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An overview of the IGBP Congress

7-13 May, 1999, Shonan Village, Japan



Courtesy of G. Szejwach

The Executive Director of the IGBP, Will Steffen, welcomes participants at the Second IGBP Congress

"And as we look further to the future, I believe that the IGBP ten years hence will definitely be even more international; hopefully it will be younger and more reflective of the world; almost certainly, it will have closer working relationships with WCRP and the IHDP; it will be more capable and braver, and finally and in some ways unfortunately, the IGBP will be even more necessary."

Berrien Moore

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Meeting tomorrow's challenges

by Berrien Moore III

When is too much time never enough time?

At the recent IGBP Congress – so wonderfully hosted by our friends in Japan, there was the understood concern that busy scholars simply could not afford to take from their demanding schedules nearly ten straight days, including travel, for IGBP. But as the Congress drew to a close, the undercurrent was that ten days was simply not enough time to accomplish all that was needed. This is simply another reflection of the extraordinary commitments that participants in the IGBP give to addressing the challenges of global environmental change.

One aspect of this challenge that we clearly recognize is that the totality of issues that together constitute global environmental change will be with us well into the 22nd century if not the 23rd.

Hence the IGBP must always look to the future and to the sustainability of our capacity to address well Global Environmental Change.

In looking to the future, we ask naturally what should be the guiding principals that could serve as beacons for the evolution of the IGBP. Amongst these beacons are those ideas and tenants which have served the IGBP so well over the past decade. Amongst these are that the IGBP should focus on the important scientific questions of global environmental change recognizing that, by definition, this implies that the IGBP will be addressing issues of societal and, hence, political relevance. Within the context of global environmental changes, the primary niche for the IGBP is the chemical and biological processes and the associated biogeochemical subsystem, and the interplay with physical-climate subsystem and increasingly with the human system. This implies, in part, that we must seek to understand global environmental change in the context of the Earth system. This focus has been central to the IGBP since its foundation. Coming out of the Fifth Science Advisory Committee (SAC-V) meeting in Nairobi is the recognition that this global focus should be complemented by a set of regional strategies and foci.



Courtesy of G. Szejwach

The Shonan Village Center where the Second IGBP Congress took place

This capacity of the IGBP to change and evolve while preserving its core strengths and focus is central to the long-term sustainability of the IGBP and to its ability to remain effective. This is important to bear in mind as we go through this phase of synthesis and transition. It is also important to remember always that the IGBP's most important resources are people and their scientific credibility and insights. This implies strongly that any evolution must always proceed with care and with attention to the human aspects of the organization.

In Japan, I discussed what might be some of the characteristics of the future structure of the IGBP. Amongst the elements, I believe that there will continue to be a core of Earth system science and crucial focused activities. These focused activities will tend to be concentrated at important interfaces in the Earth system. Complementing these Earth system component activities, the future IGBP will include programme-wide, crosscutting studies along key thematic lines such as the carbon system, the global water cycle, and food and fibre.

Regional themes will expand slowly and carefully. Such regional studies will allow specific linkage to societal issues; moreover, regional studies will allow "full" system studies. Finally and importantly,

regional studies allow a connecting of the global with the local while avoiding confronting directly internal national issues and the associate political questions.

For the IGBP, there are several important "next steps":

- complete the Core Project and IGBP-wide syntheses;
- develop the cross cutting themes (i.e., carbon, water, food and fibre);
- clarify the outstanding new scientific challenges, and
- host an Open Science Conference in July 2001.

And as we look further to the future, I believe that the IGBP ten years hence will definitely be even more international; hopefully it will be younger and more reflective of the world; almost certainly, it will have closer working relationships with WCRP and the IHDP; it will be more capable and braver, and finally and in some ways unfortunately, the IGBP will be even more necessary.

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Facing the challenges of the new Millennium:

a LUCC / IGBP perspective

by Coleen Vogel

The IGBP Second Congress was held in the scenic environs of Shonan Village, some kilometres from one of the most densely populated cities of the world, Tokyo. It is therefore fitting that at this meeting some of the emerging issues, besides the excellent science reviews in areas such as past climate change and ocean biochemistry studies, were those dealing with impacts and consequences of global change in a world of growing populations and changing technologies. The need to re-examine our vision, of trying to strike a balance between climate and other components of global change such as land-use, biological diversity, soil degradation etc., was and is ever present. Matched with this is the need for a greater understanding of the interactions and interplay between the driving forces of environmental change, the feedbacks and responses to such changes.

Presentations and debate in several sessions highlighted the need for integrated approaches that sensitively capture global change issues at various scales (particularly the regional) as well as trying to understand the drivers of such changes. In addition to some of the broader and larger questions raised at Shonan, a set of cross-cutting themes were outlined (attainable with partnerships with those involved in WCRP, IHDP, DIVERSITAS, START and many others) namely: the Global Carbon Cycle; Water Biochemistry and Resources; Food and Fibre and Ecosystem Services. Several, if not all, of these themes are sub-areas of research attention spiralling out of the Earth system analysis approach that has been integral to IGBP science and which was endorsed at the final plenary of the meeting.

Having provided a brief overview of the congress, in terms of some of the substantial issues that emerged, the Core Projects and Programmes are now left the task of taking these suggestions forward. The Land-Use/Cover Change (LUCC) Project of IGBP and IHDP, although relatively young, has been grappling with these issues for some time and has recent-

ly produced its science implementation strategy (1) as a guiding vehicle to begin articulating the science associated with understanding land-use and land-cover change issues. Some of the key scientific issues and questions which the LUCC science community (which includes social scientists, geographers, economists etc) hope to begin to understand and document are outlined in Figure 1.

One of the unique contributions that LUCC brings to the environmental change challenge is that one begins from an understanding that environmental change is an exogenous variable for much of LUCC science. Biophysical feedbacks, more so than climate change, become a key focal point. Some of the recently identified larger questions underpinning LUCC science thus include: an improved understanding of the trajectories of land-use/land-cover change that invoke positive or negative human-environment relationships (e.g. desertification, malnutrition and chronic food insecurity on the one hand, and forestation and restoration on the other); the significance of land-use/land-cover change in terms of sources and sinks of biogeochemical elements and the need to identify the drivers shaping "critical (either vulnerable or resilient) landscapes" (1). From these efforts one tries to "socialize" or explain the drivers of change as noted in the "pixels" of landscape use and change. In short, there is a need to be able to identify landscape patterns as products of both distinctive physical and social interconnections, and which in turn feed back into the Earth system, rather than focusing, singularly, on the modulating and shaping roles of the biophysical drivers of change.

Some of the interesting challenges will therefore be to understand more clearly the complex interactions of environmental change, and LUCC is well placed to make a valuable contribution to this endeavour. This, however, is not the preserve of any one programme or project. The interfaces of our various scientific activities were clearly laid bare at Shonan with much energy and thoughts given on how to connect across Programme Ele-

ments and with other partners. LUCC is clearly engaging in meaningful partnerships (e.g. Institutional Dimensions of Global Change and other aspects of IHDP) who, for example are trying to examine how institutions drive global change and/or facilitate our response to global change (2). LUCC thus helps to define links between land-use and land-cover change and such critical issues as climate change, health, urbanization, coastal zone management, water etc.

An area where IGBP and LUCC science can be strengthened in the future is to encourage probing research into the complex array and causes of some of the issues (socio-economic, political, physical) that underpin several of the pressing global change problems faced particularly by those from the "South". Issues such as water resources, food and fibre, ecological sustainability are pressing problems for the South which are often masked within the everyday experiences and realities of conflict, war, and poverty in these regions. Research (from both the physical and human dimensions) that unravels how these factors and issues are contributing to global change, and how global change is feeding back into the system and impacting communities in these regions, is needed. As we approach the Millennium, Africa, for example, is the single global region where the economic situation is expected to deteriorate, resulting in a significant proportion of the population living under conditions of poverty in both rural and urban areas (e.g. 3). The aforementioned issues, moreover, are not unusual or visible expressions of "hot spots" or "critical zones" but are often rather the relatively silent and insidious factors that encroach daily on the life and livelihoods of the poor living in the South. For those living in particularly marginal conditions in the South, the drivers of change are more often the combination of progressive social and economic realities (e.g. HIV/AIDS, armed conflict, population dislocation and economic reformist programmes) which together with environmental and climate change (e.g. drought) produce situations that require not only scientific investiga-

