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

CONTENTS

A New Challenge

Assessing Tropospheric Ozone as a Climate Gas

Scientific interest in "free tropospheric ozone" has steadily increased in the last few years. It has become apparent that: (1) ozone significantly influences the radiative forcing of the troposphere-surface climate system (records of radiative calculations show that absolute ozone density between 8-12 km in altitude exerts the greatest influence on the troposphere-surface climate system); (2) the photo-dissociation of O3 defines the "oxidation efficiency" of the troposphere and, as a result (3), ozone has indirectly modified the concentration and lifetime of other gases – especially carbon monoxide, methane and non-methane hydrocarbons.

Past assessment of ozone concentration primarily focused on two layers of the atmosphere: (1) the planetary boundary layer, where increasing levels of ozone continue to endanger health standards and measurably damage forests and agricultural crops; and (2) the stratosphere, where ozone depletion increases UV-B penetration into the troposphere, posing threats to living organisms and possibly influencing tropospheric chemistry.

Ozone (O_3) acts as a greenhouse gas by absorbing outgoing long-wave radiation. It also absorbs solar radiation, in particular, the UV-B radiation. Changes in ozone vertical distribution can perturb the solar and long-wave radiative forcing of the troposphere-surface climate system. Records of radiative calculations show that absolute ozone density between 8-12 km in altitude range will strongly modify the rate of radiative forcing.

Observational data on tropospheric ozone concentration trends were limited until only a few years ago. There had been a statistically significant increase in free tropospheric ozone concentration (within 8-12 km range) in some areas of the northern hemisphere. However, recent WMO assessment reports and articles in the reviewed literature characterise the state of knowledge regarding tropospheric ozone trends to be very sketchy. The majority of stations are located in northern mid-latitudes. There are less than 15 stations with long-term records (>15 years), and most of these are located in Canada, Europe and Japan, with one in the U.S. and one in Australia. Among these stations the data quality and sampling frequency are uneven. There is one station in the tropics with a record from 1979, but the sampling frequency has been low. If a better assessment is to be made of ozone impacts on surface temperatures, research must establish the trend in ozone concentration in the critical 8-12 km altitude regime. An increase in measurement frequency is needed at many of the existing stations, and new stations are required in regions where there are none. The assurance of continuity is required at several of the stations established in recent years. By far the greatest need is for improved data quality, for both present and future measurement stations.

Other factors must also be considered. Ozone differs distinctly from other greenhouse gases. First it is a product of photochemical reactions in the atmosphere: photo-dissociation and subsequent reactions of O('D) with water vapour trigger the formation of the hydroxyl radical (OH) in atmospheric background air. The hydroxyl

radical controls the fate of carbon monoxide and methane (the latter being a potent greenhouse gas) and generates the peroxy radical HO_2. Moreover, the conversion of NO to NO_2 by HO_2 leads to further O_3 formation due to the rapid photolysis of NO_2 which yields the oxygen atom required to produce O_3. However, at low NO concentrations, of less than about 10 parts per trillion (ppt), HO_2 will actually destroy ozone. Nitric oxide is conserved in the complex process of ozone production. In short, it can be considered a catalyst in ozone formation. Thus if nitric oxide concentrations change, they will likely modulate O_3 production and indirectly OH formation. As a result, there exists a close coupling between the radiatively active gases – ozone and methane – and the tropospheric oxidation efficiency. This will cause changes in oxidation processes, and thus prompt climate forcing. Due to these feedback processes, calculations of the climatic effect due to ozone changes have inherently larger uncertainties than similar calculations involving those greenhouse gases that are directly emitted into the atmosphere. The relatively short lifetime of ozone in the troposphere generates a considerable range of spatial and temporal variations in ozone concentrations. The impact of ozone on climate forcing stands in striking contrast to the impact from other greenhouse gases that are more uniformly distributed throughout the troposphere. Ozone lifetimes in the troposphere generally run to an order of days or weeks, but ozone lifetimes in the lower stratosphere run to many months. The climate forcing due to ozone is not uniform and the impact on surface temperature is more difficult to assess than for the other well-mixed greenhouse gases.

The demonstrated sensitivity of ozone radiative forcing to environmental parameters, in particular to lower stratospheric, is now an issue of significant concern. General Circulation Model (GCM) experiments must soon begin on how stratospheric temperatures and dynamical heating influence climate forcing due to changes in vertical ozone distribution on a seasonal and latitudinal basis. If these chemically induced changes are to be understood, more sophisticated models must be developed to assess climate change and regional distributions of ozone. Consequently, the development of climate models with coupled physical, chemical and dynamical processes is urgently needed.

If ozone depletion in the lower stratosphere (and consequently a decrease in temperature) is demonstrably attributed to a continued build-up of cholrofluorocarbons in the stratosphere, doubts will be raised regarding the alleged increase in tropospheric ozone in the middle and high latitudes of the northern hemisphere. A recent study suggests that the increases may be caused by an augmentation of ozone precursor trace gases (NO_x and hydrocarbons).

Dominant chemical processes/ reactions in the free troposphere (8-12 km range)

$NO + HO_2 \Rightarrow NO_2 + OH$

$NO_2 + h\nu\ (\lambda < 400\ nm) \Rightarrow O(^3P) + NO$

$O(^3P) + O_2 + M \Rightarrow O_3 + M$

$O_3 + h\nu\ (\lambda < 320\ nm) \Rightarrow O(^1D) + O_2$

$O(^1D) + H2O \Rightarrow 2OH$

$OH + CO \Rightarrow HO_2 + CO_2$

Further research refinement will be required. Changes in the upper tropospheric ozone are attributed to: (1) downward transports of ozone-rich stratospheric air through the tropopause during folding events that are associated with mid-latitude cyclones; and (2) an *in-situ* photochemical production from precursor gases with nitric oxides as a "catalyser".

Downward transport

The first process, of downward transport, was assumed to have remained constant over decades, even though no reliable data were available to prove the contention. Downward transport is strongly coupled with cyclogenesis. Estimates of the stratospheric-tropospheric mass exchange amount to about 3×10^{17} kg/yr. However, simulations of this exchange process are a severe challenge for numerical weather prediction models and general circulation models, involving a subtle interplay between advection and physical processes on small and large scales. Therefore, any current estimate of the magnitude of this exchange is known at best within a factor of two, and field experiments addressing specifically this problem yield results with the same degree of uncertainty. If extra tropical cyclone ($\leq$ 990 h Pa) activity exhibits a trend, it can be argued that this trend will influence the stratospheric/tropospheric air mass exchange, will modulate the transport of stratospheric ozone to the upper troposphere, and will thus induce a trend in ozone concentration within this region. A preliminary review of the available data reveals indeed an increasing trend in cyclonic activities over the North Atlantic and Europe, but a downward trend over the United States. No long-term trend data are available on a global basis, and it is therefore unknown if trends observed over limited geographic regions represent a shift in cyclone paths or a true global change. Clearly cyclonic frequency and intensity modulates upper tropospheric (8-12 km layer) ozone concentration at mid-latitudes, and knowledge of temporal trends in these two parameters is a prerequisite for understanding past or predicting future trends of ozone in the upper troposphere.

Nitric oxide in the upper troposphere

The second process focuses on the abundance of nitric oxide in the upper troposphere. It has been reasoned that any past or future changes in global NO_x emissions should have influenced or will induce increased O_3 production. Three sources of NO_x may influence *in situ* ozone production within the 8-12 km range, namely (a) lightning, (b) aircraft traffic, and (c) transport from the planetary boundary layer.

(a) Global lightning activity has been directly observed by NASA satellites and indirectly derived from the measurement of the Schumann resonance. Schumann resonances are caused by lightening discharges exiting the cavity between the earth's surface and the (conducting) ionospheric D-layer. While the NASA observations are too short for establishing a trend, they do provide a detailed picture of the global distribution of lightning discharges. On the other hand, monitoring the Schumann resonances provides a global picture of lightning activity over time, it provides, however, little geographic resolution. What is needed is a combination of all available global observation techniques operating over a long-term time period, so that geographically resolved trends can be established.

