynamic and creative programme? The name of one individual figured prominently in the consideration of candidates: Professor Thomas Rosswall of the University of Linköping in Sweden. The final choice was made by ICSU President Sir John Kendrew and it turned out to be a particularly felicitous one because

the Royal Swedish Academy of Sciences offered to provide a home for the Secretariat. This auspicious gesture was very much in the far-sighted spirit of the Swedish people whose long and continuing interest in environmental issues had led to the selection of Stockholm as the site of the seminal United Nations Conference on the Human Environment in 1972. The seeds of IGBP had been planted in Stockholm, and Sweden's Bert Bolin figured prominently in nourishing those seeds.

With those decisions made, the next few years were marked by feverish activity, sparked by the indefatigable executive leadership of Thomas Rosswall, working in harmony with the wise and mature Professor McCarthy.

IGBP has now taken its place as a worthy successor to the International Geophysical Year (IGY) of the late 1950s, and the International Biological Programme (IBP) of 1964-74. IGY brought together

physical scientists from many parts of the world to deepen an understanding of the physical aspects of the planetary home of the human species, and IBP had focused on biological aspects.

It was no accident that the synthesis of biological and physical sciences was achieved under the leadership of two quintessential biologists, McCarthy and Rosswall. The next step will be to extend that synthesis to embrace the social sciences. As the Executive Director of this magnificent interdisciplinary effort, Thomas Rosswall has established a standard of performance that will stand for decades as one worthy of emulation.

Thomas F. Malone. Director, The Sigma Xi Center, Research Triangle Park, NC, USA. Member, ICSU Executive Board, 1978-84. Co-convenor of the Ottawa Symposium on Global Change, 1984



**Thomas Rosswall
in various ecosystems**

Clockwise, from the top:

Off the coast of Texel, The Netherlands

The Berlin Wall on 10 November 1989,
with the Scientific Committee

At the South Pole

Among the spotted gum and the cycade in
Australia

In the Puerto Rican cloud forest



Chris Rapley, An Introduction

Executive Director of the IGBP from 1st September 1994

The ICSU Executive Board has appointed Prof. Chris G. Rapley to the post of Executive Director of the International Geosphere-Biosphere Programme for a period of three years, to replace Prof. Thomas Rosswall, who is leaving to become Rector of the Swedish University of Agricultural Sciences.

Professor Rapley is a UK citizen, with an M.A. in Physics from Oxford University, and an M.Sc. and a Ph.D. in Astronomy from Manchester University and University College London (UCL) respectively. He is currently Head of Remote Sensing, and Associate Director of the Department of Space and Climate Physics at UCL's Mullard Space Science Laboratory. For the last ten years his research has focused on the use of space-based instruments to study the climate-related behaviour of polar ice sheets, sea ice and inland water. He is participating in the Earth observation programmes of the European Space Agency and NASA, both as a Principal Investigator and as an advisor on the definition of mission objectives, the instrumentation, and the utilisation of the data. He has taken a close interest in the development of the IGBP Data and Information System (IGBP-DIS) and was appointed to the UK National IGBP Committee in 1992. In addition, he sits on numerous other national and international planning and advisory bodies concerned with the development of observing systems and the exploitation of data sets in the field of global change.

My first exposure to the science of global change occurred in late 1978. At the time, I was working in the USA as Project Scientist on UCL's contribution to a major new space instrument destined for launch on NASA's Solar Maximum Mission. A colleague showed me examples of the radar images of Earth obtained by the US Seasat mission. It was apparent that they represented a major advance in our ability to study the surface of our planet, and they made a deep impression on me. A few years later, when I was offered the opportunity to establish a new climate-related Earth Observation research group at UCL's Mullard Space Science Laboratory, I jumped at the chance. Initially, we concentrated on the design and construction of new instruments, and the development of novel measurement techniques using past data sets. We became closely involved in several new ESA and NASA satellite missions, and once these were successfully launched, our at-



Chris Rapley in his office at University College London

tention shifted to specific science issues, including the determination of the mass balance of the great ice sheets, the annual cycle of sea ice growth and decay, and changes in the global distribution of water in lakes, and wetlands. This involved us in the mounting of field campaigns to verify that what we deduced from our remotely sensed data was actually correct. Paradoxically, scientists expert at making measurements from space found themselves at close proximity to the Earth's surface measuring its characteristics in such diverse locations as Irish, Canadian and African lakes, the central Australian desert, and Antarctica. We have also had to confront the practical difficulties of processing and manipulating terabyte data sets.

The Mullard Space Science Laboratory remote sensing group is now some thirty strong and has established a distinguished international reputation both for the excellence of its instrument hardware and for its innovative exploitation of remotely sensed data. One of the abiding interests and pleasures throughout its development has been its numerous interdisciplinary collaborations. The benefits of physicists, mathematicians and engineers working closely with (for example) glaciologists, limnologists, and geographers have not been restricted to the research topics under study,

but have broadened and strengthened the skills and experience of all concerned. An increasing interest of my own, as the group has grown in size, has been the need to continually adapt the management structure and leadership style in order to maximise scientific effectiveness, whilst maintaining that crucial element of fun.

As I consider the IGBP and my new role within it, my initial reaction is to be both impressed and a little daunted by the magnitude and complexity of the programme that has been assembled. I regard the clarity of the programme's goals as an especial strength. Nevertheless, it is apparent that there are many potential and, in some cases, actual difficulties, notably at the interfaces internally between the core projects and externally with other internationally co-ordinated programmes. The resolution of these, the maintenance of a sharp scientific focus, and the achievement of the very highest standards of scientific excellence, are all challenges that I relish. Furthermore, I am determined to maintain tight control of the planning and co-ordination overhead so as to maximise the amount of time scientists spend doing science. Given the IGBP community's rich resources of talent, and their continuing enthusiastic and dedicated support, I look forward to my term in office with great anticipation.

Where are we and where should we go? Evaluation of the IGBP

In 1995, the IGBP will have completed the first five years of its operational phase. The Scientific Committee for the IGBP, which has responsibility for the programme, is carrying out a continuous evaluation of both its overall development and its specific components. However, the SC-IGBP has also discussed the long-term strategy of the programme and has identified a need for an external evaluation. The SC-IGBP has decided that it would be prudent to initiate a process leading to such an external evaluation and review and the International Council of Scientific Unions (ICSU) and International Group of Funding Agencies for Global Change Research (IGFA) have been invited to co-sponsor this process. Such an evaluation should consider both scientific as well as management aspects. In order for the review to be available for consideration by the Fourth Scientific Advisory Council for the IGBP (Beijing, October 1995), it should be initiated promptly and completed no later than September 1995.