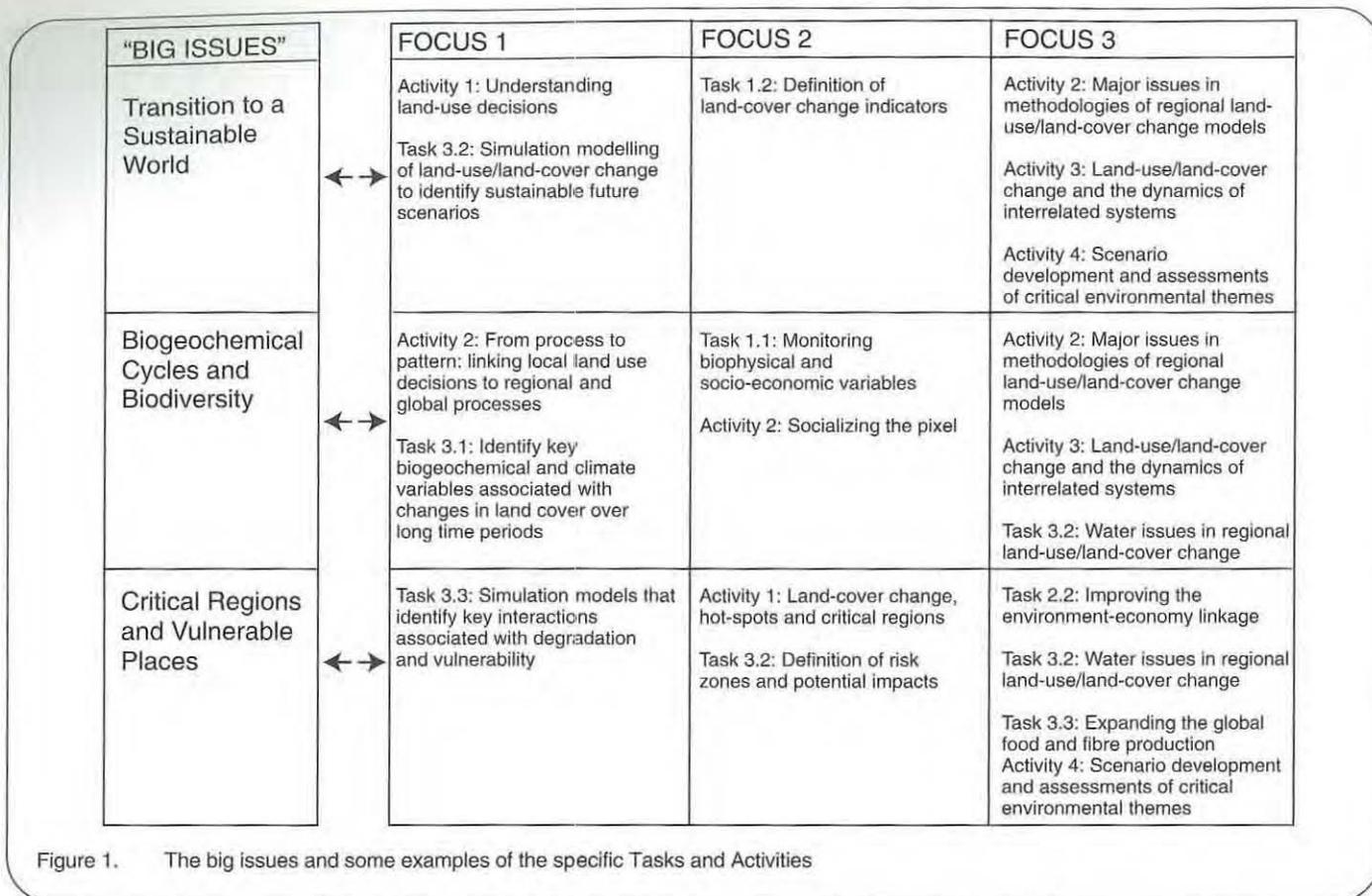


Figure 1. The big issues and some examples of the specific Tasks and Activities

tion but humanitarian concern.

Development specialists, scientists and other practitioners (health workers etc) are actively engaging with people from the South to try and understand, identify and more importantly 'mitigate' global change and "life threatening" issues. There are thus a host of notable activities being undertaken in the South, which can provide useful entry points for wider IGBP-community engagement and cooperation in joint science ventures (see for example the Global Change and Sustainable Rangelands Project where several of the IGBP community are already actively involved, 4). While much of this work is ongoing and perhaps, as often voiced by some, not in the realm of the so-called "hard sciences", the need for this work to inform and complement IGBP work is arguably inevitable. One of the roles of IGBP, as we

move into a greater regional orientation in the future, is that we may be called upon to begin to establish and strengthen networks and partnerships with those working in these regions on integrated global change science.

As we stand on the brink of new "Millennium" of IGBP science, it would seem that it is becoming increasingly important for the IGBP scientific community to continue pressing forward with excellence in global change science but also to begin to ask and answer questions (as were raised at Shonan): e.g. Where and what is the IGBP niche in future?

Not everyone will be able to engage or wish to engage in what has been termed "sustainability science" but the growing societal concerns, underpinning much of our science, cannot be downplayed. If we have a role to play in "sustainability sci-

ence" then some of us need to be asking and answering questions which are related to our scientific agenda in the next five to ten years?. More importantly, it is the opinion of this author that we need to begin to play a stronger role in providing easily accessible and understandable scientific products that will enable policy makers and others to peer behind the "veil of uncertainty" and arrive at workable solutions to growing global change problems, which for some are already daily realities.

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The IGBP Congress from an IHDP perspective

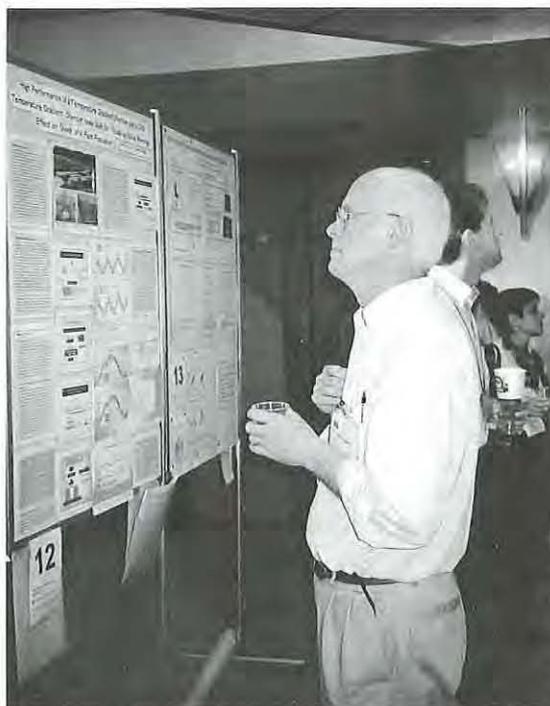
by Jill Jäger

Attending the whole of the IGBP Congress only a month after starting my job as Executive Director of IHDP provided a fascinating overview of the scientific achievements of the IGBP and a daunting array of possible areas of collaboration in the short, medium and long term. In many cases there are strong links to research on the human causes and consequences of, and responses to, global environmental change in the work of IGBP Core Projects. Work on the global carbon cycle, changing atmospheric chemistry, global threats to catchments and riverine systems, and the relationship between past climate change and human civilization are just some examples, where these links are quite obvious.

The "Earth System Overview", one of the planned products of the IGBP synthesis, will explicitly address the ways in which humans are changing the earth system. Clearly the LUCC project, which is jointly sponsored by IGBP and IHDP, can take a leading role in describing how human activities have changed the Earth system, but the list of proxy drivers of change presented by Pam Matson on the second day of the Congress included energy production and industry, areas in which IHDP's Industrial Transformation project should be able to make a contribution within the timeframe of the synthesis. Furthermore, as Matson pointed out, it will be necessary to look deeper than the proxy causes of change. She mentioned population growth and consumption as ultimate causes of change. Disentangling the roles of population growth and economic development in causing environmental pressure is a priority area of human dimensions research and one which is addressed in one way or

another in each of the IHDP projects.

On several occasions throughout the Congress the need for regional studies was addressed. As Berrien Moore pointed out in the closing plenary session, regional studies allow "full" system studies and provide a specific linkage to societal issues, as well as connecting the global with the local scales. The START presentation on the third day of the Congress illustrated the value added, when an attempt is made to synthesize the results of projects at the regional scale (this



John Gash of the BAHC SSC studies one of the contributions during the poster session organized by the Japanese hosts

example, for Southern Africa, included studies of atmospheric transport, hydrological change and changes in terrestrial ecosystems). The addition of studies of the human causes and consequences of environmental changes certainly enhances regional syntheses and makes them more policy relevant. It is worth noting, however, that within the human dimensions research community there have been

some interesting methodological developments in recent years in the area of Integrated Regional Assessment and these methodologies could be useful in regional syntheses. These methodologies will be discussed at a workshop in Budapest in August sponsored by START in collaboration with the Center for Integrated Regional Assessment (CIRA) of Pennsylvania State University.

The IHDP project on Institutional Dimensions of Global Environmental Change (IDGEC), for which the Science Plan has just been published, also recognized the value of selecting regional foci and has chosen Southeast Asia and the Circumpolar North as initial priorities for regional studies. This has led to collaboration between IDGEC and the Southeast Asia Regional Committee for START (SARCS), whose Science Plan has also recently been published and was presented in the START synthesis working session at the Congress. This SARCS plan can be seen as a pilot study with a regional focus that has included the human dimensions as an integral part of the study from the beginning.

A number of crosscutting themes that are emerging through the IGBP synthesis were discussed throughout the Congress. In each case there are clear links to IHDP research. The LUCC project is already involved in the activity on the Global Carbon Cycle, in particular in the development of a fast track 300-year historic land-use/land-cover database. However, much research in the Industrial Transformation Project will also be relevant to discussions on the global carbon cycle. IHDP collaboration on the topic of Water has already begun, with the GECHS project's participation in the Workshop on Freshwater Resources in Sub-Saharan Africa in October 1999. The LUCC project also has a focus on the linkages between water resources and use and land-use/land-cover change. Each of the IHDP projects has links to the cross cutting theme of "Food and Fibre": the LUCC project

Courtesy of S. Lumter

has identified studies of vulnerability and unsustainable land-use scenarios as a priority area for research; food security is a research focus of the GECHS project; and the Industrial Transformation project has chosen the Food Production and Consumption System as one of the sectors on which it will concentrate its research.