(b) A striking rise in civil air traffic has contributed to a significant extent to upper tropospheric sources of nitric oxide and hydrocarbons. Approximately 176 million tons of aviation fuel were burned in 1990 by a world air fleet of 375,000 civil aircraft – plus an uncertain number of military aircraft. Of this total, 12,000 units were the heavier, commercially operated aircraft that burn amounts of jet fuel that are well known as a function of altitudes and

latitudes. From the current (1990) and projected future (2015) calculated emissions of nitric oxide one must anticipate a rise in upper tropospheric ozone concentration extending well beyond the major flight corridors of the northern hemisphere. Particularly notable is the projected rise of air traffic and resulting precursor gas emissions in the Pacific rim area extending into the southern hemisphere. Since the upper troposphere in these regions is still characterised as an "NO_x poor" environment, additions of the "catalytic" substance may likely trigger ozone production rather than the currently assumed ozone destruction. To document these projected increases of ozone in the 8-12 km altitude range requires a few strategically located sensors for recording the vertical ozone distribution. These must become operational within the not too distant future.

(c) To distinguish between the consequences of ground level and aircraft emission, it is useful to look at the efficiencies in producing ozone in the upper troposphere. Preliminary assessments reveal that NO_x emitted from aircraft is much more efficient in enhancing ozone at the 8-12 km level than ground based sources of NO_x. These model estimates should now be refined and confirmed through field studies.

An unprecedented level of international co-operation and guidance must come from the atmospheric chemistry community if a research and monitoring network is to meet the needs of GCM modellers and ultimately of policy makers. The monitoring of tropospheric ozone stands today at a critical stage. Ozone clearly exerts a significant impact on surface temperature. However, since future increases in precursor gases and UV-B radiation appear to be inevitable, a higher quality of global data must be acquired to document changes in the chemical composition of the atmosphere and to improve trend analysis. To achieve this goal, an integrated set of surface and satellite based observations must be put into service. The current inventory of observational tools is insufficient to assess reliably the incidence of ozone change on a global basis.

Two global programmes have already begun to document changes in the chemical composition of the atmosphere:

- The WMO has created a Global Atmosphere Watch (GAW) programme to record long-term trends for all climate related tropospheric substances. It will eventually rely on 25 carefully selected globally dispersed stations to measure surface ozone, total column ozone and vertical ozone profiles, and other atmospheric substances.
- The International Global Atmospheric Chemistry (IGAC) programme has established a project entitled Global Tropospheric Ozone Network (GLONET). There will be a further opportunity for the atmospheric science community to focus on problems related to tropospheric ozone by participating in the proposed ITOY: International Tropospheric Ozone Years. No time should be lost in planning for this unique global experiment.

These international programmes have joined forces to promote actively the implementation of a network that provides globally representative trend information of known quality for tropospheric ozone and to improve our prognostic capabilities. Their support by national and international funding agencies should be a high priority.

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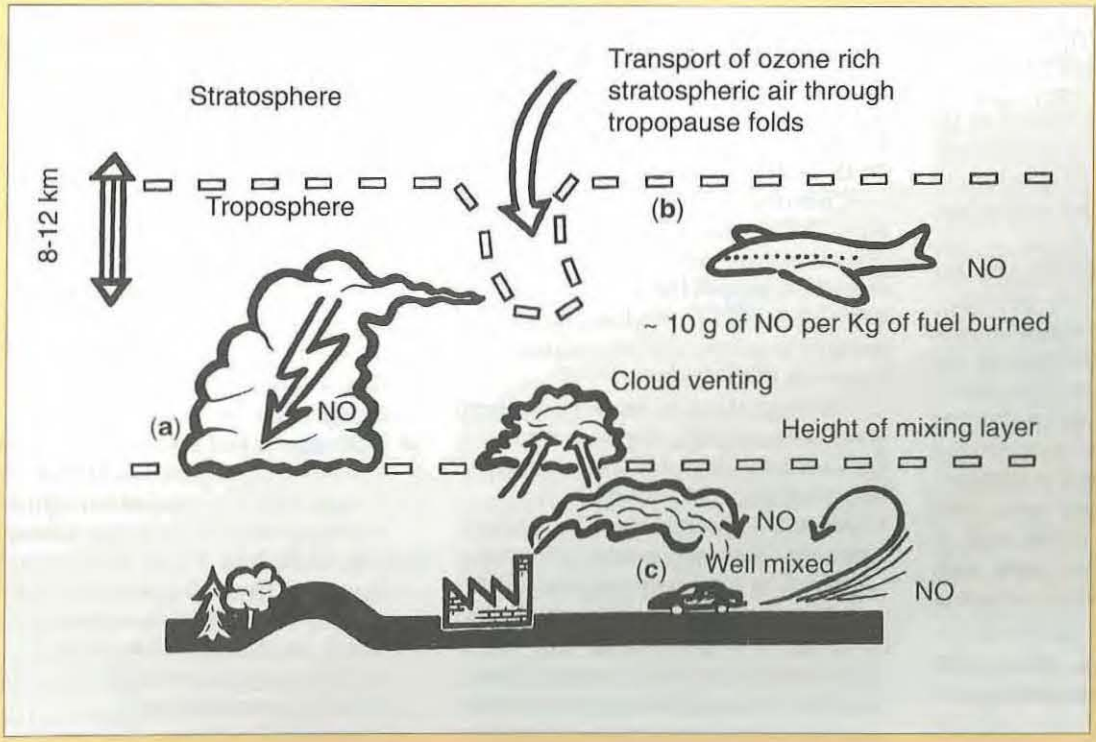

Three sources of NO_x that may influence *in situ* ozone production within the 8-12 km range

CO_2 Studies, Global Vegetation Models, and Crop Impacts

Highlights of the First GCTE Science Conference

Over 400 scientists from 35 countries around the world descended on the small Cape Cod village of Woods Hole, MA, USA, in May for the first GCTE Science Conference.

The meeting focused on the early results from GCTE, and on related research around the world. It addressed two key questions that are central to the current debate on societal responses to global environmental change: how do changes in atmospheric composition, climate and land use affect terrestrial ecosystems, including agriculture, forestry and soils; and how will these changes feed back to further change in climate and atmospheric composition?

Highlights of the conference included the rapid increase in understanding of elevated CO_2 effects, recent advances in the simulation of global vegetation distribution, and progress in predicting effects of global change on crop yields and other aspects of the performance of agricultural systems.

Elevated CO_2 effects

Considerable progress has been made over the past few years in understanding and modelling the responses of vegetation to increasing concentrations of CO_2 in the atmosphere. GCTE has focused on ecosystem-level effects, with the following generalisations emerging:

- In all natural ecosystems studied so far under elevated CO_2, there is enhanced daytime assimilation of CO_2 but no or negligible increase in above-ground biomass.
- Biomass responses are species specific, with some losing and others gaining.
- Below-ground processes seem to be particularly important in determining the fate of the additional carbon assimilated by plants, with most systems showing an initial stimulation of below-ground biomass accumulation and/or turnover. The missing carbon may have been sequestered in the soil carbon pool, or distributed among several pools, each too small to be detected with sufficient accuracy.

Global vegetation modelling

Equally rapid progress has occurred in global vegetation modelling, where just three years ago the only models were based on a broad correlation between vegetation assemblages and climate. Recent advances include:

- Incorporation of increased understanding of small-scale plant physiological mechanisms in the simulations. Thus, models are moving towards a more mechanistic and less correlative basis.
- Coupling of global vegetation models to both biogeochemical and general circulation models (GCMs), and rapid progress toward fully-linked earth system models.
- Data for validation of global models. Global maps of leaf nitrogen content and leaf-scale stomatal conductance, along with the fluxes of water vapour and CO_2 at the canopy scale, have been produced.

Despite these impressive advances, global vegetation models remain "equilibrium" models which do not capture the pathways or rates of change between one biome and another. The question of rates is a critical one. There is a growing recognition that the accelerating environmental changes impacting on terrestrial ecosystems mean that ecosystems will be progressively less in equilibrium with climate; that they will be increasingly prone to disturbances and consequent rapid changes in structure, and that their species diversity will change significantly, decreasing in some cases through extinction and increasing in others through invasions of exotic species.

Understanding, and eventually adapting to, these dynamic responses of ecosystems to global change is now becoming a central question in the political and social debate. For GCTE, providing the science required to answer these questions is also becoming a central theme.

Although this is an issue where much of the science is still in the formative stage, the Conference heard of several areas that are poised for rapid progress:

- One study reported that the composition and function of ecosystems are constrained by the pattern and scale of disturbances, which cause self-organisation of vegetation patterns that persist in time and are extensive in space. Change in these self-organising patterns usually occurs as an abrupt transition from one pattern to another, caused by a change in disturbance regime. Since global change is predicted to bring significant changes to disturbance patterns and scales, changes in vegetation patterns due to global change will likely be sudden and extensive.
- Changes in fire regimes may lead to rapid changes in pattern and process at the landscape scale. Models are now being developed to simulate the complex interaction between weather (temperature, humidity, wind velocity), fuel characteristics, and landscape pattern.
- Validating disturbance models is difficult due to lack of data. There was a strong call for GCTE to place high priority on the production of global databases of disturbance types, frequencies and extents.