In addition to the need to assess the programme at a time when most projects are mid-way through their operational phase, there are also other reasons for initiating an evaluation process at the current time:

- the added value of participation in the IGBP needs to be clearly demonstrated to the scientific community
- the IGBP needs to ascertain whether the consensus in the scientific community on the relevance of the scientific priorities calls for mid-course correction, and that IGBP research is of the highest quality
- funding agencies need to be updated with specific examples as to the added value of aligning national research priorities with those of the IGBP
- adequate and sustained funding of the central scientific co-ordination and integration activities of the IGBP can only be secured if those entities that provide that funding are convinced of the effectiveness of its spending
- IGBP is a programme without precedent, the process of definition and the procedures for implementation have been developed "along the way", and we must now step back and review their effectiveness and see what improvements are necessary.

Terms of Reference of the Evaluation

Scientific results.

What new scientific results have been obtained and what role has the programme framework had in obtaining such results?

Implementation

Is the IGBP fulfilling its Implementation and Operational Plans in a satisfactory and comprehensive manner; is there adequate attention to ensuring the scientific quality of the work; are coherence and integration of results within and between Core Projects being achieved?

Scientific relevance

Are the IGBP and Core Project and Framework Activity implementation plans still addressing the important issues?

Links to other programmes

Has effective collaboration been achieved with other relevant international global change research programmes, in particular Human Dimensions of Global Environmental Change Programme (HDP) and the World Climate Research Programme (WCRP)?

Data systems

What have been the bottlenecks in identifying needs for global data sets, developing new sets with global coverage and providing easy access to such data sets, and how have they been addressed? Has the distribution of data been approached in the best way?

Global change monitoring

Has the IGBP sufficiently addressed the need for monitoring of key parameters and established appropriate linkages with the internationally planned global monitoring programmes (Global Climate Observing System, Global Ocean Observing System, Global Terrestrial Observing System)?

Policy relevance

How much impact has the work of the IGBP had in the policy sector; what improvements are needed to enhance that impact?

Communication, publications

Has communication of the results been sufficient and effective: to the scientific community, to the policy sector (science and environmental policy), to the general public?

Funding

Has the level of science funding been adequate; how have funding problems of the research been addressed (priority setting); has the funding of the central activities been adequate; have problems in the central funding been adequately addressed?

Capacity building

Has sufficient attention been given to the need for involving all relevant disciplines in research in all regions of the world? Has the involvement of the third world in IGBP research been sufficient; what is needed to enhance that involvement?

Links to national research programmes

Are the mechanisms to adopt and guide national research contributions to Core Project research sufficiently developed to ensure coherence and full implementation?

Organisation and structure

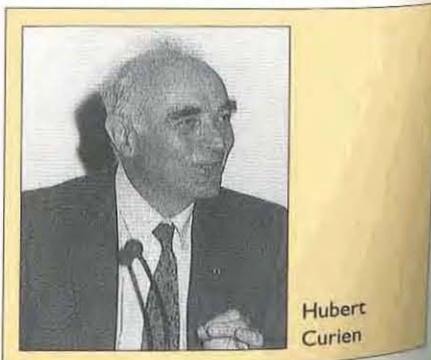
Is the organisation and the management of the IGBP and its component activities adequate (structure, procedures, quality) to effectively achieve the objectives?

Recommendations (to come)

Implementation

The evaluation is guided by a sponsors' committee chaired by Michel Petit (ICSU). Other members of the sponsors' committee are Istvan Lang (ICSU), Robert Corell (IGFA), Werner Menden (IGFA), the Chairman of the SC-IGBP, Peter Liss, and the IGBP Executive Director, Thomas Rosswall/Chris Rapley.

An Evaluation Committee has been appointed under the chairmanship of Professor Hubert Curien. All committee members are distinguished leaders in science and policy, and have broad experience in rele-



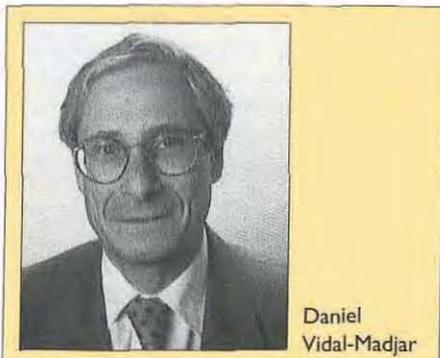
Hubert
Curien

vant scientific and/or policy areas. They are not directly involved with the IGBP. Collectively they have knowledge of the sister programmes HDP and WCRP, and also with the policy process, including the Intergovernmental Panel on Climate Change and the International Negotiating Committee for the Framework Convention on Climate Change. This committee will be solely responsible for the planning and conduct of the evaluation within the terms-of-reference established by the sponsors group.

One member of the Evaluation Committee per Core Project or Framework Activity has been identified as responsible for evaluating the issues listed in the terms-of-reference that are relevant to that specific project or activity. In this evaluation, the committee will be assisted by three experts per Core Project and Framework Activity with more detailed knowledge of the project to be evaluated. One of the experts will be asked to serve as rapporteur for a draft of the project evaluation.

The Evaluation Committee will be assisted by Daniel Vidal-Madjar, ICSU Staff Officer on Environmental and Earth System Research. Consultations with bodies performing evaluations, such as those at UNESCO, the European Commission and OECD, will ensure that the evaluation is performed in an optimal fashion. The first meeting of the Evaluation Committee will take place at ICSU in Paris on 5-6 July 1994 and it is expected that the final meeting will be held within 12 months.