Finally, at several points during the Congress, in plenary sessions and in smaller less formal gatherings, **the need for a revision of the "Bretherton Diagram" was raised.** The diagram has been useful, especially in illustrating the links between IGBP, WCRP and IHDP **but our understanding of the Earth system has evolved,** as the IGBP Congress clearly showed. I hope that serious attempts to revise the diagram will involve members of the IHDP research community, so that the human causes and consequences of

changes to the Earth system and the various interactions between the human and natural systems can be included. Some thought will also have to be given to the implications of linkages at the local and regional level, as well as the global level. Furthermore, it goes almost without saying that the design and carrying out of the revision should be a joint activity throughout the international programmes on global environmental change with broad participation.

In summary, the interesting presentations and in-depth discussions at the IGBP Congress showed a range of areas in which collaboration between natural and social sciences is urgently needed. As the IHDP continues to develop its own research agenda, it will also make every effort to respond to these challenges and to be a productive and effective partner of IGBP.

As indicated earlier, the IHDP has already initiated work that would facilitate collaboration, and more can and will be done.

Now it is up to national funding agencies and others willing to support human dimensions research to provide adequate core and project funding for IHDP. While so far the response of several countries, most notably Germany and the USA, has been heartening, there is an urgent need for adequate support from other countries as well.

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Courting coastal collaboration at the Congress

by Chris Crossland

Synthesis, synthesis.....opportunity, opportunity! The challenges for interaction and seeking future advantage had been imprinted on all who met for the IGBP Congress in Shonan Village, Japan. Gathering a large group of scientists, from disparate disciplines, and trying to point them towards a common goal could be viewed as a folly – something akin to "herding cats". However, among others, Will Steffen and the Secretariat crew provided a programme and a climate which brought the sometimes cynical to synergy.

The need for a high profile of socio-economic – or human – dimensions within IGBP proved to be a timely and major scientific discussion point. The increasing evidence of a collegiate approach to the IGBP goals was another plus. Indeed, the Congress, through some checks in reality, seems to have laid the groundwork for metamorphosis rather than maturation of the programme as a whole.

The contingent of LOICZ folk (SSC and guests) rapidly moved from a rather

bemused and glassy-eyed state induced by a foreboding over the plethora of planned sessions and workshops, to their normally highly energetic and interactive mode. We "did a lot of business" and built on-going, collaborative activities with individuals, Core Projects and associated agencies. Overall, we made a significant jump forward.

LOICZ is more fairly represented as a synthesis-based, rather than thematic-based, Core Project. We have to bridge terrestrial, sea and air interactions plus the human dimensions in meeting our goals. The nature and empathy of the Congress removed or diminished the artificial boundaries that, on occasion, separate IGBP activities. We believe that LOICZ is stronger from the Congress and will be better placed to be more contributory to the Programme.

Beyond the regular SSC work of the meeting, we were able to build out our tactical plan for synthesis and delivery against our target date of end 2002. The experience of other individuals and projects as a whole was freely accessible

during the Congress, to help in building our work plans.

Research gaps were recognized, and thought and discussion put into ways of resolving the bits we had missed. For example, the "sleeper" of coastal zone material flux – submarine groundwater – was highlighted in plenary and workshop discussions. Bill Burnett (Chair, SCOR-LOICZ WG112) provided a challenge to researchers in terrestrial and marine systems by an outline of the difficulties and needs for resolving the importance of the groundwater phenomenon. Direct groundwater flow into the coastal ocean occurs in seeps and springs in many parts of the world, and as persistent seepage along most shorelines. This can carry potentially significant amounts of flow and dissolved materials – degradation of groundwater through contamination and withdrawal is known in many areas. Over the last decade or so, convincing argument has been building that groundwater flow can be vitally important (ecologically and economically) in some areas. However, we have evaluation difficulties

and no measure of the significance of the phenomenon globally. The Working Group will be making three main thrusts: (i) Calculation and modelling; (ii) Measurement, sampling and experimental design; and (iii) Typology, integration and globalization.

Two evening meetings, with working groups convening in between, saw LOICZ and GLOBEC get together. The biogeochemical budgets boffins and the fisheries folk extended their association with the establishment of two joint task groups: one dealing with teleconnections (and societal relevance); the second, addressing typology approaches. The first will focus on linking LOICZ biogeochemical budget box model information with the "black box" between zooplankton and nutrients; and looking at the human changes in coastal systems and the way these affect fisheries and the socio-economic system of the coastal community. The second task group will link activities in areas of typology and database development and applications, combining GLOBEC databases and LOICZ methodologies and approaches. These initiatives should see a closer blending of cause-and-effect relationships between coastal changes and fisheries resources, and improved ways to assess, scale and represent the information.

The "hot issue" research area of typology (essentially global classification systems which allow up-scaling of local and regional data and information) was further carried forward by combination of BAHC, GLOBEC, LOICZ, and LUCC in a vital show-and-tell workshop. The river work led by Charles Vörösmarty and Michel Meybeck in BAHC, and the coastal databases and cluster analysis approach of LOICZ under Bob Buddemeier's orchestration is being jointly pursued through a collaborative team approach, and related to the Continental Aquatic System initiative. It is expected that close links will be sustained with LUCC and

PAGES (for example, the LUCIFS project) developments in carrying this broadly integrative work forward. There was real excitement in the various camps during the workshop, as bridges were built and the real and potential opportunities were identified. Since then, midnight oil has

export production from the coastal ocean. The CMTT will address flux inventory and processes questions relating to boundary currents and marginal seas through five regional working groups, over the next two years. A global synthesis of material flux in these coastal-oceans interface systems will be published. Both SSCs had the pleasure of endorsing the work plan and look forward to the "synthesis" book in 2002.

The broad synthesis of START and its activities provided LOICZ with a wider picture of opportunities to extend existing joint actions. Regional studies are a fundamental tool in the LOICZ project, and the building of synergies through links with START (and LUCC) were discussed, taken home and are being acted on.

Interaction by individuals—peers and cross-disciplines—has had a number of rewards. In the typology arena, LOICZ has gained databases and wider involvement of individual players in its network of research activities. Networking with representatives of potential donor agencies is bearing fruit and appears likely to advance the LOICZ science agenda in regions from Asia-Pacific through Latin America.

It was a Congress worth doing and, on reflection, it was more upbeat than indicated within the exhaustion levels often prevailing at the time. The cool light of departure's dawn found most folk with new and additional challenges, but also with a sense of progressive accomplishment—clearly, IGBP is making significant headway in its work of illustrating the Great Big Picture through understanding of the Earth's systems.

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Courtesy of S. Lunter

Isao Koike, Vice-Chair SC-IGBP and local host, gives a speech during the Congress Banquet

continued to be burnt in various laboratories and further joint workshopping will occur at the LOICZ Open Science Meeting in November.

The joint JGOFS-LOICZ Continental Margins Task Team (CMTT) took on a second phase of activity aimed at assessment and global synthesis of CO₂ and nutrient fluxes in marginal seas and boundary currents. Building on earlier work, key issues for understanding material fluxes along continental shelf margins include: CO₂ sequestration, processes in boundary currents (e.g., continental shelf pumping, control mechanisms for variability in air/sea CO₂ fluxes), and re-evaluation of the (apparently "too high")

An outsider's view of the Congress

by Neil Hamilton

Following the Bad Münstereifel Congress in 1996, three participants were asked to provide their reactions to, and opinions of, the Congress in articles for the IGBP NewsLetter (No. 26, June 1996). Those three (Bob Buddemeier, Steve Sanderson, and Marilyn Wasson) produced an amazingly insightful analysis of IGBP. It is one worth reading and reflecting upon three years later. I first read those articles as a young geographer circling around the edges of the global change community in far away Canberra. I was impressed by the achievements of the IGBP, but was alienated by what I perceived to be a lack of relevance to real world issues. Today, I sit as an "outsider" still, or perhaps a "tweener", trying to understand how far IGBP has come since that first Congress.

The three authors of 1996 approached their IGBP Congress from entirely different perspectives. Interestingly, they identified an essentially similar set of issues:

1. the difficulty of establishing a culture of "international science";
2. the need for transdisciplinary, integrative research involving the human dimensions of global change;
3. the fundamental necessity of engaging the social science, and other, communities;
4. the sense of maturity of the IGBP and the need to look to the future.

I believe the same issues still exist, and are now crucial to the future of global change research. I came away from Shonan incredibly mentally stimulated, and physically exhausted. The most pervasive but encouraging impression I received was of a scientific community that wants to find answers to each of the four issues identified in 1996.



Ritual Japanese music was performed at the Congress Banquet

Courtesy of S. Lunter

The cultures of international science

Shonan was a Congress of an international scientific organization. However, it was not the same Congress that was held in 1996: the scientific discussions were often inclusive and cross-disciplinary, the international organization discussions were about comparative and collaborative studies. It seems clear to me that IGBP is changing, and changing fast, turning away from the narrow disciplinary bounds that nurtured it, towards an ill-defined but hopefully fruitful future. The question of institutional culture, however, remains.

Bob Buddemeier wrote in his 1996 views of the first Congress that international *science* programmes often are good at finding solutions, but not at defining the problems or applying their results, while *international science* programmes are better at defining the problems, but are poor at delivering scientific results. Arguably, these are the paradigms we

have been operating within (or between) until recently. The presentations I saw at Shonan show IGBP to be searching for a better way, indeed a way that explicitly includes consideration of society *and* environment. The paradox that arises from this search for a new paradigm is that the scientific dogma and myths we all adhere to must be at least temporarily discarded. Perhaps Kuhnian revolutions do exist, after all.

The linkages across disciplines and between projects that were the focus of the Congress require active consideration of another important culture of *international science* present (on the fringes) at Shonan: "social science". I lost count of the number of speakers who paid lip service to these disciplines. I even saw presentations by biophysically-trained scientists trying to undertake research that requires social science research skills, often in apparent ignorance of, or without input from, groups who could make significant contributions. The ever-present divide seems as broad as ever, despite our attempts to bridge it.