Effects of global change on agriculture

Impacts of global change on terrestrial production systems are of immense concern to human societies, and play a prominent role in the GCTE research effort. Research in the GCTE crop networks is now moving ahead strongly, and they are becoming a major international mechanism for integrating modelling and experimentation on global change impact on production. Highlights from the GCTE wheat network, and from other initiatives in GCTE's Focus 3, were presented at the conference:

- An analysis of climate change impacts on wheat show a surprising divergence of results from model simulations. Yield predictions, for an identical climatic dataset, varied from 2 to 8 tonnes/ha for a North American site and from 5 to 10 tonnes/ha for a European site. More details are given in the IGBP *Global Change NewsLetter* No. 18, June 1994.
- Prototype linked pest-crop models are now being developed. GCTE is actively supporting this initiative through close collaboration between its crop networks and its Activity 3.2 on global change impacts on pests, diseases and weeds. A detailed implementation plan for research on managed forests has been produced, and a co-ordinated research effort is now coalescing.
- Frameworks for progressing research in global change aspects of soil biology

Members of the GCTE Core Project Office by the sea at Woods Hole, Massachusetts, USA, where the Science Conference for Global Change and Terrestrial Ecosystems was hosted by the Marine Biological Laboratory. From left to right: Rowena Foster (GCTE Administrative Officer), Brian Walker (Chair, GCTE-SSC), Sheree Baker (GCTE Administrative Assistant), Will Steffen (GCTE Core Project Officer).

and soil erosion were presented, and implementation workshops are developing detailed work plans for each.

New Research

Some areas of research discussed at the Conference are still diffuse, full of good and stimulating ideas at the very forefront of scientific thought, and primed for the initiation of an exciting and vigorous research effort. In many cases, these areas are strongly multidisciplinary, and require the active and close collaboration of types of scientists that have not often worked together in the past. GCTE is just now initiating its research in these areas.

One such issue is global change impacts on complex agroecosystems, which demand links among agricultural, ecological and social scientists. This is a critical issue for a large portion of the human population, which depends on multi-crop systems or agro-forestry for much of their food and fibre. The assumption that these agroecosystems will be inherently more stable than monocultures in the face of global change is being questioned by emerging evidence presented at the conference.

A second issue is global change and ecological complexity. Ecological complexity encompasses the spatial patterning between and within ecosystems, the numbers and relative abundance of species, and the structure of their trophic networks. The relationships between this complexity and the functioning of ecosystems, and how global change will affect these relationships, is the central theme of GCTE's Focus 4. (See IGBP *Global Change NewsLetter* No. 18, June 1994, for more information on Focus 4.)

Early evidence from studies on primary production and plant species diversity in grasslands shows that removal of species that didn't contribute much to total production didn't alter total production (their removal was compensated for), but, as expected, removal of dominant species resulted in an overall drop in production. Studies also indicate that species diversity increases the stability of the system, for example, the ability of a grassland system to withstand and recover from drought. This result contrasts with the early work on the stability of complex agroecosystems, mentioned above, and highlights the need for a concerted research effort in this area.

Future directions

A particularly pleasing outcome of the Conference was the large number of young scientists who presented reports on a wide range of new and exciting studies. These scientists will form the nucleus of the next generation of research leaders to tackle global change issues. In addition, the large variety of scientific disciplines represented at the meeting is evidence of the new alliances evolving within the scientific community in response to the questions posed by rapid environmental change and its impacts on terrestrial ecosystems.

Another encouraging result was the strong participation from many countries around the world, which indicates the commitment of the scientific community to GCTE research. However, the lack of encouragement, recognition and rewards for individual scientists in many countries to participate in international research programmes like IGBP was identified as a major impediment to further progress. It is essential that nations make available their best scientists to ensure the success of GCTE and other Core Projects.

The GCTE Science Conference, which attracted three times the number of participants originally estimated, was organised and supported by the Core Project Office and by the Marine Biological Laboratory, Woods Hole. The latter, in particular, played a key role in ensuring efficient local logistics for what the Director of the MBL called "the conference that ate Woods Hole".

The papers presented at the GCTE Science Conference will be published in two volumes. The plenary papers will be published by Cambridge University Press in the IGBP book series. The contributed papers will be published as a special edition of *Global Ecology and Biogeography Letters*.

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Global Terrestrial Net Primary Productivity

At a unique meeting on global models of terrestrial net primary productivity, organised by GAIM, IGBP-DIS, and GCTE, scientists discussed data results displayed by interactive, live visualisations of global maps that IGBP-DIS had formatted from full datasets supplied by the participants. User-friendly visualisation software was provided by IGBP-DIS for generating the global maps. Each working group had access to several UNIX workstations provided by the Potsdam Institute for Climate Impact Research, and each participant could visualise model parameters and compare them with those from other meeting participants by producing colour maps at request. The results were surprising.

Global primary production of ecosystems on land and in the oceans is a crucial component of biogeochemical model development within IGBP. Thirty-four researchers from the United States, France, Germany, Sweden, Belgium, Holland, Australia and the United Kingdom, who are involved in several IGBP Core Projects, participated in a meeting on the comparison of global models of terrestrial net primary productivity (NPP) in Potsdam, Germany, from July 6-8, 1994. The scientific sponsorship of this workshop was jointly by the IGBP-Data and Information System, the Global Analysis, Interpretation and Modelling Task Team, and the Global Change and Terrestrial Ecosystems Core Project. It was hosted by the Potsdam Institute of Climate Impact Research (PIK), with financial support from NASA, the European Commission, and the U.S. Environmental Protection Agency.

The aim was to bring together scientists from most groups that are currently involved in modelling the terrestrial biosphere, with specific interests in comparing output on net primary productivity. The group assembled and compared an extensive number of input datasets and model results which are in use for the development of approximately 17 different models. The key dataset for model intercomparison was each group's global map of net primary production, but other output data sets, including relevant input data, were compared as well. The major objectives of the meeting were: (i) to initiate the establishment of a model intercomparison methodology and protocol, (ii) to make a pilot intercomparison effort during the meeting, and (iii) to establish NPP baseline datasets for future intercomparisons.

Background

Geographically referenced net primary productivity (NPP) and gross primary productivity (GPP) and their corresponding seasonal variation are key components in the terrestrial carbon cycle. They are needed to understand both the function of living ecosystems and also their effects on the environment. Productivity is also a key variable for the sustainability of human use of the biosphere by, for example, agriculture, animal production and forestry. Recently, it has become possible to investigate the magnitude and geographical distribution of these processes on a global scale by a combination of ecosystem process modelling and monitoring by remote sensing. Since agricultural and forestry production provide the principal food and fuel resources for the world, monitoring and modelling of biospheric primary production are important to support global economic and political policy making.

In the last few years, a coordinated strategy has been developed to improve estimates of terrestrial net and gross primary productivity through measurement and modelling under the leadership of IGBP-DIS, the GAIM Task Force and the GCTE Core Project. Following the recommendations of a planning group which met in Paris, France, in November 1993, it was decided that much could be gained by a formal model intercomparison activity. Several independent models exist, which are in various stages of development, and they adopt widely differing approaches to describe primary production at regional and global scales. So far, only few of these models had systematically been compared to each other concerning their strengths and weaknesses. Therefore, an intercomparison would illustrate for a broader community of terrestrial ecologists which types of data that would be central to achieve a better understanding of the role of the terrestrial ecosystem in the global carbon cycle. A multi-step approach was recommended that would allow us to learn how to inter-compare models by actually doing it. This was the basic rationale for the Potsdam Workshop.

Meeting structure and emerging issues

During the opening of the workshop, S. Ichtiaque Rasool (DIS), Berrien Moore III (GAIM) and Wolfgang Cramer (PIK/GCTE) gave brief accounts of the purposes of the meeting. The first session then consisted of review presentations on the 17 global models that were to be compared, classified in three groups: a first type based on the use of satellite measurements (diagnostic models), a second on empirical schemes (climate- based regression models) and a third on mechanistic models (biogeochemical models). Each group gave a brief description of their model by explaining the major processes and factors involved. During the next session, the entire meeting was divided in four working groups to make comparisons of key issues across all existing models. These included different approaches to model partial processes, such as respiration, the underlying data sources, long-term vs. annual climatologies etc. The groups also focused on comparing their data for driving variables such as precipitation, temperature, normalised difference vegetation index (NDVI), solar irradiance and model results such as global sum NPP/GPP, or heterotrophic respiration. After a full day of comparisons, the discussion groups presented their findings as a number of major differences amongst the 17 models and the input/output data. During the last session, the workshop concluded by reviewing data needs for validation and their availability and the next steps of the intercomparison of models to be continued in the future.