The members of the Evaluation Committee are: Hubert Curien, Chairman (Paris, France) Amadou Tidian Ba (Dakar, Senegal), André L. Berger (Louvain-la-Neuve, Belgium), Eileen Buttle (Swindon, UK), David Carson (Bracknell, UK), Brian Flannery (Annandale, NJ, USA), José Goldemberg (São Paulo, Brazil), Gotthilf Hempel (Bremen, Germany), Yoshinori Ishii (Tsukuba, Japan), Valentin Koptuyug (Novosibirsk, Russia), Devendra Lal (La Jolla, CA, USA), Jean-François Minster (Toulouse, France), Graeme I. Pearman (Mordialloc, Victoria, Australia), John W. B. Stewart (Saskatoon, Canada), Sun Shu (Beijing, China), Anne V. Whyte (Ottawa, Canada)



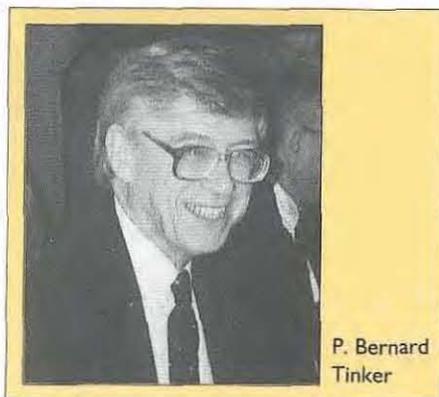
Daniel
Vidal-Madjar

People with IGBP

New member of the GCTE Scientific Steering Committee

C. Lee Campbell joined the Scientific Steering Committee for Global Change and Terrestrial Ecosystems in May. He is Professor in the Department of Plant Pathology, North Carolina State University, a Collaborator with the US Department of Agriculture's Agricultural Research Service, and Technical Director of the Agroecosystem Resource Group of the US Environmental Protection Agency's Environmental Monitoring and Assessment Program. As Director of the EMAP-Agroecosystems Program, which co-ordinates interagency activities in programme development for pilot field studies, Campbell leads the development, evaluation and implementation of a monitoring programme designed to evaluate the status, trends, and change in the condition of US agroecological resources on a regional and national basis.

Professor Campbell's areas of research expertise cover quantitative epidemiology of plant diseases, environmental monitoring and assessment of agroecosystem health, and the history and development of phytopathology.

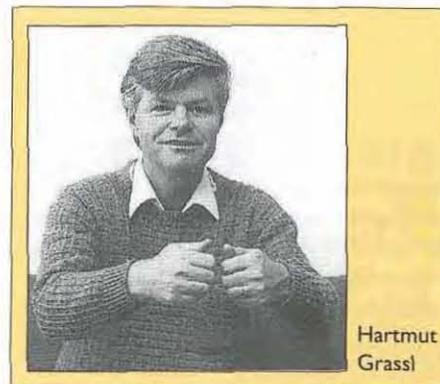


P. Bernard
Tinker

The Council of the Royal Geographical Society has awarded the Busk Medal to P. Bernard Tinker for contributions to global terrestrial research. Dr. Tinker is a member of the Scientific Committee for the IGBP since 1993, and of the Scientific Steering Committee for GCTE, where he is leader of Focus 3 research on global change impact on agriculture and forestry.

New Director of the World Climate Research Programme

Hartmut Grassl, Professor at the Max Planck Institute for Meteorology in Ham-



Hartmut
Grassl

burg, has accepted the joint invitation of the World Meteorological Organisation, ICSU, and the Intergovernmental Oceanographic Commission to become Director of the World Climate Research Programme. The WCRP, whose Secretariat is located at the WMO headquarters in Geneva, is the sister programme to the IGBP. Prof. Grassl plans to take up the post on 1 October.

Since 1988 Prof. Grassl has been head of the Experimental Meteorology Department at the University of Hamburg, and one of the three directors of the Max Planck Institute for Meteorology. His scientific interests range over many facets of Earth system sciences, from atmospheric radiation transfer and the radiative impact of aerosols, to the numerical modelling of the coupled atmosphere-land-ocean ice-system.

He is also one of the Vice Chairmen of the IPCC Working Group on Science, and chairs the Global Change Advisory Board of the German government.

Professor Grassl replaces Pierre Morel who will retire in as the Director of the WCRP in July. Professor Morel has held this post since 1982, and was responsible for formulating the original framework of the WCRP, steering the diverse communities of atmospheric scientists, oceanographers, hydrologists and polar scientists toward an integrated multi-disciplinary perception of climate research. He was one of the original members of the Joint Organising Committee for the Global Atmospheric Research Programme (GARP), the immediate predecessor to the WCRP. He is Professor at the University of Paris, lecturing in basic physics, geophysical fluid dynamics, meteorology, oceanography and climate dynamics.

Announcements

Head of the BAHC Core Project Office

The International Geosphere-Biosphere Programme (IGBP) invites applications for the position of the Head of the Biospheric Aspects of the Hydrological Cycle Core Project Office (BAHC CPO). 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 BAHC project includes: patch scale observational and modelling studies of soil-vegetation-atmosphere transfer processes; regional scale studies of hydrological fluxes and other land-atmosphere interactions; spatial and temporal synthesis of biospheric parameters at the regional to continental scale; and the down-scaling of weather information from GCMs, for application to ecosystem research.

Under the direction of the BAHC Scientific Steering Committee (SSC) and its chairman, the Head of the BAHC CPO will be responsible for guiding the development and implementation of the core project. In particular, the Head 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 the World Climate Research Programme, Human Dimensions of Global Environmental Change Programme, and the International Hydrological Programme, as well as improvement of links to international socio-economic science groups
- supervise the scientific, administrative, and financial staff of the Core Project Office (ca. 3 persons).

The successful candidate should

- have international research reputation and a Ph.D. degree 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 travel to all parts of the world
- have excellent command of both written and spoken English; knowledge of other languages is an advantage.

The Head of the BAHC CPO, to be appointed for a 3-year period (with the possibility of renewal) will be an employee of the Potsdam Institute of Climate Impact Research (PIK). The Head works under the directives of the BAHC SSC, and reports to its Chair. The salary will be negotiable in the framework of the salary scale for public employees in Germany, and will take due account of experience and qualifications of the candidate and the costs and benefits of living in Germany.

A letter of application, with a *curriculum vitae* and the names of two referees, should be received no later than 15 July 1994 by Dr. P. 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, or by Dr. A. Becker, BAHC SSC Vice Chair, PIK, Telegraphenberg, D-14473 Potsdam, Germany, tel.: (+49-331) 288 2541, fax: (+49-331) 288 2640.

NB: If you have not read this before the deadline and wish to apply, contact immediately the above addresses and mention that you have seen the announcement here in the June issue of the *Global Change Newsletter*, in which case your application will be taken into consideration.