Transdisciplinarity and integration with human dimensions research

The transdisciplinarity and integration foci of the Congress are not new ideas. IGBP Report No. 12 ("The Initial Core Projects") proposed that three factors made the creation of IGBP (itself seen as a transdisciplinary programme) possible:

1. Disciplinary progress had made truly interdisciplinary projects possible;
2. Appropriate tools are now available;
3. The necessary communications infrastructure now exists.

Even discounting the necessary optimism of the day, these points are technically correct. So why are transdisciplinary, integrated projects still so rare in global change science? I believe the answer is sociological: science, like any other institution, has developed structures to communicate, solve problems, and organize itself. However, it has neither the social and cultural tools nor the communications skills to undertake truly transdisciplinary studies. This is as true within IGBP as it is between IGBP and other organizations. I know of no way of developing these skills and tools without being painfully honest about our motivations and values, and establishing a dialogue with the groups we see as necessary parts of the integrated whole - in short, to be "open", and to listen to people outside our community.

Engaging with social scientists

One group we urgently need to listen to are social scientists. We spend countless hours discussing how to develop "a common language" but have made little progress in this area. My own discipline, geography, the crossroads of the social and biophysical sciences, has itself a very mixed record of bridging the gaps.

How do we progress? Two tools spring to mind. First, to develop a set of issue-based forums for dialogue, and be open and inclusive in encouraging participation. The new cross-cutting themes developed within IGBP provide a perfect opportunity to initiate this process: each of the themes is critically relevant to social

scientists and policy agencies. Second, to develop a selected set of integrated projects with social scientists, with an explicit aim of learning how do transdisciplinary research, as well as the more usual scientific objectives. This could be achieved through **the developing regional focus within IGBP.**

These and other tools have been tried before, with mixed success. The key issue is to begin the process in a managed and coordinated way, soon.

Programme maturity

IGBP is now without doubt a mature and highly successful ICSU programme. The amount of effort involved in the programme is extraordinary. A huge volume of research output has been published. The sort of "synthesis" sessions I attended at the IGBP Congress reinforced my belief that we are now a considerable way towards answering the original questions that drove the development of IGBP. Each of the Core Projects, and indeed the individual scientists, appeared willing to grapple with the task of pulling together the disparate strands of global change research within their mandate, to produce a clearer picture of the whole.

However, the path to maturity also brings the tension, questioning of authority and direction, and independence of adult life. I was glad to see some signs of this at Shonan. There is no doubt that the IGBP community has been growing intellectually, learning how to improve international collaborative research, perhaps changing the direction of approach to its objectives. The results I saw were very positive and creative. The steps towards the development of crosscutting themes and regional studies, while maintaining the disciplinary strengths which support individual scientists and Core Projects, are crucial to the organization's vitality. I am sure that some are uncomfortable with this refocusing, but in my view that is an unavoidable consequence of growing up.

The focus on "Synthesis" at the Congress also reflects the maturity of the programme - the need to stop momentarily, reflect on where we have been, what we have learned, and where we should go next. Too often, my own research has become a headlong rush to the next fascinating project, field trip, or conference, so the forced introspection of a synthetic process is a welcome respite. As individual researchers, we utilize synthetic ap-

proaches every day without thinking too much about the process. I saw at Shonan the impressive degree of individual and organizational leadership required to perform such a synthesis of the work of hundreds of scientists. Given the analogy of "herding cats" usually applied to the management of scientists, the IGBP Synthesis is an extraordinary social process.

The way the IGBP community approaches the four issues above will determine the future direction of international global change research. It will also determine the relevance of that research. There is now acknowledgement by global change scientists that global change is of wide community concern, and that the scientists have an obligation to engage with that community. I hope I can look back from the next Congress and be as impressed with progress in the next few years as I am with IGBP's achievements since the last Congress.

Neil Hamilton

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IGBP's vision scares me

by Barry Huebert

If you only look up, you're likely to trip on a crack in the sidewalk and fall flat on your face. The moral: To make progress you also have to keep looking down.

Integration is clearly the heart and soul of IGBP, and it should be. The very name "Geosphere-Biosphere" says that we are taking a wide view of how the Earth works and are trying to integrate ideas and observations from many disciplines. I'm excited by this prospect, and support it wholeheartedly. Disciplinary barriers have prevented us from understanding the whole of the Earth system, and IGBP is helping to lower them.

So why did I get an uneasy feeling in the pit of my stomach as Will Steffen and Berrien Moore laid out their visions for the next decade of IGBP work at the end of the Second IGBP Congress in Shonan Village? Their message, as I heard it, was that we're ready to put even greater emphasis on the integration of terrestrial, marine, and atmospheric models. Isn't this a good thing?

I finally traced my unease to a concern about the solidity of the blocks being used to build this integrated structure. Let me use an example I'm familiar with: air-sea exchange, but I'm sure that each of us could cite many more examples from our own disciplines that make this same point.

Air-sea exchange is one of the critical processes that we need to model when we try to put these pieces together. There are a number of very central questions. How accurately can we compute the flux of CO₂ (or iron, nitrate, etc.) from the atmosphere to the ocean? In this case, uncertainties of ten percent or less make a big difference in predictions of atmospheric CO₂ increases. How accurately can we predict the flux of DMS (or methane, ammonia, etc.) from the ocean to the atmosphere? DMS forms particles that control the radiative properties of clouds. Given that a few percent change in the reflectivity of clouds generates a radiative forcing comparable to that of doubling CO₂, we need to make this estimate accurate to within a few percent to see

how changes in marine biology might affect the climate.

Unfortunately, none of these fluxes can be calculated to much better than a factor of two, even though we need to know them with at most one tenth that much uncertainty. The excellent JGOFS report at the Congress demonstrated our dilemma: some fluxes were computed using the Liss and Merlivat parametrization and others were derived using Wanninkhof's parametrization. Under most conditions these two differ by almost a factor of two, and we don't have reliable ways of deciding which is better under any given circumstances. This would be scandalous if it weren't for the fact that much of the geoscience community has become resigned to this fuzziness and tends to accept it as the best we can do. Calculations using either approach are accepted without apology.

But what does this do to the ability of our integrated models to represent reality? Can we even be certain that trends are realistic, if critical parameters may be off by a factor of two? If the air-sea exchange rates were the only uncertainties, maybe we could deal with it. But when you look closely at each sub-discipline, you will find similar examples. How well do we know the temperature-dependence of the

emission of N₂O from soils that plays a role in changing nutrient stocks as climate changes? How well can we quantify factors controlling the sinking of carbon from the euphotic zone? The deposition flux of iron from deserts limits productivity in important parts of the ocean, yet it may only be estimable to within an order of magnitude. In many cases, the people working on process details are not confident that their results are ready for prime time. How realistic, then, can our integrated models be?

One of my concerns is that the emphasis on integration will reduce our determination to keep at the less glamorous job of whittling down those uncertainties on process rates. For instance, there are promising new technologies for directly measuring the flux of DMS and other species by eddy correlation. These could allow us to do direct tests of the various parametrizations and learn when Liss and Merlivat or Wanninkhof or some new theory should be applied. All it takes at this point is a commitment to fund this kind of development work. Yet that was not among the high-priority recommendations from the JGOFS report, which reflects our common acceptance of a situation that is not good enough. I also didn't see an emphasis on process work in the visions articulated for the next decade of

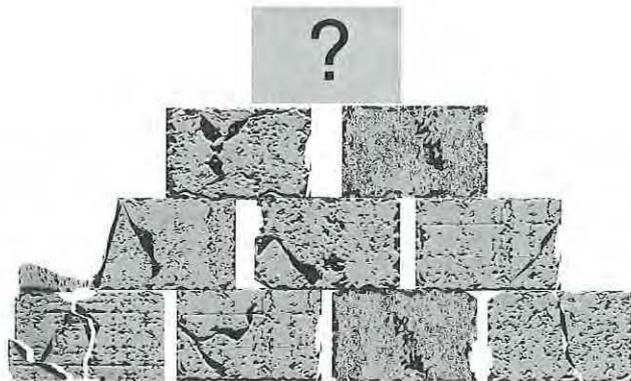


Figure 1. IGBP Pyramid

IGBP. My view is that we should seek out the most sensitive and uncertain parameters and insist that efforts be focused on improving them.

How could we quantify the effect of all these uncertain parameters? I'm on thin ice, here, due to my own ignorance of numerical analysis. But I believe there are ways of doing sensitivity analyses on the responses of large systems to changes in input parameters. It seems to me that at the very least we should be seeking out the best numerical analysts (if that is even the right term) to interest them in addressing this globally-important problem. Which of our parameters can cause the biggest fluctuations in the model output and which are relatively benign? If we don't find a way to encourage funding agencies to pay for that kind of analysis alongside our large modelling, we will never be able to demonstrate that our models are meaningful. Nor will we be

able to pinpoint the processes for which additional expenditures would make the greatest improvement in our models.

I like to think of geoscience as a pyramid, in which the fundamental sciences like laboratory photochemistry, cell biology, and the physics of air-sea exchange form the foundation blocks. The next higher level of blocks are the combinations of processes into primitive models that couple just a few reactions or species. On the next level are more complex models within one regime, like chemical transport models or marine ecological models. At the top of this conceptual pyramid are the grand, integrated Earth-system models that link all these systems together. All IGBP scientists can be thought of as rolling big stones up inclines to various levels, in the hope that we can finally get the top one in place.