The informal, yet well-structured, format of the meeting contributed greatly to its success. Much time was spent discussing interactive, 'live' visualisations of global maps that provided insight into the spatial pattern of the various data sets. Most groups had provided their full datasets beforehand and in such a way that the organisers had been able to reformat the data for fast and efficient visualisation using standard colour scales and map formats. This was a very successful logistic preparation that made the meeting unique in its kind. Each working group had access to several UNIX-workstations with user-friendly visualisation software, along with

an assistant to further free them from the technical aspects of the comparison. Clearly, each participant felt free to visualise one of his/her model parameters and to compare it with those from other meeting participants by just generating colour maps 'on the fly'.

Major results

- The most surprising result was that there was an approximate factor of 1.5 between the lowest and the highest estimates of total, terrestrial NPP for the 17 models. It ranged from 45 Gt C yr-1 to 68 Gt C yr-1 (Fig.1). The differences persisted even when input meteorological/climatic data were identical.
- Even when the models predicted similar annual NPP, large discrepancies were noted in the spatial pattern (Fig.2).
- Large NPP discrepancies were found for most biomes. Two diagnostic models which both used NDVI as input, predicted contradictory results, particularly for tropical forests and croplands (Fig.3).

The major differences were in the input data used by the modellers, especially for solar irradiance, climatic datasets, vegetation maps (including biome classification), use of potential versus actual vegetation. Field datasets for model validation were noted as missing by all participants.

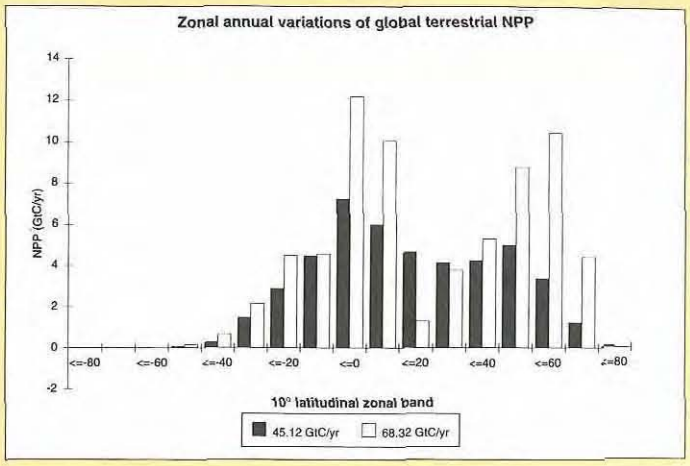

Figure 1. Two extreme models of annual zonal variations of global terrestrial NPP, calculated over 10 (degree sign will be used) bands for one year, with a factor of 1.5 difference between the two models.

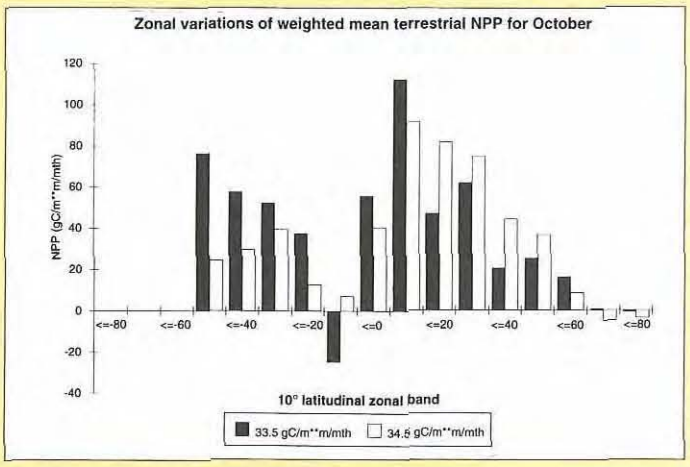

Figure 2. Mean terrestrial NPP for October is weighted by land surface area and calculated over a 10 (degree) latitude band. For two models predicitng nearly the same mean NPP large differences are noted in the zonal distribution.

Future steps

A small group (S. D. Prince, G. Dedieu, W. Parton, W. Emanuel) was appointed to develop a proposal and to seek sponsors for an international program to collect an appropriate field dataset and to make it widely available. It is expected that a committee will be established, the membership of which will reflect available expertise and the interests of the sponsors. It will identify primary production and associated environmental data sets for specific field sites, organise and interpret the data to provide the parametrization and the validation data needed in support of modelling global primary production and other applications. This effort will work closely with GCTE.

A file server for the NPP modelling comparison will be installed in October 1994 at the Potsdam Institute for Climate Impact Research. As a first step, all of the datasets, inter-comparison analyses, colour maps and charts used at the meeting will be available to the participants and, after publication, to the entire biosphere modelling community.

To ensure the intercomparison of models, common input data sets need to be established:

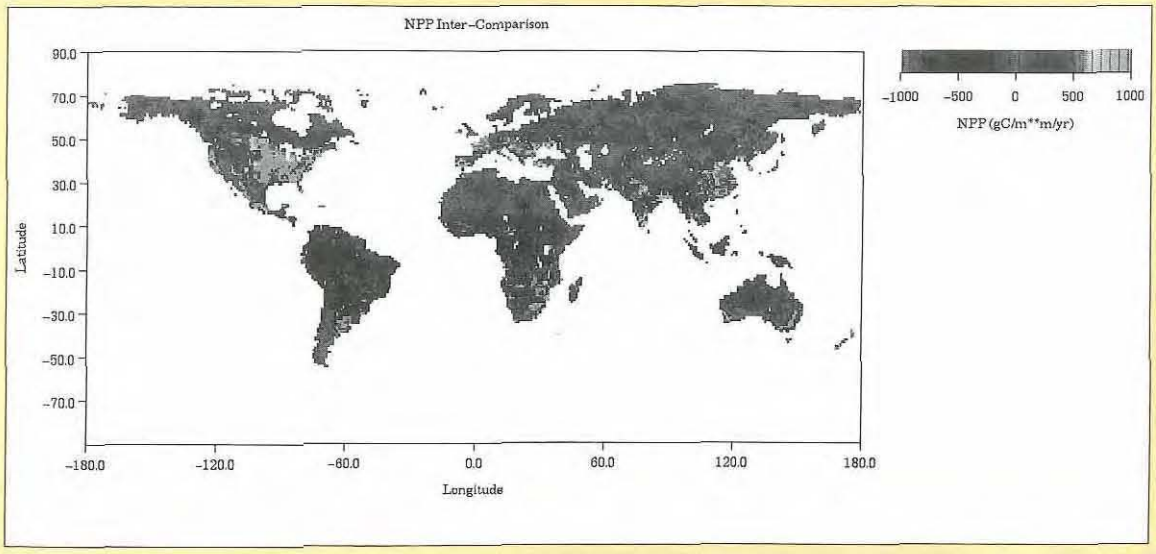

Figure 3. Absolute difference map between two models both using NDVI datasets. Negative values are dark and positive values are light. Most contradictory results are noted in the tropical forests and croplands.

- The Cramer & Leemans long term climate database, which is already used by the majority of groups, will be the common choice for use on the global scale and be made available through the file server for the next inter-comparison effort.
- The global datasets from the ISLSCP CD-ROM for the 1987-1988 year (NDVI, leaf area index, fractional photosynthetically active radiation, vegetation classification, near surface meteorology, solar radiation, soil reflectance fields, snow, ice, etc) will also be available for the modelling community.
- Efficiency values of photosynthetic active radiation at the top of the canopy based on net solar irradiance will be compiled by R. Otto, J. Kaduk and A. Haxeltine as a common baseline data set.
- A standard interpretation of the soil texture data set from Zobler will be provided by R. Otto.
- A standard weather generator for global applications will be provided by A. Friend
- A 62483 pixels terrestrial mask or template will be provided by W.Cramer.

Following these activities, a second step in the model inter-comparison will be a new workshop at Potsdam ("Potsdam '95"). The same modelling teams and hopefully others will meet in the summer of 1995 and continue this exciting and productive investigation.