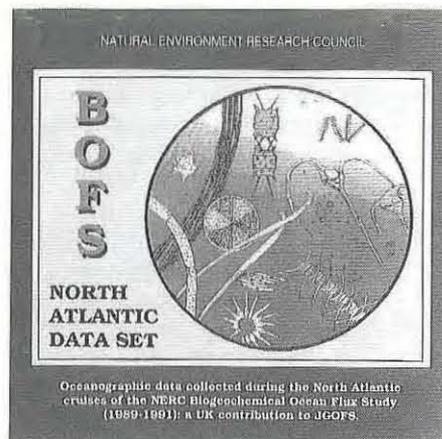
Internet information from Finland

Information concerning the Finnish Research Programme on Climate Change can be obtained from Internet. Go to Finnish Gophers and to item 31, Academy of Finland. At the present, there are lists of the projects and the publications of the programme, detailed description of the programme and a section "current in SIL-MU". In June the abstracts of all the projects will be published as well as the address list of the researchers. At present more than 70 individual research projects

have been included in the programme, ranging from atmospheric chemistry to sociology. There are currently more than one hundred and eighty scientists working within the programme in eight universities and eleven research institutions.

UK-JGOFS North Atlantic database on compact disk

The data base for UK Joint Global Ocean Flux Study in the North Atlantic has been released on CD-ROM by the British Oceanographic Data Centre (BODS), Bidston. It contains in a readily accessible (and easily manipulated) form the main data sets arising from 11 research cruises of the Biogeochemical Ocean Flux Study (BOFS) over the period 1989-1991. In addition to the JGOFS level 1 measurements, as a "kit form" data base, the CD-ROM includes



Seasonal and underway carbon-chemistry data; phytoplankton species composition; Kasten core X-ray images and other benthic data; a selection of relevant processed satellite (AVHRR) imagery; and CTD profile plots - all with protocol documentation. An attractively packaged User Guide, with supporting software (IBM compatible), is provided with the CD-ROM. Copies of the UK-JGOFS DC-ROM database are available to researchers (for non-commercial use) at £50, the charge being necessary to cover their production costs.

Contact:

Dr. Roy Lowry, BODC at NERC Proudman Oceanographic Laboratory, Birkenhead, Merseyside L43 7RA, UK. Tel: (+44-51) 653 8633, Fax: (+44-51) 652 3963

low, Virginia Institute of Marine Science, The College of William and Mary, PO Box 1346, Gloucester Point, VA 23062 USA. Tel: (+1 804) 642-7332, Fax: (+1 804)-642-7079, E-mail: hducklow@vims.edu

21-23 October, Washington DC, USA

PAGES Workshop multi-proxy-mapping. Contact: Eric Grimm, Illinois State Museum, 1920 South 10 1/2 Street, Springfield IL 62703 USA. Tel: (+1 217) 785 486, Fax: (+1 217) 785 2857, E-mail: grimm@denr1.igis.uiuc.edu

24-28 October, Potsdam, Germany

GCTE Functional Types Symposium. Wolfgang Cramer, Potsdam Institute for Climate Impact Research, Telegrafenberg, D-14412 Potsdam, Germany. Fax: (+49 331) 310 011

25 October, Seattle, USA

PAGES Scientific Session at the Geological Society of America to report on PALE results. Gifford Miller, Institute of Arctic and Alpine Research, University of Colorado, Campus Box 450, Boulder CO 80309, USA. Fax: (+1 303) 492 6388

26-28 October, Paris, France

IGBP-DIS Standing Committee.

31 October-1 November, Stockholm, Sweden

3rd Core Project Officers Meeting. IGBP Secretariat

2-4 November, Stockholm, Sweden

BAHC-IGAC-GCTE Task Team Meeting: Planning of Siberian Transect-Land Surface Experiment. Will Steffen, GCTE Core Project Officer, Division of Wildlife and Ecology, CSIRO, PO Box 84, Lyncham ACT 2602, Australia. Fax: (+61-6) 241 2362, Internet: wls@ebr.dwe.csiro.au

14-15 November, Venice, Italy

Pages Executive Meeting. Contact: Suzanne Leroy, PAGES Core Project Office, Bärenplatz 2, CH 3011 Bern, Switzerland. Tel: (+41-31) 312 31 33, Fax: (+41-31) 312 31 68, E-mail: pages@ub.edu.unibe.ch

14-16 November, Salvador, Brazil

GCTE Cassava Network Inauguration. John Ingram, CGTE Focus 3 Office, Dept. of Plant Sciences, University of Oxford, South Parks Rd., Oxford OX1 3RB, UK. Fax: (+44 865) 275 060, Internet: ingram@vax.ox.ac.uk

14-17 November, Sapporo, Japan

International Symposium on Global Fluxes of Carbon and its Related Substances in the Coastal Sea-Ocean-Atmosphere System, including LOICZ Focus 1 Workshop on Coastal Modelling. Shizuo Tsunogai, Faculty of Fisheries, Hokkaido University, Hakodate 041, Japan. Fax: (+81-138) 43 5015, Tel: (+81-138) 40 8808 or Tetsuo Yanagi, Faculty of Engineering, Ehime University, Bunkyo 3, Matsuyama 790, Japan. Tel: (+81-899) 24 7111, Fax: (+81-899) 27 5852, Internet: yanagi@ehimegw.dpc.ehime-u.ac.jp

14-18 November, India

START Regional Committee for South Asia (SASCOM) Planning Workshop on Climate Variability and its Implications, in conjunction with GCTE and CLIVAR (WCRP)

14-25 November, North Ryde, Sydney, Australia

PILPS-GAIM-BAHC-GCTE Workshop on Regional Interactions of Climate & Ecosystems (RICE): Soil Moisture, Vegetation & Climate Code Comparison. Ann Henderson-Sellers, Climatic Impacts Centre, Macquarie University, Balaclava Road, North Ryde NSW 2109, Australia. Fax: (+61-2) 805 8428. Internet: ann@mqclimat.cic.mq.edu.au

16-19 November, Venice, Italy

PAGES-CLIVAR (Climate Variability and Predictability) Joint Meeting. Jean-Claude Duplessy, Centre des Faibles Radioactivités, CNRS-CEA BP 1, Parc du CNRS, Av. de la Terrasse, Gif-sur-Yvette F-91198, France. Fax: (+33-1) 69 82 35 68, Internet: duplessy@eole.cfr.cnrs.gif.fr

21-22 November, Kathmandu, Nepal

Second Meeting of the START Regional Committee for South Asia (SASCOM). A.P. Mitra, National Physical Laboratory, Hillside Rd. New Delhi 110 012, India. Tel: (+91 11) 575 2678, Fax: (+91-11) 575 2678, Internet: apm@sirnetd.ernet.in; apmitra@doc.ernet.in