Unfortunately, our conceptual pyramid could be built with fundamental sci-

ence that is seriously flawed, and we would never know it! In a way it's comforting to know that in a real stone pyramid, if the foundation blocks aren't solid, the whole thing falls down. We should be so lucky: our integrated models could be way off base and we would be blissfully ignorant.

IGBP needs to devise a system that allows us to quantify the impacts of process uncertainties. Then we must pursue incremental improvements in these process descriptions with the same vigor as we do the fabrication of more and more complex models.

Barry Huebert

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The past is not over yet

PAGES at the Congress

by Frank Oldfield

The Congress in Japan, by prompting a review of each Programme Element, encouraged us to identify the exciting areas of progress over the last four years. In so doing, it brought home, even to those closely involved, how dynamic PAGES research is.

We now see that the sudden and dramatic climate shifts (Dansgaard/Oeschger events) recorded in the Greenland ice core records from the last glacial are paralleled by simultaneous changes right across the Northern Hemisphere; they are recorded in archives as diverse as Chinese loess and marine sediments off the coast of California. Using the globally synchronous record of changing methane concentrations in bubbles trapped in the polar ice at each pole as a basis for correlating the palaeo-temperature reconstructions, it is now apparent that not only does Antarctica lead the Northern Hemisphere in the warming trend at the end of the Last Glacial Maximum, but the major oscillations in temperature during the glacial noted above were in anti-phase between Greenland and Antarctic (see Figure 1 on page 12). These observations

have important implications for understanding the dynamics of past global change, for we must now elucidate a mechanism that includes strong atmospheric linkage across the Northern Hemisphere, as well as a bi-polar Atlantic thermohaline "see-saw" modulating the system at high latitudes in opposite hemispheres. Comparisons between the ice core records of changing atmospheric greenhouse gas concentrations and temperature proxies have become increasingly refined. This reflects better time control on the processes leading to the occlusion of gas bubbles in the ice, improved analytical precision, stable isotope analyses of the trace gases themselves and the availability of records from four glacial cycles, thanks to the outstanding results from the recently completed new Vostok core from Antarctica. At each glacial termination, as the climate warms, greenhouse gas concentrations track temperature. Despite remaining uncertainties about the precise phase relationships, the indications are that greenhouse gases probably contributed to the warming mainly through feedback processes, in-

volving both the marine carbon reservoir and the terrestrial biosphere, rather than as primary forcing.

Moving into our present interglacial, the Holocene, spanning the last 11.5 kyr, we see growing evidence to qualify indications from the Greenland ice core record that this was a remarkably stable period. Evidence from Europe, Africa, South America and lower latitude marine sediment cores highlights strong variability. In the case of continental records from the tropics, vast changes in hydrology are recorded in both the history of lake level fluctuations and the reconstructions of past vegetation change. Climate models only approach a realistic simulation of the wet, vegetated periods in the Sahara/Sahel when account is taken of feedbacks from both the ocean and the terrestrial biosphere—a marvellous example of synergy between present day observations and the palaeo-record. Even within the last 1,000 years, a growing number of detailed, quantitative reconstructions of changing hydrology are emerging from sites as far apart as East Africa and the northern Great Plains in the USA to show

that regional droughts have been much more severe in the geologically recent but pre-instrumental period than any that have been characterized in either the instrumental or documentary record. The past human consequences were severe, as indeed they would be in the future were similar events to occur again.

Very recent and increasingly robust reconstructions of past temperature changes in the Northern Hemisphere over the past 1000 years, based on instrumentally calibrated proxy records, constitute an impressive articulation of the stated goals of PAGES Timestream 1 research, which focuses on palaeo-environmental reconstructions for the last two millennia with, ideally, seasonal to annual resolution. They show that 1998 was the warmest year of the millennium in the Northern Hemisphere, even when full account is taken of the increasing uncertainties associated with reconstructions of individual years prior to CE 1600 (see Figure 2). Moreover, an analysis of records spanning the last 600 years shows that there are statistically valid links between pre-20th century temperature variability and both solar and volcanic forcing, whereas during the last 70 years, there is every indication of an increasingly strong correlation between the temperature trend and the rapid increase in atmospheric CO₂.

Among the synthesis sessions organized by PAGES were two designed to establish the way forward for Focus 3 - "Human Interactions in Past Environmental Change". Three activities are now fully endorsed by the PAGES SSC, dealing respectively with terrestrial, fluvial and lacustrine systems, and their interactions within catchments. As well as articulating more fully the structure of Focus 3 and setting in motion a programme of work oriented towards strong interaction with LUCC and GAIM in the area of past land cover reconstruction (an initiative becoming known as 'BIOME 300'), the sessions also laid the ground for ensuring a contribution to synthesis at both PAGES and IGBP levels from this area of activity. A key task for PAGES will be to improve the empirical basis for reconstructing land cover change on both a global and a regional basis for the period between CE 1700 and 1950.

The second of the 'Focus 3' sessions dealt with the role of palaeo-science in the study of ecological and hydrological processes, notably those operating on decadal to century timescales. The rationale for this session was that many ecosystem proc-

Asynchrony of Antarctic and Greenland Climate

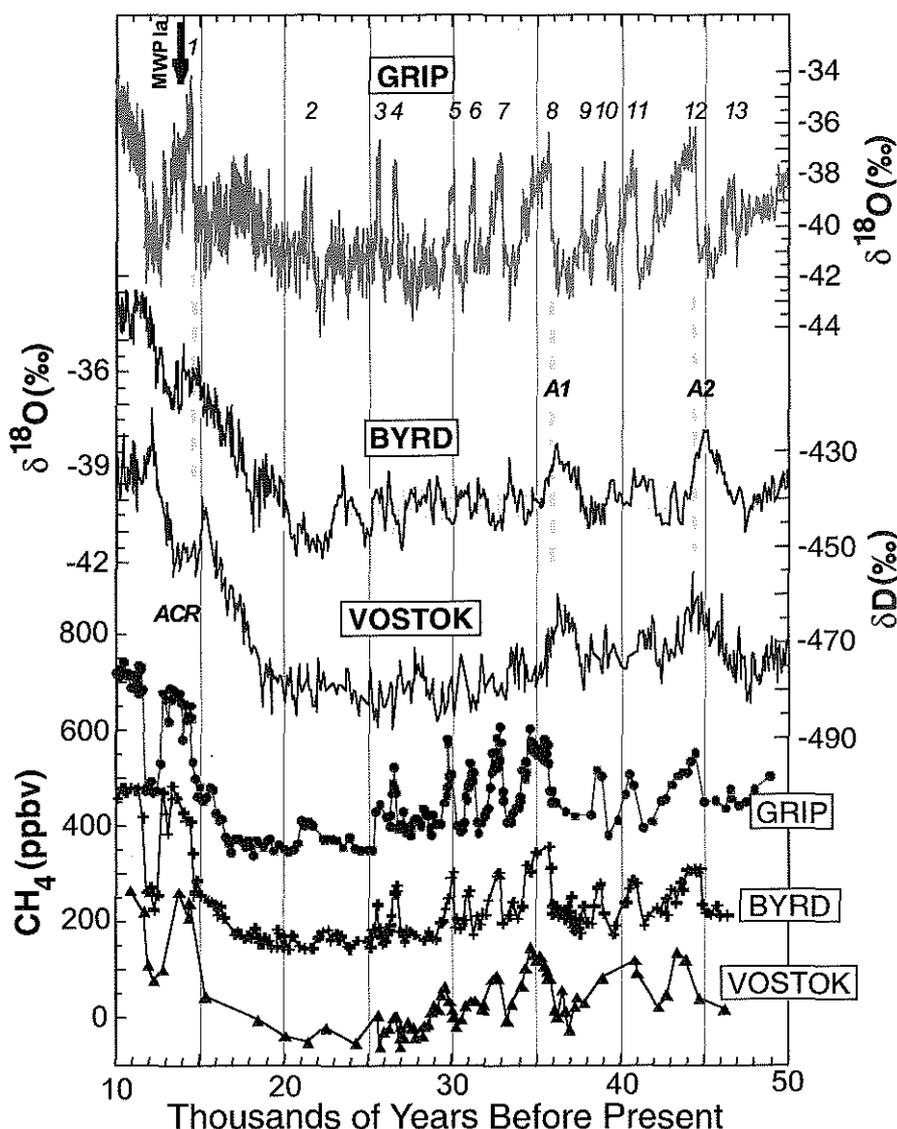


Figure 1. The plots illustrate the way in which indications of warming at the end of the Last Glacial Maximum in the Antarctic actually precede any evidence for significant warming from the northern hemisphere ice cores. They also highlight the antiphase relationship between Greenland and Antarctica (Byrd and Vostok, though not Taylor Dome) during the main Dansgaard-Oeschger (D/O) 'cycles', including the Bölling-Alleröd/Younger Dryas oscillation immediately predating the opening of the Holocene. The chronologies are synchronized by matching on the basis of methane concentration variations. The broad, pecked, vertical lines highlight key episodes.