The way ahead

Lessons learnt from this international collaboration were that a good preparation with 'live' visualisations, availability of workstations to manipulate model inputs vs. outputs, and a casual atmosphere were the keys to the success of the workshop. The combination of rapid internet data exchange and efficient and well-prepared visualisation created an atmosphere of open exchange along with new possibilities for interpretation. Through the decision to set up the Potsdam NPP file server and to compile the common datasets, a mechanism has been established to make sure that inter-comparison in the terrestrial NPP area becomes a continuing activity.

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Joint IGBP-DIS-GAIM Working Paper #1.

BIOME 6000: Towards a Global Palaeovegetation Data Set

Global palaeovegetation data for climate-biosphere model evaluation cut accross several IGBP projects. Four of them, Data and Information System, Global Analysis Interpretation and Modelling, Past Global Changes, and Global Change and Terrestrial Ecosystems met in Sweden on 11-13 May 1994, to plan development of global biome data sets from pollen and plant macrofossil records for 6000 and 18000 ^{14}C-yr BP, key times in palaeoclimate modelling and palaeodata synthesis.

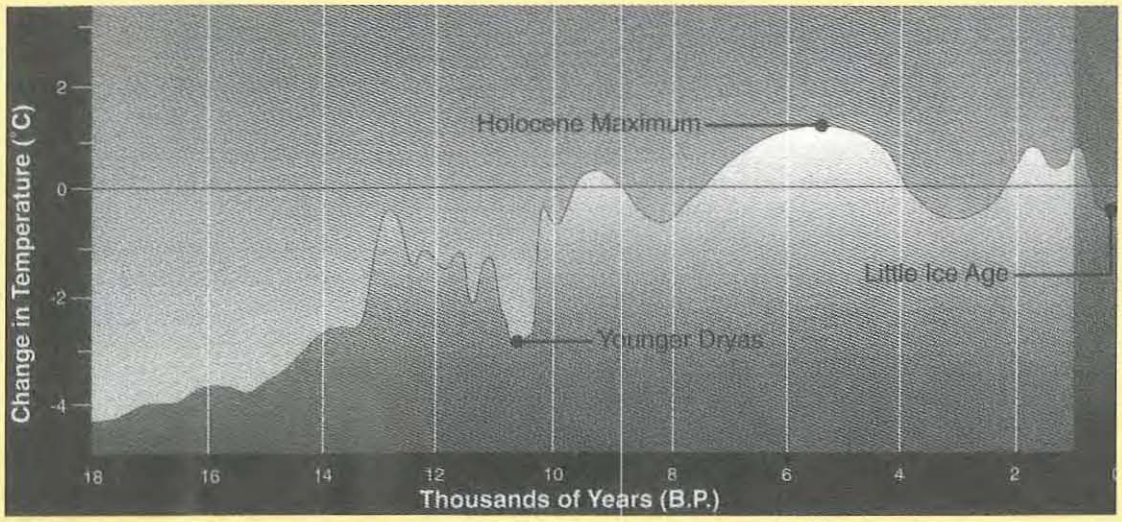
"Climate-vegetation interactions: a 6000 yr BP experiment" is a focus of the IGBP Task Force on Global Analysis Interpretation and Modelling (GAIM). The aim of the experiment is to assess the importance of biogeophysical feedbacks in the climate system by comparing the performance of coupled and uncoupled climate biosphere models, driven by the Earth's orbital change from 6000 yr BP to present. The existing, extensive coverage of palaeodata describing the state of the terrestrial biosphere at 6000 yr BP should - if properly collected and summarised - provide a decisive standard against which to evaluate model results.

The experiment has two major components, modelling and data synthesis. The modelling component relies on the existence of mechanistic models (biome models) that predict the distributions of broad-scale ecosystem types (biomes) as a function of physical environment, and also on the potential for linking such models asynchronously to atmospheric general circulation models through modification of land-surface parameters. The modelling component is well advanced and there is therefore concern to stimulate the required data synthesis component. What is most urgently needed is a *global* data set describing the actual distribution of biomes during the centuries around 6000 yr BP, based on pollen and plant macrofossil records.

Another GAIM experiment, not yet designed in as much detail as the 6000 yr BP experiment, aims to account for natural changes in atmospheric trace-gas composition after the Last Glacial Maximum (LGM, ≈ 18000 ^{14}C-yr BP) as shown by ice-core palaeorecords, through coupling models of physical climate, atmospheric chemistry and terrestrial biosphere trace-gas sources and sinks. Future model-coupling experiments may also explore the causes of natural changes in atmospheric CO_2 and terrestrial carbon storage after the LGM. The two periods of 6000 yr BP and the LGM are accepted "key times" both for palaeoclimate modelling as in the Palaeoclimate Model Intercomparison Project, (PMIP) and the Co-operative Holocene Mapping Project (COHMAP), and for palaeodata synthesis. Data for the LGM are more sparse that for 6000 yr BP, but they show very large changes. A global data set of describing biome distributions around the LGM is therefore a second desideratum and could provide key constraints for a range of earth system model experiments.

At several recent forums, researchers in palaeoecology have expressed community-wide support for the proposed development of both 6000 yr BP and LGM global palaeovegetation data sets. It has been emphasised that if these data sets are to have lasting value, the primary data must be assembled in an accessible form, and quality control must be clearly documented. In addition, biomes must be inferred from the primary data using a repeatable and globally consistent approach based on plant functional types. This is essential to allow comparability between regions with taxonomically distinct floras. A suitable biome reconstruction method has now been developed, and has shown to produce accurate modern biome distributions when tested with spatial networks of surface pollen-sample data from Europe, east Africa and eastern North America. The project therefore appears feasible with existing techniques, and builds on a firm collaborative basis.

With this background, a workshop was held in Hörby, Sweden in May 1994, under the joint sponsorship of the GAIM Task Force, the IGBP Data and Information System (DIS), and the PAGES (Past Global Changes) and GCTE (Global Change and Terrestrial Ecosystems) core projects. The workshop formally initiated a world wide collaborative project to develop a global palaeovegetation data set for 6000 yr BP and the LGM. Almost all of the scientists who attended the workshop are palaeoecologists who combine active field research programmes with large-scale mapping and data analysis interests. Each continent was represented by a good cross-



18000 and 6000 yrs BP are key times in the palaeoclimate.

Development is planned of global biome data sets from pollen and plant macrofossil records for 6000 and 18000 ^{14}C-yr BP.

section of the relevant research leaders. Those present included several who are most actively involved in the collection of new data in the tropics and semi-arid regions, which are under-represented in previous data compilations. The project will give first priority to 6000 yr BP in the context of the current GAIM focus on climate vegetation interactions. However, the workshop also recognised the specific usefulness of both the 6000 yr BP and LGM efforts for other current projects such as PMIP and COHMAP, and their broader future relevance in testing earth system models. Discussions quickly established that the project can draw heavily on major data synthesis activities already under way in every continent.

A number of organisational and technical issues arose, leading to the following operational decisions:

- The project organisation will consist of a general co-ordinator (Colin Prentice, Lund Unviersity); a data co-ordinator, who will be responsible for assembling and curating the primary and derived data sets (Tom Webb, Brown University); a steering committee (including both co-ordinators and five other individuals): and eight regional working groups. The regionalization adopted reflects a combination of biogeographic boundaries and existing organisation considerations. A number of scientists not at the workshop have subsequently agreed to participate in the regional working groups, and more may join.
- Community pollen data bases will provide a key data resource wherever they exist (Europe, North America) or are nascent (South America, Southwest Pacific, China, Japan). The co-ordinators of these data bases are *de facto* participants in the project.
- The key data sources will be pollen and plant macrofossil records (potentially including fossil wood). Only data sources directly recording *plants* will be used as evidence for past vegetation. Thus, the project is complementary to other palaeomapping activities concerned with lake levels, animal distributions, soils, etc.
- Biome reconstructions will be based directly on primary data to the greatest extent possible. These data will be compiled at Brown University. Regional "contact persons" (one or more from each working group) will facilitate the compilation.
- The target dates for data extraction will be 6000 and 18000 ^{14}C-years BP. It was recognised that the most appropriate technique to identify the sample closest to each target date may vary with sedimentation conditions, and involves some investigator judgement.
- The locations of the primary data points, the reliability of dating control on every point, and the logic used to reconstruct the biome, must be transparent to users. A draft protocol for rapid documentation of sample selection procedure and dating control was drawn up and circulated afterwards.
- Biome reconstructions will be carried out using a standard methodology, either at Lund University or by other (mostly North American) groups. The regional contact persons will provide required information on plant type assignments, and feedback on initial results. Reconstructions will be made separately for each region or subdivisions thereof, then consistency checks will be carried out before the global biome data set is compiled.
- A need was identified for three regional data workshops to be held in 1995: Southeast Asia/Oceania (already planned). China, and Africa. The Africa workshop is envisaged as a potential START activity, which could involve and bring together the dispersed community of palaeoecologist working in African countries.
- The evolving products of the project will be accessible to active participants throughout the course of the project. A second project workshop would be held in 1996 to assess progress, decide policy regarding future access to and curation of the primary and derived data sets, and develop a detailed publication plan. The project's total duration is envisaged as 2-3 years, and its final products are expected to be available for comparison with global model results by early 1997.