21-23 November, Piracicaba, Brazil

BAHC Planning Meeting for the Hydrological Component of the joint IGBP-WCRP Regional Scale Land-Surface Experiment in Amazonia. Reynaldo Luiz Victoria, Centro de Energia Nuclear na Agricultura, Uni. de São Paulo-Piracicaba, Avenida Centenario 303, CP 96, Piracicaba, SP, Brazil. Tel: (+55-194) 335 122, Fax: (+55-334) 228 339, Internet: reyna@pintado.ciagri.usp.br

November, Seattle, WA, USA

IGAC-TRAGEX (Trace Gas Exchange between Mid-Latitude Terrestrial Ecosystems and Atmosphere) Coordinating Committee meeting. K. A. Smith, Edinburgh School of Agriculture, West Mains Rd. Edinburgh EH9 3JG, UK. Fax: (+44 31) 667 2601

November, Oxford, UK

GCTE Crops Committee Business Meeting. John Ingram, CGTE Focus 3 Office, Dept. of Plant Sciences, University of Oxford, South Parks Rd., Oxford OX1 3RB, UK. Fax: (+44 865) 275 060, Internet: ingram@vax.ox.ac.uk

November, Reno, NV, USA

GCTE CO₂-Stress Interactions. Jeff Seeman and Tim Ball, Desert Research Institution, Biological Sciences Center, 7010 Dandini Blvd. Reno, NV 89512, USA.

November, Italy or USA

BAHC Focus 3 Workshop on Strategies for Monitoring and Modelling CO₂ and Water Fluxes over Terrestrial Ecosystems. Riccardo Valentini, University of Tuscia, Dept. of Forest Science and Environment, Via S. Camillo de Lellis, I-01100 Viterbo, Italy. Fax: (+39 761) 357 389, Internet: rik@tusmx1.utovrm.i

12-15 December, Canberra, Australia

9th Meeting of the Scientific Committee for the IGBP. IGBP Secretariat and Brian Walker, CSIRO, Division of Wildlife and Ecology, PO Box 84, Lyncham ACT 2602, Australia. Fax: (+61-6) 241 3343 or 241 1742

December, Fort Collins, Colorado, USA

GCTE Soil Organic Matter Committee Business Meeting. John Ingram, CGTE Focus 3 Office, Dept. of Plant Sciences, University of Oxford, South Parks Rd., Oxford OX1 3RB, UK. Fax: (+44 865) 275 060, Internet: ingram@vax.ox.ac.uk

December, Abidjan, Ivory Coast

Third Meeting of the START Regional Committee for Northern Africa (NAFCOM). Amino Anabelle Konan-Brou, Centre de Recherches Océanologiques, Laboratoire d'Ecologie Benthique, 29, rue des pêcheurs BP V 18 Abidjan, Côte d'Ivoire. Tel: (+225) 35 50 14; Telex: 214 235 mix croa, Fax: (+225) 35 11 55

December, Abidjan, Ivory Coast

START Workshop on Desertification, Deforestation and Vegetation Change: Impacts on and from Climate and Climate-Driven Land Cover Change, Including Biomass Burning, in conjunction with Measurements of Trace Chemical Fluxes, IGAC-DEBITS (Deposition of Biogeochemically Important Trace Species)-MEDIAS. Amino Anabelle Konan-Brou, Centre de Recherches Océanologiques, Laboratoire d'Ecologie Benthique, 29, rue des pêcheurs BP V 18 Abidjan, Côte d'Ivoire. Tel: (+225) 35 50 14; Telex: 214 235 mix croa, Fax: (+225) 35 11 55

End 1994-early 1995

IGAC-GLOCHEM (Global Atmospheric Chemical

Survey) Aircraft Group meeting. D. H. Ehhalt, Institute for Atmospheric Chemistry, KFA Research Centre Jülich GmbH, Leo-Brand-Strasse, PO Box 19 13, D-52425 Jülich, Germany. Fax: (+49 2461) 61 5346, Internet: ICH302@zam001.zam.kfa-juelich

End 1994-early 1995, USA or China

IGAC-MILOX (Mid-Latitude Ecosystems and Photochemical Oxidants) Implementation Planning Meeting. William L. Chameides, Georgia Institute of Technology, School of Geophysical Sciences, 923 Dalney St. Baker Bldg. Atlanta, GA 30332-0340, USA. Fax: (+1-404) 853 0232, Internet: wcham@eas.gatech.edu

End 1994-early 1995, Germany

IGAC Task Force on Microorganisms and Soil. R. Conrad, Max Planck Institute for Terrestrial Microbiology, Division of Biogeochemistry, Karl-von-Frisch-Strasse, D-35043 Marburg/Lahn, Germany. Fax: (+49 6421) 16 1470, Internet: conrad@mail.uni-marburg.de; conrad@papin.HRZ.Uni-Marburg.de

End 1994-early 1995

START Regional Committee for Oceania. Jane Soons, Dept. of Geography, University of Canterbury, Private Bag 4800, Christchurch, New Zealand. Fax: (+64 3) 364 2907, Internet: a.moloney@scs.canterbury.ac.nz

End 1994-early 1995

BAHC Focus 4 Open Meeting on the Weather Generator. Ephrat Lahmer-Naim, BAHC Core Project Office, Institute for Meteorology, Freie Universität Berlin, Carl-Heinrich-Becker-Weg 6-10, D-12165 Berlin, Germany. Fax: (+49-30) 838-711 85, Internet: ephrat@fub46.zedat.fu-berlin.de and Brad Bass, Atmospheric Environment Service, Canadian Climate Centre, 4905 Dufferin Street, Downsview, Ontario M3H 5T4, Canada. Tel: (+1-416) 739 4358, Fax: (+1-416) 739 4297, E-mail: bbass@cid.aes.doe.ca

1995

January, Nairobi, Kenya

START Workshop on Modelling Climate Systems, with GAIM and MEDIAS (France).

16-19 January, Cape Town, South Africa

JGOFs Executive Committee

January

IGBP-WCRP Joint Working Group on Land-Surface Experiments. James Shuttleworth, Department of Hydrology and Water Resources, College of Engineering and Mines, Building 11, University of Arizona, Tucson, AZ 85721, USA. Fax: (+1 602) 621 1422, Internet: shuttle@hwr.arizona.edu (Internet)

January/February, Kathmandu, Nepal

BAHC-GCTE-SASCOM Workshop on Global Change and Mountainous Regions. Alfred Becker, Potsdam Institute for Climate Impact Research, Telegrafenberg, PO Box 601203, D-14412 Potsdam, Germany. Fax: (+49-331) 288 2600, Internet: becker@pik-potsdam.de

February, Hawaii, USA

IGAC Aerosol Characterization Experiment Meeting to Discuss Requirements and Plan Specifics of Modelling Aspects. Timothy S. Bates, National Oceanic & Atmospheric Administration, PMEL-OCRD, Bldg. 3, 7600 Sand Point Way NE, Seattle, WA 98115, USA. Fax: (+1 206) 526 6744, Internet: bates@noaa.pmel.gov, Omnet: T.Bates

February-March

GCTE-LUCC-GAIM-DIS Workshop on Incorporating Land-Use Change in Dynamic Global Vegetation Models.