Reprinted by permission from Nature. Reference: T. Blunier et al (1998) Asynchrony of Antarctic and Greenland climate change during the last glacial period, *Nature*, 394, 739-743. Copyright 1998 Macmillan Magazines Ltd.

cesses occur on timescales longer than the span of direct observation. PAGES has powerful research tools to explore these processes and link the perspectives they provide to the insights derived from other research methodologies such as field or laboratory experiments, coordinated large scale observation programmes, re-

mote sensing and modelling. Within the climate domain, this period of overlap and intersection between present instrumental observations, data re analysis and high resolution, quantitative palaeo-reconstruction has become one of the most important areas of activity, as witness the emerging *PAGES/CLIVAR Intersection*,

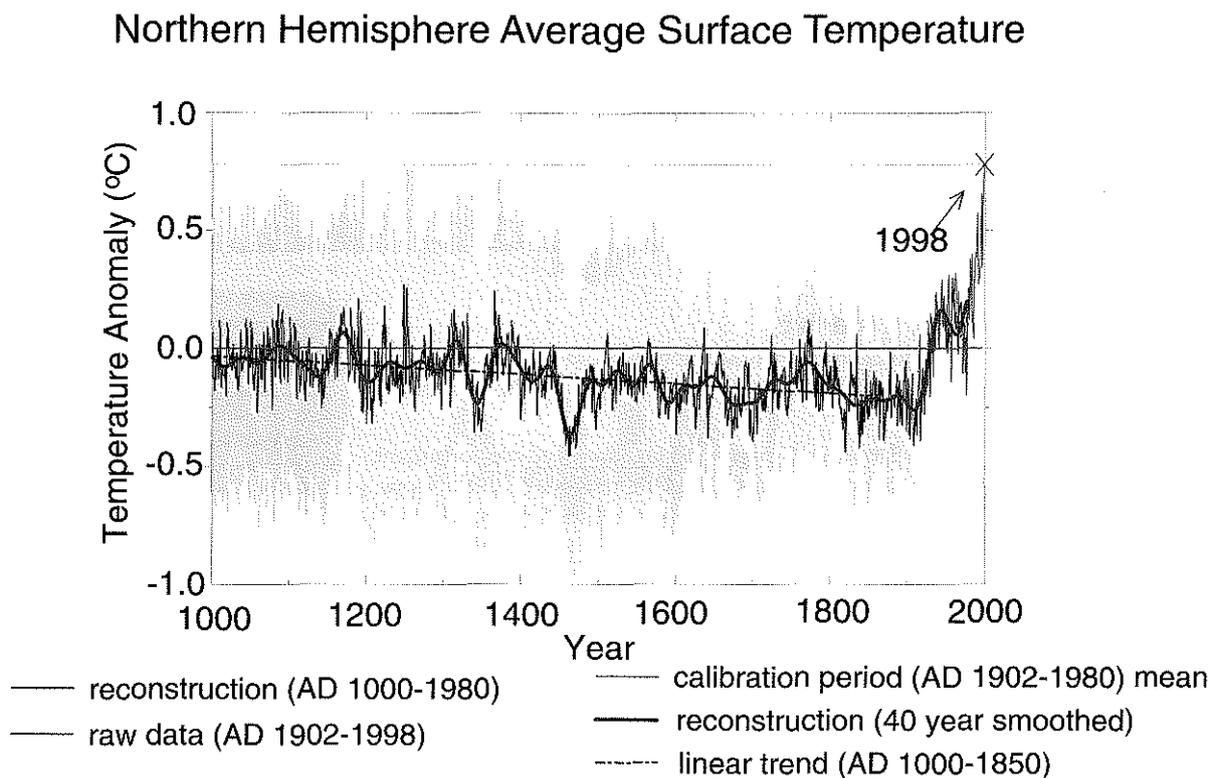


Figure 2. This plot forms the basis for the claim that 1998 was the warmest of the millennium in the Northern Hemisphere, even when full account is taken of the increasing uncertainties associated with reconstructions of individual years prior to CE 1600. A previously published analysis of the post-CE 1600 record indicates that there are statistically valid links between pre-20th century temperature variability and both solar and volcanic forcing, whereas during recent decades, there is every indication of an increasingly strong correlation between the temperature trend and the influence of atmospheric CO_2 . (Reference: Mann, M. et al (1999) Northern Hemisphere Temperatures During the Past Millennium: Inferences, Uncertainties and Limitations, *Geophysical Research Letters*, **26**, 6, p.759.)

jointly sponsored by IGBP-PAGES and WCRP-CLIVAR. A challenging task for the future will be to achieve a comparable degree of synergy within the context of the ecological and biogeochemical aspects of IGBP research. The goal, in so doing, will be to improve our understanding of issues such as land degradation, soil erosion, eutrophication and pollution of both fresh water and marine aquatic systems, surface water acidification, non-linear changes in ecosystem structure and function and the impact of multiple stresses arising from the combination of climate variability and human actions, especially in areas of high value or vulnerability. The next step, arising from the "PAGES and Processes" session, will be a joint publication based on the presentations.

All this makes for an exciting challenge to those now wrestling with PAGES synthesis. During the course of the Congress, a roadmap for achieving the synthesis was sketched out and endorsed by the SSC. Crucial to this process are the identification of lead writers, a sequence

of preparatory activities, landmark writing workshops and key questions.

The overall theme will be:
"What is the significance of the palaeo-record for understanding the future?"
 and the book will be structured as follows:

Chapter 1: *The Human Rationale for Past Global Change Research*

A "Results" section comprising five chapters, each structured around a central question:

Chapter 2. *What has been the history of trace gases and aerosols?*

Chapter 3. *What has been the history of atmospheric, oceanic and cryospheric dynamics?*

Chapter 4. *What has been the history of the carbon and other biogeochemical cycles?*

Chapter 5. *What have been the roles and responses of vegetation in the climate system?*

Chapter 6. *How has the Earth system changed during the last 1,000 years?*

Chapters 7+: A crosscutting synthesis

and discussion section. Topics to be considered include: the potential for surprises; implications for future change and sustainability of ecosystems and resources; modelling the future – lessons from palaeoclimatic reconstructions.

Vladimir Nabokov once wrote that "What we perceive as the present is the bright crest of an ever growing past and what we call the future is a looming abstraction ever coming into concrete appearance". PAGES sheds an increasingly clear light on that 'ever growing past' and in so doing, informs our views on the present and the future in essential ways. The Congress greatly helped to further our endeavours.

Frank Oldfield
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 Bärenplatz 2, 3011 Bern, Switzerland.
 E-mail: oldfield@pages.unibe.ch

People and Events

New director for IHDP Secretariat

Jill Jäger received her B.Sc. degree in Environmental Sciences from the University of East Anglia (UK) in 1971. She was awarded her Ph.D. in geography by the University of Colorado (USA) in 1974.



Jill Jäger

Between 1979 and 1994 Jäger worked as a consultant for numerous national and international organizations, including: the Federal German Environment Agency (Umweltbundesamt, UBA), Berlin; the United Nations Environment Programme (UNEP); the International Institute for Applied Systems Analysis (IIASA), Laxenburg, Austria; the International Meteorological Institute, University of Stockholm; the OECD, Paris; the Canadian Government; the Commonwealth Secretariat, London; the Beijer Institute and Stockholm Environment Institute, Stockholm. Her work focused on international, interdisciplinary studies of the interactions between humans and the global environment.

In November 1991 Jäger became Director of the Climate Policy Division of the Wuppertal Institute for Climate, Environment and Energy, Wuppertal, Germany. In September 1994 she joined the International Institute for Applied Systems Analysis (IIASA, Laxenburg) as Deputy Director for Programs and from October 1996 till May 1998 she was Deputy Director of IIASA. Since 1996 she has been a member of the core faculty of the Global Environmental Assessment (GEA) project, based at Harvard University.

Project scientist for Regional Initiative

Neil Hamilton is a geographer, from Australia, with broad research interests including coastal geomorphology, marine resource management, global and regional futures studies, social sustainability, and indigenous human rights issues. He obtained his PhD from the University of Sydney in the early 1990s, followed by employment as a senior research scientist at CSIRO, developing population-development-environment models for Australia. He was a foundation research fellow at the University of Technology, Sydney, where he helped establish the Institute for Sustainable Futures. Neil also has extensive consulting experience in strategic natural resource management. He recently organized the successful proposal for the Cooperative Research Centre for Terrestrial Carbon Accounting with Ian Noble.



Neil Hamilton

Neil's task in IGBP and START is to develop and coordinate the Regional Initiative. He is currently undertaking a global review of regional research projects, in preparation for the development of an integrated set of global change research projects in different regions around the world. This work includes the development of a regional research metadatabase. At the moment Neil is located at the International START Secretariat in Washington DC, USA, and during August and September he will work at the IGBP Secretariat in Stockholm, Sweden.



Courtesy of S. Lunter

On the last evening the ritual opening of a sake barrel was performed. From left to right: Berrien Moore, Chair SC-IGBP, Will Steffen, Executive Director IGBP Secretariat, Isamu Kayane, Chair National IGBP Committee for Japan, Isao Koike, Vice-Chair SC-IGBP, Sheila Lunter, IGBP Secretariat.



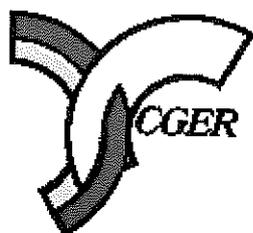
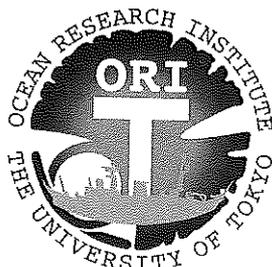
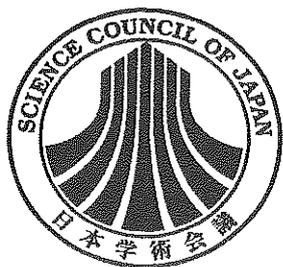
Courtesy of S. Lunter

Ian Noble (left), Chair of the GCTE SSC, and Pep Canadell, (right) GCTE Executive Officer



Courtesy of S. Lunter

Mikiko Hagiwara (left), organizer of the Congress Corporation, and Elise Wännman (right), IGBP Secretariat



The Second IGBP Congress was made possible by the generous funding of: the Science Council of Japan; the Ocean Research Institute, the University of Tokyo; the National Institute for Environmental Studies (NIES) and the Center for Global Environmental Research (CGER); the Asia-Pacific Network for Global Change Research (APN); and the Research Council of Norway.