The workshop made significant progress in assessing the current coverage of data in each region. In some tropical regions, especially, the coverage of pollen data for 6000 yr BP appears to have improved dramatically, both in terms of numbers of sites and in terms of "plugging" spatial gaps, since the last published synthesis.

Finally, each regional working group produced a list of frequently identified pollen taxa for the entire region, with provisional assignments to plant functional types. This attempt provides an important starting point for the biome reconstruction work and may lead to refinements of the global plant functional type concepts used both in this data project and in vegetation modelling.

Colin Prentice, *Univeristy of Lund, Sweden, and* **Thompson Webb III**, *Brown University, Providence, Rhode Island, USA*

Two JGOFS Positions Open

Core Project Officer
Assistant Core Project Officer

The Joint Global Ocean Flux Study, sponsored by the Scientific Committee on Oceanic Research (SCOR) is a core project of the International Geosphere-Biosphere Programme (IGBP). The operational goal of JGOFS is to improve our knowledge of the processes controlling carbon fluxes between the atmosphere, surface ocean, ocean interior and its continental changes.

Applications are invited for two positions. They are JGOFS Core Project Officer (CPO) and Assistant Core Project Officer. In both cases the successful applicants will be expected to spend half-time on JGOFS Core Project Office matters and half time on their own scientific work; preferably this should be related to JGOFS. The JGOFS Core Project Office (JGOFS Büro) is currently located at the Institut fur Meereskunde, Kiel University, in the Baltic Sea coastal city of Kiel, Germany. The JGOFS CPO is responsible for the day-today management of the programme, and for the operation of JGOFS Büro.

Acceptance of a successful application is contingent on supplying evidence of secondment or a commitment by the applicant's home institution or national funding agency to provide salary support and benefits for the core project officer. At present, a half-time salary is available courtesy of the German Government for one of the posts. Previous JGOFS core project scientists have been supported by Canada, Germany and the USA. Travel and other support funds will be provided by JGOFS. Relocation expenses will be provided

Applicants should possess a PhD degree and have research experience in a field closely related to JGOFS, and in the management of collaborative scientific projects. Previous experience with the JGOFS Programme is desirable but not a requirement. Applicants must be willing to relocate to the Project Office for a period of 2 years. The JGOFS Büro staff currently includes a half-time secretary and half-time assistant scientific officer.. Responsibilities and requirements for the CPO and Assistant CPO include:

- Provision of support to the Chair of the International JGOFS Scientific Steering Committee, other members of the SCC and Chairs of the JGOFS Scientific Task Teams and Regional Planning Groups.
- The identification, assessment, discussion and development of scientific issues as the JGOFS Programme evolves.
- Service as the primary liaison between JGOFS and the IGBP, including liaison with other IGBP Core Projects. Attend annual meetings of the IGBP and its Core Project Officers. Foster scientific collaboration with IGBP core projects as these benefit the overall goals of JGOFS and other developing scientific needs. Communicate information on the progress and planned operations of the IGBP to the CC, national JGOFS programmes, and other relevant bodies.
- Establishment and maintenance of close liaison with JGOFS National Programmes and other international oceanographic programmes such as the World Ocean Circulation Experiment, Tropical Oceans Global Atmosphere, Global Ocean Observing System, and Global Oceans Ecosystems Dynamics. Collect and assess information on their scientific and operational progress, resources, etc. in relation to the objectives and future needs of JGOFS. Present and distribute the results of these analyses as needed to the SSC, national JGOFS committees, funding agencies, etc.
- The continuous monitoring of the success of JGOFS in meeting its scientific objectives through the strategies defined in the JGOFS Implementation Plan. This involves constant assessment of resources committed to the programme and the preparation and dissemination of regular updates to the Implementation Plan.
- Prepare and distribute agendas, documentation and minutes of the JGOFS SSC meetings, and meetings of the JGOFS Executive Committee.
- Represent the SSC as needed at relevant national and international meetings.
- Work closely with the Executive Director of SCOR in the preparation of annual budgets for international JGOFS planning activities, of proposals to funding agencies for financial support, preparation, publication and distribution of JGOFS Reports, logistic arrangements for meetings of the SSC and its subsidiary bodies and in other administrative aspects of the programme.
- Management of the JGOFS distributed database inventory and promoting data exchange amongst JGOFS databases and scientists
- Assist the JGOFS Synthesis and Modelling Task Team
- Other responsibilities as assigned by the JGOFS SSC.

Skills and expertise in the following areas are needed in one or the other of the posts, or both:

- Data and information systems;
- Synthesis and modelling;
- Communication skills; with an excellent command of spoken and written English
- Office organisation;
- Ability to work independently and with others;
- Scientific skills and interest in the JGOFS area

The Assistant Core Project Officer position is equivalent to post-doctoral level, and recent graduate students or post-doctoral fellows and junior faculty are encouraged to apply. The Core Project Officer is a Senior position, for which scientific research experience beyond the post doctoral level is required. Senior personnel up to and including full professor level or senior research fellows are encouraged to apply. The Chair of the JGOFS SSC and the Executive of JGOFS will give every assistance to a strong candidate to get funding support.

Applications, stating which of the two positions is being apply for, should be received by **31 December** to the JGOFS Core Project Officer or the SCOR Executive Director, who are available for any further information you may wish.

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News from Biospheric Aspects of the Hydrological Cycle

Aggregate representations of heterogeneous land surfaces

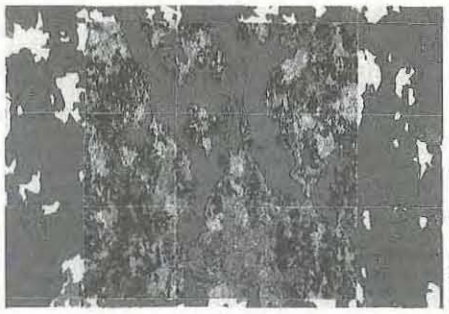
The Tucson Workshop

In the course of the last decade it has become apparent that research into the surface-atmosphere interactions of natural, heterogeneous land covers is most effectively carried out through interdisciplinary research. Recognizing this, a significant proportion of BAHC's research in this subject area has been carried out in close and effective collaboration with the World Climate Research Programme and, in particular in recent years, in collaboration with the International Satellite Land Surface Climatology Project (ISLSCP).

During such investigation, the complementary emphasis between understanding ecohydrological processes in the case of BAHC and satellite-based monitoring and modeling of land-surface interactions in the case of ISLSCP has been remarkably productive. In March 1994, BAHC and ISLSCP both accepted the University of Arizona's invitation to hold meetings of their respective Scientific Steering Committees in Tucson, Arizona. Linking these two meetings, on 23-24 March 1993, they held a jointly sponsored Workshop focused around the topic of defining progress in providing practical, aggregate representations of heterogeneous land surfaces which are suitable for application in meteorological models.

The workshop comprised five working sessions, in each case with two leading researchers invited to give complementary review talks. These provided the foundation for a subsequent, directed discussion of a related research question. The review talks and the substance of the ensuing discussion will be published in upcoming special issue of the Journal of Hydrology.

The issues addressed in the workshop and the associated invited speakers were as follows:



Swedish Space Corporation

Satellite data, Landsat TM. 5 km squares of southern Sweden.