March, Mendoza, Argentina

PAGESSSC meeting. Contact: Suzanne Leroy, PAGES Core Project Office, Bärenplatz 2, CH 3011 Bern.

Switzerland. Tel: (+41-31) 312.31.33, Fax: (+41-31) 312.31.68, E-mail: pages@ubcclu.unibe.ch

March, Venezuela

IGAC Scientific Steering Committee. Alex Pszenny, IGAC Core Project Office, Building 24-409, Massachusetts Institute of Technology, Cambridge, MA 02139, USA. Fax: (+1-617) 253 9886, Internet: pszenny@mit.edu

13-15 March, Buenos Aires, Argentina

GCTE Scientific Steering Committee Meeting. Will Steffen, GCTE Core Project Officer, Division of Wildlife & Ecology, Commonwealth Scientific & Industrial Research Organization (CSIRO), PO Box 84, Lyncham ACT 2602, Australia. Fax: (+61 6) 241 2362. Internet: wls@cbr.dwe.csiro.au

13-16 March, Garmisch-Partenkirchen, Germany

IGAC-GLONET (Global Tropospheric Ozone Network) Coordinating Committee Meeting. V. A. Mohren, Dept. Earth Sciences University of New York of Stony Brook, 1400 Washington Avenue, Albany, NY 12222, USA.

13-17 March, Williamsburg, VA, USA

IGAC-BIBEX (Biomass Burning Experiment) Coordinating Committee Meeting: M. O. Andreae, Max-Planck-Institute for Chemistry, Biogeochemistry Dept., Saarstrasse 23, Postfach 3060, D-55020 Mainz, Germany. Fax: (+49 6131) 305 487, Internet: moa@diane.mpch-mainz.mpg.de

20-24 March, Bangkok, Thailand

GCTE Rice Network Planning Workshop. M. Kropff, International Rice Research Institute, PO Box 933, 1099 Manila, Philippines. Fax: (+63 2) 817 8470, 818 2087

27-31 March, Reading, UK

GCTE Wheat Network Experimentation and Modelling Workshop. John Ingram, GCTE Focus 3 Office, Dept. of Plant Sciences, University of Oxford, South Parks Rd., Oxford OX1 3RB, UK. Fax: (+44 865) 275 060, Internet: ingram@vax.ox.ac.uk

March or April, Tokyo, Japan

IGAC-APARE (East Asian-North Pacific Regional Study) Coordinating Committee Meeting. Hajime Akimoto, Research Center for Advanced Science and Technology, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153, Japan. Fax: (+86-3) 3481 4562, Internet: akimothj@tansei.cc.u-tokyo.ac.jp

Early April, Hamburg, Germany

5th BAHC Scientific Steering Committee. BAHC Core Project Office, Institute for Meteorology, Freie Universität Berlin, Carl-Heinrich-Becker-Weg 6-10, D-12165 Berlin, Germany. Fax: (+49-30) 838-711 85, Internet: bahc@fub46.zedat.fu-berlin.de

3-7 April, Hamburg, Germany

First BAHC Science Conference, in conjunction with the EGS General Assembly. Pavel Kabat, Winand Starfing Centre, PO Box 125, NL-6700 AC Wageningen, The Netherlands. Fax: (+31) 8370 24812, Internet: kabat@sc.agro.nl

24-26 April, Pretoria, South Africa

Global Environmental Change: Implications for Southern Africa. Regional Conference on Southern Africa's Scientific Input to Global Environmental Change, organised by South Africa IGBP National Committee. Louise Botten, Coordinator, Foundation for Research Development, PO Box 2600, Pretoria 0001, South Africa. Fax: (+27-12) 841 3791, Internet: louise@frd.ac.za

April-May, Qingdao, China

LOICZ Scientific Steering Committee. John Pernetta, LOICZ Core Project Office, Netherlands Institute for Sea Research, PO Box 59, 1790 AB Den

Burg-Textel, Netherlands. Fax: (+31) 2220 69430, Internet: Pernetta@nioz.nl

April-May, South East Asia

LOICZ Open Science Meeting. John Pernetta, LOICZ Core Project Office, Netherlands Institute for Sea Research, PO Box 59, 1790 AB Den Burg, Texel, The Netherlands. Fax: (+31) 2220 69430, Internet: pernetta@nioz.nl

April-May, Hawaii, USA

BAHC Focus 1 Workshop on SVATs: Components, Synthesis, Comparison & Validation. Steven W. Running, School of Forestry, University of Montana, Missoula, MT 59812, USA. Fax: (+1-406) 243 4510, Internet: srunning@nasamail.nasa.gov; swr@hps1.ntsg.umt.edu

April-May

GCTE-IGAC Soils Workshop.

April-May, Brazil or USA

LBA (LAMBADA-BATERISTA-AMBIACE) Planning Meeting. Carlos Nobre, Centre for Weather Forecasting & Climate Research, National Space Research Institute, Av. dos Astronautas 1758, CP 515, 12.227-010 São José dos Campos, SP, Brazil. Tel (+55-123) 41 8977, ext. 270, Fax: (+55-123) 41 1876, Internet: nobre@cptec.inpe.br, OMNET: INPE.MET

9-13 May, Villefranche, France

JGOFS Scientific Symposium. Guy Jacques, Observatoire Océanographique de Banyuls, Observatoire Océanologique de Banyuls du CNRS, F-66650 Banyuls-sur-Mer, France. Fax: (+33) 68 88 10 69.

July, USA

GCTE Meeting on Development of Dynamic Global Vegetation Model. Will Steffen, GCTE Core Project Officer, Division of Wildlife and Ecology, CSIRO, PO Box 84, Lyncham ACT 2602, Australia. Fax: (+61-6) 241 2362, Internet: wls@cbr.dwe.csiro.au

August, Russia

PAGES Multiproxy Mapping Session at the International Geographical Union, Moscow, Russia. A. Velichko, Institute of Geography, Academy of Sciences, Staromonetny per 29, Moscow 109017, Russia. Tel: (+7 095) 238 02 9+8, Telex: (64) 411781 globe, Fax: (+7 095) 230 20 90

6-12 August, Tampere, Finland

GCTE Session at the International Union of Forestry Research Organisations XX World Congress.