FIRST ANNOUNCEMENT

2nd JGOFS Open Science Conference

Ocean Biogeochemistry: a New Paradigm

The Conference focuses on the challenges of the JGOFS Synthesis and Modelling phase. The purpose of this conference is to provide an opportunity for scientists who are involved in the observational and modelling activities to present and discuss the results of JGOFS 10-year field programme to the broader ocean, atmosphere and terrestrial science communities. In addition, the conference aims to highlight the new and ongoing intellectual challenges that remain, in order to derive maximum benefit from the investment in JGOFS by national funding agencies.

Format and Themes

The Conference format will consist of keynote talks on ocean biogeochemical themes, discussion sessions, and contributed papers and posters on the following themes:

- Ocean Biogeochemical Regimes (Hugh Ducklow, USA)
- Carbon Dioxide Flux (Andrew Watson, UK)
- Regional and Global Primary Production (Paul Falkowski, USA)
- Continental Margins (K.K. Liu, Taiwan)
- Community Structure (Michael Landry, USA)
- Water Column Biogeochemistry (Paul Tréguer, France)
- Deep-Ocean Fluxes (Karin Lochte, Germany)
- Temporal Variability of Biogeochemistry (TBD)
- Ocean Carbon and Ecosystem Modelling (Scott Doney, USA)
- Feedback Processes (Phillip Boyd, New Zealand)

Committees

Conference organizers

Michael Fasham, Roger Hanson, and Karin Lochte

Science programme committee

Véronique Garçon, K.K. Liu, Graham Shimmiel, Toshiro Saino and Ulf Lie

Local Norwegian committee

Roger Hanson, Ulf Lie, Truls Johannessen, Dag Aksnes, and Beatriz Baliño

Conference arrangements

PLUS Convention AS, Judith Stokke

Abstracts

The call for papers and posters (abstracts) will be made in **August 1999** with a submission deadline of 1 October 1999. A book of abstracts will be produced prior to the meeting. Young scientists are encouraged to present JGOFS work.

Enquiries

Enquiries regarding the scientific programme should be directed to:

JGOFS International Project Office, SMR/UIB, High Technology Center, 5020 Bergen, Norway. Tel: (+47-55) 58 4246

Fax: (+47-55) 58 9687, E-mail: jgofs@smr.no

IGBP Meetings

Only meetings with * are open for all scientists to attend. All other meetings are by invitation only.

1999

**Swiss Summer School on the Dynamics of the Earth System:
Processes and Records of Past Climate Change
(in collaboration with PAGES and START)**

17-24 July, Hasliberg, Switzerland

Contact: Thomas Stocker, Climate and Environmental Physics, University of Bern, Sidlerstrasse 5, 3012 Bern, Switzerland.
Fax: (+41-31) 631 44 05.

BAHC Sessions at XXII IUGG Meeting

18-30 July, Birmingham, UK

Contact: IUGG99, School of Earth Sciences, University of Birmingham, Edgbaston, Birmingham B15 2TT, UK.
Fax: (+44-121) 414 4942, E-mail: iugg99@bham.ac.uk
<http://www.wlu.ca/~wwwiahs/index.html>

START Temperate East Asia Regional Synthesis Meeting

19-21 July, Beijing, China

Contact: Congbin Fu, E-mail: fcb@ast590.tea.ac.cn

**LOICZ/UNEP Workshop on estuarine systems of the
South China Seas**

19-22 July, Manila, Philippines

Contact: Stephen Smith, University of Hawaii, E-mail: svsmith@soest.hawaii.edu

**GCTE Session in VI International Rangeland Conference on
Range management and plant functional types**

19-23 July, Townsville, Australia

Contact: Sue McIntyre, E-mail: sue.mcintyre@tag.csiro.au

**SCOR/LOICZ Submarine Groundwater Working Group 112 meeting
in conjunction with XXII IUGG Meeting**

22-24 July, Birmingham, UK

Contact: Bill Burnett, Department of Oceanography, Florida State University, Tallahassee, Florida 32306-4320, USA.
E-mail: wburnett@mailier.fsu.edu

**GCTE Focus 1/2 Workshop on Intercomparison of gap models
and examination of how much physiology is needed in them**

July, Colorado, USA

Contact: James Reynolds, E-mail: jfreynol@acpub.duke.edu

GCTE Soil Erosion Network: Gully Erosion

31 July-4 August, Rio de Janeiro, Brazil

Contact: Tony Guerra, Avenida Canal de Marapendi, 1100, apto. 608, Bloco II, Barra da Tijuca, Rio de Janeiro - RJ, CEP 22.631-050, Brazil. Fax: (+55-21) 598 3280,

**Canopy dynamics and Forest Management - A missing link?
Joint workshop by the IUFRO and GCTE**

1-11 August, Estonia/Finland/Sweden

Contact: Sune Linder, Activity Leader. Email: sune.linder@emc.slu.se

**START Central and East European Workshop on Integrate Regional
Assessment of Climate Change (in collaboration with IHDP)**

7-12 August, Budapest, Hungary

Contact: CEE Workshop c/o CIRA, 248 Deike Building, University Park, PA 16802, USA. Fax: (+1-814) 865 3191,
E-mail: CIRA@essc.psu.edu

GLOBEC Southern Ocean Planning Group**8-9 August, Cambridge, UK**

Contact: Roger Harris, GLOBEC International Project Office, Plymouth Marine Laboratory, Prospect Place, Plymouth PL1 3DH, UK.
 Fax: (+44-1752) 633 101, E-mail: r.harris@pml.ac.uk

PAGES Workshop: Inter-PEP Linkages**1-2 September, Bern, Switzerland**

Contact: Vera Markgraf, Institute of Arctic and Alpine Research, University of Colorado, Boulder CO 80309-0450, USA. Fax: (+1-303) 492 6388, E-mail: markgraf@spot.colorado.edu

Second International Symposium on Non-CO₂ Greenhouse Gases (NCGG-2): Scientific Understanding, Control, and Implementation organized by the Dutch Association of Environmental Professionals (VVM)

8-10 September, Noordwijkerhout, Netherlands

Contact: Joop van Ham, c/o VVM Section on Clean Air in the Netherlands (CLAN), P.O. Box 6013, NL-2600 JA Delft, The Netherlands; Fax: (+31-15) 261-3186; Email: j.vanham@plant.nl

***6th IGAC Scientific Conference jointly organized by IGAC, the European Commission, and Consiglio Nazionale delle Ricerche Istituto FISBAT**

13-17 September, Bologna, Italy

Contact: <http://www.fisbat.bo.cnr.it/IGAC99/>

GCTE Focus 3 Science Conference*20-23 September, Reading, UK**

Contact: John Ingram, GCTE Focus 3 Office, Center for Ecology and Hydrology, McLean Building, Crowmarsh Gifford, Wallingford OX19 8BB, UK. Fax: (+44-1491) 692 313, E-mail: j.ingram@ioh.ac.uk

2nd Meeting of the JGOFS North Atlantic Synthesis Group**20-24 September, Toulouse, France**

Contact: Véronique Garçon, Cent. Nat. de la Recherche Scientifique, GRGS, 18 av Edouard Belin, F. 31055 Toulouse Cedex, France. E-mail: veronique.garcon@cnes.fr

START/IGBP/IHDP/WCRP**Climate Variability and Agriculture (CLIMAG) Workshop****27-29 September, Geneva, Switzerland**

Contact: International START Secretariat, Washington DC, USA. E-mail: start@agu.org

JGOFS Executive Meeting**September/October, Bergen, Norway**

Contact: Roger Hanson, JGOFS International Project Office, Center for Studies of Environment and Resources, Bergen High-Technology Centre, University of Bergen, Norway. Fax: (+47-555) 89687, E-mail: Roger.Hanson@jgofs.uib.no

BAHC / GCTE / GEWEX Workshop on Modelling Root**Water Uptake in Hydrological and Climate Models****30 September – 2 October, Gif-sur-Yvette, France**

Contact: Holger Hoff, BAHC IPO, Potsdam Institute for Climate Impact Research, PO Box 601 203, 14412 Potsdam, Germany. Fax: (49-331) 288 2547, E-mail: bahc@pik-potsdam.de

Swedish National IGBP-PAGES Meeting**30 September-3 October, Lund/Höör, Sweden**

Contact: Barbara Wohlfarth, Department of Quaternary Geology, Tornavägen 13, 223 63 Lund, Sweden. Fax: 46-22-24830, E-mail: barbara.wohlfarth@geol.lu.se

LOICZ/SCOPE Workshop on Land-Ocean Nutrient Fluxes:**The Changing Silica Cycle****3-4 October, Linköping, Sweden**

Contact: Christoph Humborg, Department of Systems Ecology, Stockholm University, Svante Arrhenius Väg 21A, 10691 Stockholm, Sweden. Fax: (+46-8) 158 417, E-mail: christoph@system.ecology.su.se

3rd Palaeoclimate Modelling Intercomparison Project (PMIP) Workshop**4-8 October, Montréal, Canada**

Contact: Martine Lapointe – GEOTOP, Université du Québec à Montréal, C.P. 8888, Succursale Centre-Ville, Montréal (Québec), Canada H3C 3P1. Fax: (+1-514) 987 3635, E-mail: pmip@er.uqam.ca