1. Aggregate Representation of Soil-Vegetation-Atmosphere Interactions for Land-surfaces with Limited Topography and Mesoscale Heterogeneity: Speakers - Noilhon (CNRM), Pielke (Colorado)
2. Aggregate Representation of Soil-Vegetation-Atmosphere Interactions for Land-surfaces with Limited Topography and Patch-scale Heterogeneity: Speakers - Dolman (Wageningen), Sellers (NASA)
3. Aggregate Interaction of Surface Features in Areas with Significant Topography: Speakers - Raupach (CSIRO), Running (Montana)
4. Progress in Defining Practical Aggregate Rules for Remotely Sensed Variables: Speakers - Hall (NASA), Moran and Hulme (USDA)
5. Progress in Defining Practical Aggregation Rules for Sub-surface Variables: Speakers - Kabat (Wageningen), Wood (Princeton)

The Workshop determined that there had been very substantial progress in some of the above subject areas, but worthwhile although still insufficient progress in others. Some of the primary conclusions were as follows:

- Simple "aggregation" rules for defining effective values for the parameters in land surface schemes seem adequate to an accuracy of 10% in most situations in the case of both patch-scale and mesoscale surface heterogeneity, and these should be applied pending refined understanding. However, there is need for greater research emphasis on understanding
  (i) how to define aggregate soil properties, and
  (ii) the effect of distinct changes in the effective sink height of atmospheric fluxes in the canopy between patches of vegetation.
- Mesoscale heterogeneity is now known to be capable of generating mesoscale circulations which can significantly enhance vertical transfer in the atmosphere. Parameterization of this phenomenon may be possible, and should be investigated.
- Remotely sensed vegetation indices contain useful information on the bulk stomatal resistance and photosynthetic uptake of vegetation cover, but the parameters involved in this need to be determined for a much broader range of space-distinguishable land cover classes, and the role of nutrients requires investigation.
- The basic modeling tools for investigating the effect of topography on ecohydrologic interactions have been developed, and preliminary model studies suggest that the influence of ensuing changes in near-surface meteorological variables is limited, but there is a substantial need for
  (i) additional ecohydrological modeling with field verification, and
  (ii) greater emphasis on research which facilitates the spatial re-distribution of model calculated, area-average values of near-surface meteorological variables especially precipitation - in mountainous regions.
- There has been substantial progress by careful analysis of plot-scale field surveys in understanding the small-scale "scaling" of ecohydrologically-relevant soil parameters, but this progress little recognized by the global science community, and the applicability of these scaling procedures at regional scale is unexplored.
- Evidence suggests that the area-average value of remote sensed variables is a reasonable estimate of the linear average value for component covers for both dense and sparse vegetation. Their application should therefore proceed, but there is considerable need for basic research to understand the meaning and relevance of these variables, particularly for sparse canopies and in relation to soil processes.

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Multiscale Nested Drainage Basin Approach (HYNEST) for Hydrological Modelling

in the framework of the Biosphere-Atmosphere Field Experiment in Amazonia (LBA)

A brief description was given about the Biosphere-Atmosphere Field Experiment in Amazonia (LBA) in the last issue of the *Global Change Newsletter* (No.18, 1994) by Carlos Nobre, the chief coordinator of the experiment in Brazil. He presented the three major components of LBA:

- LAMBADA: Large-scale Atmospheric Moisture Balance of Amazonia using Data Assimilation
- BATERISTA: Biosphere-Atmosphere Transfers and Ecological Research In situ Studies
- AMBIACE: Amazon Ecology and Atmospheric Chemistry Experiment.

Hydrological processes play an important role in all three components; and even more they form a link between them, in particular between LAMBADA and BATERISTA. Considering this, multiscale nested river drainage basin related hydrological modelling (HYNEST) is planned in the framework of LBA to bridge the gap between the large scale investigations and modelling for the entire Amazon basin (LAMBADA) on one hand, and the smaller scale investigations and modelling for BATERISTA sites on the other. To achieve the bridging, special research and modelling activities are additionally needed at an intermediate spatial scale (regional or mesoscale), i.e. for larger tributaries of the Amazon.

The first ideas on HYNEST were presented and discussed during the first planning meetings for LBA, in Greenbelt, Maryland, June 1992. Starting from these discussions and from a proposal developed in the framework of humid tropics research within the International Hydrological Programme (IHP) of UNESCO, a group of experts from IGBP-BAHC and IHP prepared a proposal on "Hydrological Investigations in the Framework of a Large-Scale Biosphere-Atmosphere Field Experiment in the Amazon Basin" for the second LBA planning meeting held in São José dos Campos, Brazil, September 1993. The meeting welcomed this proposal and recommended its further development with taking into account the planned nesting of mesoscale atmospheric models, in particular a mesoscale 4-Dimensional Data Assimilation Scheme (4DDA) into Global Circulation Models (GCM). Advances in this development are briefly reported in the following.

Modelling of land-surface processes, including hydrological modelling, takes place at all relevant spatial scales: micro, meso, and macro. This is also the case in the Amazon experiment, as is illustrated in Table 1. This table provides some specific information about typical spatial domains to be considered in modelling across various spatial scales (column 2), and the corresponding spatial resolutions to be applied (col. 5). Reference is made to the above mentioned scale ranges (col. 1), and also to LAMBADA and BATERISTA (col. 3). Additionally a so-called "model validation potential" is specified (col. 6), which should characterise in a general form the degree of process understanding, knowledge about the structure and behaving of the natural systems to be modelled, and the availability of measuring and observation data for model validation purposes.

The principle approach of HYNEST is to use in a "nested", well coordinated manner atmospheric and distributed land-surface hydrological models with different spatial resolution at different spatial domains. In the Amazon basin all types of areas listed in Table 1 must be considered, and also the availability of data from existing networks and from field studies (ground measurements, remote sensing, etc.), as well as from measurement campaigns during the forthcoming experiment. Three levels, and accordingly scales, have been identified as being of special interest (see Table 1 and Figure 1):

A The entire Amazon basin (LAMBADA-domain) for which mesoscale atmospheric models with a resolution of 35 to 50 km are under development. These models will be nested into global circulation models (GCM's).

B A few (at least two) well selected large tributary river basins within the Amazon basin, with drainage basin areas between several hundred and about 10^4 km2, where advanced land surface descriptions are available, and BATERISTA research areas, as mentioned in Table 1, are included. A meso-beta-scale atmospheric model (hydrostatic) will be applied for these areas in a smaller scale mode than mentioned under A, for instance with a space resolution of 10 km.

C BATERISTA research areas, sites and

Scales, Spatial Domains and Resolutions in Multiscale Modelling

Scale	Typical Spatial Domains in Modelling			Modeling Level	Spatial Resolution in Modelling (km)	Potential for Model Validation
	in General	in the Amazon Experiment	Approximate size (km)			
Macro scale	• Continents, regions, state territories, GCM grid units	• Entire Amazon Basin = LAMBADA reference area	~3000	A	≥ 50 (often ≥ 100, min.~ 35)	small
Meso scale	Heterogeneous landscapes: • large study areas, • river basins, • administrative units etc.	• Amazon tributary river basins • BATERISTA sites, supersites, research areas and catchments	~25 - 100 ~10 - 25	B C	5 - 20 1 - 5	medium
Micro scale	Small, more or less homogeneous elementary unit areas: • hydrotopes • patches • research plots	• Small hydrological research catchments • Field plots with special measurements (patches) • Point measuring stations, tower sites, lysimeters... (within BATERISTA sites, research areas...)	~1 - 5 < ~ 0,5		0,02 - 0,1 ≤ 0,01	great

International Tropospheric Ozone Years (ITOY)

Update on Planning

At the first meeting of the *ad hoc* Steering Committee of ITOY with a small group of interested scientists in Geneva, Switzerland, on 23 and 24 July, 1994, chaired by Drs. P. Crutzen and H. Rodhe, it was decided that, as a next step, this circular letter would be distributed to the scientific community to inform and to seek advice, especially regarding the siting of the measurement stations.

Science Aims of ITOY

Ozone (O_3) is one of the most important trace gases not only in the stratosphere, but also in the troposphere. It is an important greenhouse gas in both atmospheric regions and its distribution is affected by a variety of human activities. It is also the precursor of the hydroxyl radical, the major cleansing agent in the troposphere. Thus, O_3 impacts on the lifetimes and, consequently, on the tropospheric concentrations of most atmospheric trace gases, including CH_4 and the hydrogen containing replacements of the CFCs (HCFCs, HFCs) which are themselves greenhouse gases. Finally, O_3 is a toxic gas, and in many heavily populated regions of the globe it has reached concentrations which are harmful to man, crops, and the biosphere in general. This is not only the case in the developed world, but also in the developing world due to emissions of CO, hydrocarbons, and NO_x, that result from extensive biomass burning that takes place in the tropics and subtropics during the dry season, as well as from growing industrial development.