August, Seattle, WA, USA

IGAC-MAC Aerosol Measurement Protocol Development Workshop. Timothy S. Bates, National Oceanic & Atmospheric Administration, PMEL-OCRD, Bldg. 3, 7600 Sand Point Way NE, Seattle, WA 98115, USA. Tel: (+1 206) 526 6248, Fax (+1 206) 526 6744, Internet: bates@noaa.pmel.gov, Omnet: T.Bates

25-29 September, Garmisch-Partenkirchen, Germany

GAIM Science Conference. Berrion Moore, Berrion Moore, Institute for the Study of Earth Oceans and Space (EOS), Complex Systems Research Center, Morse Hall, 39 College Rd., University of New Hampshire, Durham, NH 03824-3525, USA. Fax: (+1 603) 862 1915, Omnet: B.Moore

Autumn, USA

BAHC Focus 3-GCTE Workshop on Classifying Terrestrial Vegetation: The Role of Plant Functional Types. Steven W. Running, School of Forestry, University of Montana, Missoula, MT 59812, USA. Fax: (+1-406) 243 4510, Internet: srunning@nasamail.nasa.gov, swr@hps1.ntsg.umt.edu

October, Beijing, China

IGAC Scientific Steering Committee. Alex Pszenny, IGAC Core Project Office, Building 24-409, Massa-

chusetts Institute of Technology, Cambridge, MA 02139, USA. Fax: (+1-617) 253 9886, Internet: pszenny@mit.edu

October, Beijing, China

WMO-IGAC Conference on the Measurement and Assessment of Atmospheric Composition Change (Third IGAC Scientific Conference)-Contact: J. M. Miller, World Meteorological Organisation, 41 Avenue Giuseppe Motta, CP 2300, CH-1211 Geneva 2, Switzerland. Fax: (+41 22) 740 0984. Omnet: J.Miller.ARL, Internet: j.miller.arl@omnet.nasa.gov

20 October, Beijing, China

10th Meeting of the SC-IGBP. IGBP Secretariat

21-22 October, Beijing, China

ICSU Global Change Forum. ICSU Secretariat, 51 bd. de Montmorency, 75016 Paris, France. Fax: (+33-1) 42 88 94 31, 45 24 01 16, Internet: icsu@paris7.jussieu.fr

23-27 October, Beijing, China

SAC IV: Fourth Scientific Advisory Council for the IGBP. IGBP Secretariat

28 October, Beijing, China

10th Meeting of the SC-IGBP (continued)

November-December

PAGES-PEP II (Pole-Equator-Pole) Investigators meeting.

1996

Spring, Brazil

BAHC Focus 3-GCTE-GEWEX Workshop on Bidirectional Ecosystem-Atmosphere Interactions at the Mesoscale. Roni Avissar, Department of Meteorology & Physical Oceanography, Rutgers University, Cook College, PO Box 231, New Brunswick, NJ 08903-023, USA. Fax: (+1-908) 932 7922, Internet: avissar@gaia.rutgers.edu

Autumn, USA

BAHC Focus 3-GCTE-IGBP-DIS Workshop on Large-Scale Pattern and Process in Root System Structure and Dynamics. Bhaskar Choudhury, NASA/Goddard Space Flight Center, Code 974, Greenbelt, Maryland 20071, USA. Fax: (+1-301) 286 1758

ACRONYMS

AMBIACE	Amazon Biogeochemistry and Atmospheric Chemistry Experiment
BAHC	Biospheric Aspects of the Hydrological Cycle
BATERISTA	Biosphere-Atmosphere Transfers and Ecological Research <i>In situ</i> Studies
GAIM	Global Analysis, Interpretation and Modelling
GCTE	Global Change and Terrestrial Ecosystems
GEWEX	Global Energy and Water Cycle Experiment (WCRP)
IGAC	International Global Atmospheric Chemistry Project
IGBP-DIS	IGBP Data and Information System
JGOFS	Joint Global Ocean Flux Study
LAMBADA	Large Scale Atmospheric Moisture Balance of Amazonia using Data Assimilation
LOICZ	Land Ocean Interactions in the Coastal Zone
LUCS	Land Use/Cover Change
PAGES	Past Global Changes
SAFCOM	START Regional Committee for Southern, Central and Eastern Africa
SARCS	Southeast Asia Regional Committee for START
START	Global Change System for Analysis, Research and Training

Publications

IGBP Publications

IGBP Report No. 30

IGBP Global Modelling and Data Activities, 1994-1998. Strategy and Implementation Plans for Global Analysis, Interpretation and Modelling (GAIM) and the IGBP Data and Information System (IGBP-DIS). Stockholm: IGBP, 86 pp.

This report sets out the goals and directions for GAIM and IGBP-DIS over the next five years, expanding on the recent overview of their activities within IGBP Report 28 (1994). It describes the work within IGBP-DIS directed at the assembly of global databases of land surface characteristics, and within GAIM, directed at modelling the global carbon cycle and climate-vegetation interactions

IGBP Report No. 31

African Savannas and the Global Atmosphere. Research Agenda. 1994. Report of a joint IGBP/START/IGAC/GCTE/GAIM/DIS Workshop on African Savannas, Land use and Global Change: Interactions of Climate, Productivity and Emissions, 1-5 June 1993, Victoria Falls, Zimbabwe. Edited by Chris Justice, Bob Scholes & Peter Frost. Stockholm: IGBP, 53 pp. *The workshop focused on interactions between African savannas and the global atmosphere, specifically addressing land-atmosphere interactions, with emphasis on sources and sinks of trace gases and aerosol particles. The report discusses the ecology of African savannas, the research issues related to carbon sequestration, ongoing and proposed activities, and gives a research agenda.*

Core Projects

Global Change and Terrestrial Ecosystems

The Application of Patch Models of Vegetation Dynamics to Global Change Issues. Workshop Summary, Edited by: T. M. Smith, R. Leemans & H. H. Schugart. [Off-print by Kluwer Academic Publishers, Netherlands. The proceedings of the Workshop are being submitted for publication as a special issue of the journal *Climatic Change*]. Thomas M. Smith, Department of Environmental Sciences, University of Virginia, Clark Hall, Charlottesville, VA 22903, USA. Fax: (+1-804) 982 2137, Internet: tms@virginia.edu

International Global Atmospheric Chemistry Project

Southern Hemisphere Marine Aerosol Characterization Experiment (ACE-1) Radiative Effects of Aerosols in the Remote Marine Atmosphere. Science and Implementation Plan, April 1994. Cambridge: IGAC Multiphase Atmospheric Chemistry (MAC) & Marine Aerosol & Gas Exchange (MAGE) Activities. Alex Pszenny, IGAC Core Project Office, Massachusetts Institute of Technology, Building 24-409, Cambridge, MA 02139, USA. Fax: (+1-617) 253 9886, Internet: pszenny@mit.edu.