LOICZ North Asia Workshop on basins and coastal systems (tentative)**10-12 October, TBA**

Contact: LOICZ IPO, NIOZ, PO Box 59, 1790 AB Den Burg, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl

GLOBEC Sessions at the 8th PICES Annual Meeting**8-17 October, Vladivostok, Russia**

Contact: Roger Harris, GLOBEC International Project Office, Plymouth Marine Laboratory, Prospect Place, Plymouth PL1 3DH, UK.
Fax: (+44-1752) 633 101, E-mail: r.harris@pml.ac.uk

**New Phytologists/GCTE Focus 1 Workshop on
Effects of global changes on fine root physiology and turnover** 19-22 October, Townsend TN, USA

Contact: Richard Norrby, E-mail: rjn@ornl.gov

LUTEA Database Development Working Group Meeting (tentative) 25-27 October, Beijing, China

Contact: Dennis Ojima, Natural Resource Ecology Laboratory, E-mail: dennis@nrel.colostate.edu

**Workshop on Freshwater Resources in Africa,
with Emphasis on Regional Scale Interactions of Land use and Climate** 26-29 October, Nairobi, Kenya

Contact: Wilhelmine Seelig, BAHC IPO, Potsdam Institute, for Climate Impact Research, P.O. Box 60 12 03, 14412 Potsdam, Germany; phone: +49-331-288-2543 Fax: +49-331-228 2547, E-mail: bahc@pik-potsdam.de

**IMAGES Meeting on Correlation of the post-glacial high-resolution
palaeoceanographic records from Eurasian Arctic and Far-Eastern Seas** 25-31 October, Moscow, Russia

Contact: Michael Levitan, Shirshov Institute of Oceanology, Russian Academy of Sciences, 36 Nakhimovskiy Prosp., 117851 Moscow, Russia. Fax: (+7-095) 1124 5983, E-mail: mlevitan@sedim.msk.ru

13th START SSC Meeting 27-29 October, Beijing, China

Contact: International START Secretariat, Washington DC, USA. E-mail: start@agu.org

**LUCC Data Expert Meeting on Indo-Gangetic Plains
(co-organized by LUCC/IGBP-DIS)** End of October, New Delhi, India

Contact: Inder Pal Abrol, Centre for the Advancement of Sustainable Agriculture, New Delhi, India. Fax: (+91-11) 5753678, E-mail: iabrol@vsnl.com

**LOICZ/UNEP Workshop on biogeochemical budgets in
estuarine systems of Latin America** 10-12 November, Bahia Blanca, Argentina

Contact: Stephen Smith, University of Hawaii, E-mail: svsmith@soest.hawaii.edu

LOICZ Workshop on Latin American basins 11-13 November, Bahia Blanca, Argentina

Contact: Wim Salomons, GKSS Research Centre, Geesthacht, Germany. E-mail: wim.salomons@gkss.de

SARCS/WOTRO/LOICZ Southeast Asia Workshop 12-13 November, Bahia Blanca, Argentina

Contact: LOICZ IPO, PO Box 59, 1790 AB Den Burg, Texel, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl

**GCTE Focus 2 and Canadian Forest Service Workshop on
Landscape fire modelling** 15-16 November, Victoria BC, Canada

Contact: Mike Flannigan, E-mail: mflannig@nrcc.gc.ca

***4th LOICZ Open Science Meeting** 15-18 November, Bahia Blanca, Argentina

Contact: LOICZ IPO, NIOZ, PO Box 59, 1790 AB Den Burg, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl

**Hydrological and geochemical processes in large-scale river basins
(co-organized by BAHC)** 16-19 November, Manaus, Brazil

Contact: Jean Loup Guyot, ORSTOM, CP 7091, Lago Sul, 71619-970 Brasilia DF, Brazil. Fax: (+55-61) 312 5881, E-mail: jean.guyot@apis.com.br

LOICZ SSC Meeting 18-20 November, Bahia Blanca, Argentina

Contact: LOICZ IPO, NIOZ, PO Box 59, 1790 AB Den Burg, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl

Second BAHC Synthesis Workshop December, Heidelberg, Germany

Contact: Wilhelmine Seelig, BAHC IPO, Potsdam Institute, for Climate Impact Research, P.O. Box 60 12 03, 14412 Potsdam, Germany; phone: +49-331-288-2543 Fax: +49-331-228 2547, E-mail: bahc@pik-potsdam.de

ELOISE Annual Meeting**1-5 December, Noordwijkerhout, Netherlands**

Contact: Carlo Heip, Netherlands Institute of Ecology, Centre of Estuarine and Coastal Ecology, PO Box 140, 4400 AC Yerseke, Netherlands. Fax: (+31-113) 573 616, E-mail: heip@cemo.nioo.knau.nl

Current progress in quantifying spatially explicit causes and effects of land use/cover change: examples from different parts of the world

7-8 December, Wageningen, Netherlands

Contact: Tom A. Veldkamp; Dept. Soil Science and Geology, Wageningen Agricultural University; Duijvendaal 10. PO Box 37; NL-6700 AA; Wageningen; ; The Netherlands. Fax: (+ 31-317) 482419. E-mail: tom.veldkamp@geomis.beng.wau.nl;

2000**LOICZ/UNEP Workshop on estuarine systems of South Asia****25-28 January, TBA, India**

Contact: Stephen Smith, University of Hawaii, E-mail: svsmith@soest.hawaii.edu

PAGES SSC Meeting**2-3 February, Pune, India**

Contact: PAGES IPO, Bärenplatz 2, 3011 Bern, Switzerland. Fax: (+41-31) 312 3168, E-mail: pages@pages.unibe.ch

PAGES Workshop on South Asian Palaeoenvironments*4-5 February, Pune, India**

Contact: PAGES IPO, Bärenplatz 2, 3011 Bern, Switzerland. Fax: (+41-31) 312 3168, E-mail: pages@pages.unibe.ch

SOLAS Open Science Meeting*20-24 February, Kiel, Germany**

Contact: Peter S. Liss, School of Environmental Sciences, University of East Anglia, Norwich NR4 7TJ, UK. Fax: (+44-1603) 507714, E-mail: p.liss@uea.ac.uk

15th SC-IGBP Meeting**22-25 February, TBA, Mexico**

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

IPO Executive Officers Meeting**26 February, TBA, Mexico**

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

LUCC Synthesis Workshop**13-15 March, Stockholm, Sweden**

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

LOICZ/UNEP Workshop on estuarine systems of East Asia**April, TBA**

Contact: Stephen Smith, University of Hawaii, E-mail: svsmith@soest.hawaii.edu

BAHC SSC Meeting**10-14 April, TBA, Venezuela**

Contact: Wilhelmine Seelig, BAHC IPO, Potsdam Institute, for Climate Impact Research, P.O. Box 60 12 03, 14412 Potsdam, Germany; phone: +49-331-288-2543 Fax: +49-331-228 2547, E-mail: bahc@pik-potsdam.de

Second JGOFS Science Conference*12-17 April, Bergen, Norway**

Contact: Roger B. Hanson, Centre for Studies of Environment and Resources, University of Bergen, High-Technology Centre, N-5020 Bergen, Norway. Fax: (+47-55) 58 96 87, E-mail: Roger.Hanson@jgofs.uib.no

15th JGOFS SSC Meeting**10-11, 18 April, Bergen Norway**

Contact: Roger B. Hanson, Centre for Studies of Environment and Resources, University of Bergen, High-Technology Centre, N-5020 Bergen, Norway. Fax: (+47-55) 58 96 87, E-mail: Roger.Hanson@jgofs.uib.no

***International Conference on " The future of the Mediterranean rural environment: prospects for sustainable land use and management"**

8-11 May, Menemen, Turkey

Contact: Gill Burrows, Cranfield University at Silsoe, Silsoe, Bedfordshire, MK45 4DT, UK. Fax: (+44-1525) 863 344, E-mail: g.burrows@cranfield.ac.uk

LOICZ/UNEP Workshop on estuarine systems of West Africa

July, TBA

*Contact: Stephen Smith, University of Hawaii, E-mail: svsmith@soest.hawaii.edu***LOICZ/UNEP Regional workshop on biogeochemical processes in estuaries: Americas and Caribbean**

September, TBA

*Contact: LOICZ IPO, PO Box 59, 1790 AB Den Burg, Texel, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl***LOICZ SSC Meeting**

October, Arcachon, France

*Contact: LOICZ IPO, PO Box 59, 1790 AB Den Burg, Texel, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl***LOICZ/UNEP Workshop on estuarine systems of East Africa**

November, TBA

*Contact: Stephen Smith, University of Hawaii, E-mail: svsmith@soest.hawaii.edu***2001****LOICZ/UNEP Regional workshop on biogeochemical processes in estuaries: Asia and Oceania**

January, TBA

*Contact: LOICZ IPO, PO Box 59, 1790 AB Den Burg, Texel, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl***LOICZ/UNEP Regional workshop on biogeochemical processes in estuaries: Africa and Europe**

April, TBA

*Contact: LOICZ IPO, PO Box 59, 1790 AB Den Burg, Texel, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl***LOICZ/UNEP workshop on biogeochemical processes in estuaries: global synthesis**

July, TBA

*Contact: LOICZ IPO, PO Box 59, 1790 AB Den Burg, Texel, Netherlands. Fax: (+31-222) 369 430, E-mail: loicz@nioz.nl****IGBP Open Science Conference**

10-14 July, Amsterdam, Netherlands

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

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