Biospheric Aspects of the Hydrological Cycle

BAHC Report #1: The Weather Generator Project. Summary report on Activity 4.1: Data Requirements for Ecological and Hydrological Studies and Related Management Purposes (Bratislava, SK, 16-18 September 1993). Planning Report on Activity 4.2: Development of the Weather Generator (Toronto, Canada, 1-3 December 1993).

BAHC Report #2: Climate-Hydrology-Ecosystems Interrelations in Mountainous Regions (CHESMO), and international initiative for integrative research (St. Moritz, Switzerland, 2-5 December 1993).

Joint Global Ocean Flux Study and Land-Ocean Interactions in the Coastal Zone

Report of the JGOFS/LOICZ Task Team on Continental Margin Studies, April 1994. JGOFS Report No. 15. JGOFS Core Project Office, Institut für Meereskunde, Universität Kiel, Düsternbrooker Weg 20, D-24105 Kiel, Germany. Fax: (+49-431) 565 876, Internet: jgofs@meereskunde.uni-kiel.d400.de

Land-Ocean Interactions in the Coastal Zone

Economic and Social Impacts of Global Change on Coastal Systems. 1994. Report of the Workshop on LOICZ Focus 4, Amsterdam, 30 March 1994. LOICZ Meeting Report No. 1. LOICZ Core Project Office, Netherlands Institute for Sea Research (NIOZ), Texel, The Netherlands

Past Global Changes

Research Protocols for PALE: Paleoclimates of Arctic Lakes and Estuaries. 1994. Issued by PALE Steering Committee. PAGES Workshop Report Series, 94-1. PAGES Core Project Office, Bärenplatz 2, CH-3011 Berne, Switzerland. Fax: (+41-31) 312 31 68, Internet: pages@ubeclu.unibe.ch

National IGBP Committees

Finland

Carter, Tim; Eero Holopainen & Markku Kanninen, (eds) 1993. Techniques for Developing Regional Climatic Scenarios for Finland. The Finnish Research Programme on Climate change (SILMU). Publications of the Academy of Finland 2/93. 63 pp.

Kanninen, Markku, (ed) 1993. Carbon Balance of World Forested Ecosystems: Towards a Global Assessment. Proceedings of the IPCC AFOS Workshop held in Joensuu, Finland, 11-15 May 1992. The Finnish Research Programme on Climate Change (SILMU). Publications of the Academy of Finland 3/93. 271 pp.

Kanninen, Markku & Pirkko Heikinheimo (Eds) 1994. The Finnish Research Programme On Climate Change. Second Progress Report. Publications of the Academy of Finland 1/94.

The above publications are available at: The Academy of Finland/SILMU, PO Box 57, SF-00551 Helsinki, Finland. Fax: (+358-0) 7748 8299

Netherlands

The Collaboration Between Natural and Social Sciences in Global Environmental Change Research. 1994 Proceedings of the IGFA Meeting, Noordwijk, The Netherlands, September 1993. Edited by Haasje van der Mandele (Advisory Council for Research on Nature and Environment), Jacky Bax (Ministry of Education and Science), and Paul Berendsen (Netherlands Organisation for Scientific Research.). RMNO, 93. 94 pp. RMNO Secretariat, PO Box 5306, 2280 Rijswijk, Fax: (+31-70) 336 4310

Norway

Global Change and Arctic Terrestrial Ecosystems. An International Conference, 21-26 August 1993, Oppdal, Norway. Oslo: Recommendations, edited by Walter C. Oechel & Jarle I. Holten. 1994. Trondheim: Norwegian Institute for Nature Research, 53 pp. Jarle I. Holten, NINA, Tungasletta 2, N.7005 Trondheim, Norway. Fax: (+47) 73 91 54 33

Romania

Proceedings of the Symposium on Romanian Research with Implications for the Tasks of the International Geosphere-Biosphere Programme. 1993. (Romanian IGBP Bulletin No. 3) Prof. Liviu Constantinescu, Romanian Academy, Institute of Geography, str. D. Racovijia 12, RO-7037 Bucuresti 20, Romania. Fax: (+40-1) 312 0209

Russia

The Russian Academy of Sciences issued its first newsletter for the IGBP and the HDP in March. It gives informative reports on Russian scientific meetings, activities and results within the framework of the IGBP Core Projects, and lists of committee members and other important contacts. Vladimir M. Kotlyakov, Institute of Geography, Russian Academy of Sciences, Staromonetny per. 29, Moscow 109017, Russia. Fax: (+7.095) 230 20 90.

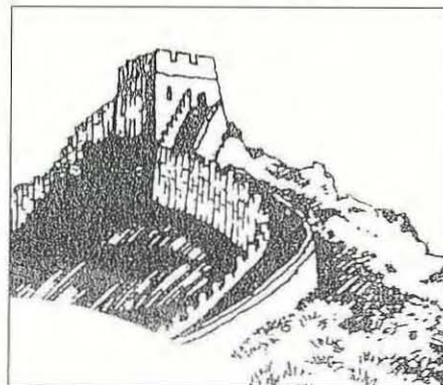
USA

Our Changing Planet. 1994. The Fiscal Year 1995 US Global Change Research Program. A Report by the Committee on Environment and Natural Resources Research of the National Science and Technology Council. Washington; 132 p. *Global Change Research Information Office, 1825 K Street, NW, Suite 805, Washington DC 20006, USA. Fax: (202) 775 6622, Internet: gbarton@gcrio.org*

SAC IV

Beijing, China

23-27 October, 1995



The Fourth Meeting of the Scientific Advisory Council for the IGBP will be hosted by the Chinese IGBP Committee in Beijing. ICSU will hold its third Global Change Forum on the two preceding days, 21-22 October.

GLOBAL CHANGE NEWSLETTER

Edited by Suzanne Nash
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