Given its great importance for climate and air quality, as well as for atmospheric chemistry, the global distribution of O_3 in the troposphere is surprisingly poorly known. Outside the major population centers of the developed world there exist only a few stations from which (mostly episodic) measurements of the vertical distribution of tropospheric O_3 are being made. These measurements are far too few to characterize the present spatial and temporal distribution of O_3 variations on a global scale. The ITOY effort is proposed to be conducted over a 2 year period, most likely during 1998 and 1999. In addition to upgrading and intensifying programs at existing stations, ITOY proposes to establish about 50 additional sites from which balloon-borne ozonesondes will be launched at a rate of one to three soundings per week depending upon the location of the station and season of the year. The ozonesondes will be augmented by tropospheric O_3 lidars where available. Most of the new sites would be located in the tropics and subtropics, i.e., between approximately 30°N and 30°S latitude, some in the mid latitudes of the Southern Hemisphere and some over the territory of the former Soviet Union.

There are several important reasons for the emphasis on the tropics and subtropics, apart from the fact that the data coverage in that region is particularly sparse:

1. Industrial and agricultural growth will be very large in this part of the world and with it there will be strong increases in the emissions of industrial and agricultural atmospheric pollutants including the chemical precursors of O_3: carbon monoxide, hydrocarbons and NO_x.

2. Because of the large fluxes of solar UV and the higher temperatures and water vapor content, atmospheric photochemistry and the self-cleansing processes are by far the most intense in the tropical troposphere. Anthropogenic perturbations of that system could affect the atmospheric levels of several important greenhouse gases (e.g. CH_4, HCFCs, HFCs) with potential global consequences for climate.

3. Because of the high input of solar radiation at the Earth's surface, convection processes maximize in the tropics resulting in fast and efficient vertical transport of pollutants from the surface to high altitudes, thus affecting the chemistry of the upper troposphere. Because the atmospheric lifetime of NO_x increases strongly with altitude, the O_3 production efficiency does as well, implying a possibility for a substantial increase in upper tropospheric O_3 concentrations. It is also in these altitude regions that O_3 is most effective as a greenhouse gas, especially in the tropics.

Connected with the vertical O_3 sounding program of ITOY, special measurement campaigns and modeling efforts will be conducted, within the IGAC/IGBP scientific program to be funded by other sources. Such campaigns would involve determinations of the atmospheric concentrations of compounds that are most critical for constraining the O_3 budget and are aimed at quantifying, for instance, the rate of fast vertical transport, tropospheric-stratospheric exchange of O_3, and the quantities of NO_x that are produced by lightning. This information will be used to improve the quality of models, so that they can be used for predictions and policy advice.

In summary, ITOY is an indispensable program which is critically needed to assess the present and future, direct and indirect importance of O_3 as a greenhouse gas, especially in the tropics. It strongly complements the efforts taking place within the World Meteorological Organization's Global Atmospheric Watch (WMO/GAW) which is aimed at the reliable detection of long-term trends in the global O_3 distribution. The program will also play an important role in capacity building in the developing world.

Quality Assurance Requirements

A quality assurance plan will be developed and implemented in ITOY in order to achieve the necessary quality of the data. The plan, comprising a comprehensive set of QA procedures, will ensure that ITOY participants are performing according to uniform protocols with accepted standards.

Quality assurance procedures for O_3 measurements are already being developed in WMO/GAW and in IGAC's Global Tropospheric Ozone Network (GLONET) Activity. ITOY will adopt these procedures to the greatest possible extent.

Quality assurance-related tasks include the following:

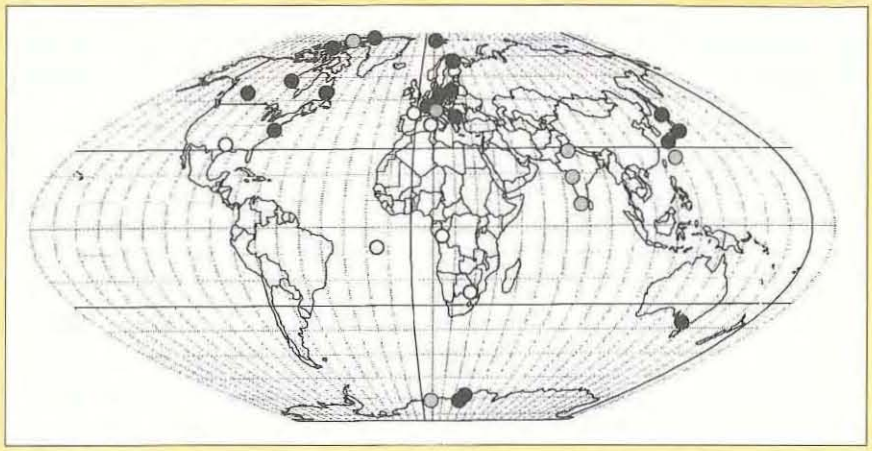


Figure 1: McBryde-Thomas equal-area projection map showing locations of ozonesonde stations that are reporting or have reported data to the World Ozone Data Center. Solid circles mark active stations for which >150 soundings have been reported. Shaded circles mark active stations for which <150 soundings have been reported or for which the number of observations was not available. Open circles mark stations that are known to have discontinued observations. Data from Table 1.

Table 1. Ozonesonde Stations: Data Available at WODC

Station record[1]	Lat	Lon	Alt (m)	Type record[1]	No.	Data
Alert	82°N	62°W	62	ECC	342	1/88-8/93
Eureka	80°N	85°W			54	11/92-8/93
Ny-Ålesund	79°N	12°E	0	ECC	211	10/90-9/93
Resolute	75°N	95°W	64	BM/ECC	1182	1/66-12/93
Sodankylä	67°N	27°E	179	ECC	254	1/89-12/92
Churchill	59°N	94°W	35	BM/ECC	834	10/73-10/93
Edmonton	53°N	114°W	668	BM/ECC	903	10/72-12/93
Goose Bay	53°N	60°W	44	BM/ECC	1163	6/69-12/93
Legionowo	53°N	21°E	96	OSE/ECC	551	1/79-4/94
Lindenberg	52°N	14°E	98	OSE/ECC	1075	1/75-4/94
Prague	50°N	14°E	305	OSE/ECC	546	1/79-4/93
Hohenpeissenberg	48°N	11°E	975	BM	2682	3/65-12/93
Garmisch-P'kirchen	48°N	11°E	800	ECC	456	1/78-7/85
Payérne	47°N	7°E	491	BM	note 2	note 2
San Pietro Capofiume	45°N	12°E	11	ECC	30	3/91-12/91
Biscarosse*	44°N	1°W	18	BM	361	3/76-1/83
Sofia	43°N	23°E	588	OSE	239	2/82-12/91
Sapporo	43°N	141°E	19	KC	391	12/68-12/93
Cagliari*	39°N	9°E	4	BM	419	7/68-7/80
Wallops Island	38°N	76°W	4	ECC	749	5/70-4/93
Tateno	36°N	140°E	31	KC	523	11/68-12/93
Kagoshima	32°N	131°E	283	KC	356	12/68-12/93
Palestine*	32°N	96°W	121	ECC	212	2/75-6/85
New Delhi	29°N	77°E	220	Ind	113	1/69-12/86
Naha	26°N	128°E	27	KC	135	9/89-12/93
Poona	19°N	74°E	559	Ind	185	2/66-11/86
Trivandrum	8°N	77°E	60	Ind	68	7/69-10/86
Brazzaville*	4°S	14°E		ECC	69	4/90-8/92
Ascension Island*	8°S	15°W		ECC	47	7/90-8/92
Pretoria/Irene*	26°S	28°E	1369	ECC	147	7/90-10/93
Aspendale/Laverton	38°S	145°E	0	BM	907	6/65-12/90
Marambio	64°S	57°W	198	ECC	131	11/88-12/93
Syowa	69°S	39°E	21	KC	455	3/66-12/93
Forster	71°S	39°E	110	OSE	401	5/85-2/91
Neumayer	71°S	8°E	5		59	3/92-2/93

1. This table is based on data available from WODC in August, 1994. Preliminary data are available for many stations for early 1994. Those stations marked with an asterisk (*) are known to have discontinued observations.
2. Data for 1969-1985 and 1992-93 are at WODC. There is a continuous record of data since 1969, with >3500 observations.

1. Detailed characterization and intercomparison of all existing ozonesonde types. ITOY will make extensive use of the World Calibration and Instrument Intercomparison Facility which is now being established at the KFA in Julich, Germany. In-flight comparisons will also be performed.
2. Securing agreement on measurement frequency and timing, measurements of related variables (e.g., humidity) and procedures for data processing.
3. Development of standard operating procedures for ozonesonde and surface O_3 measurements. WMO/GAW is now implementing such procedures.
4. Development of education and training programs and expert visits in cooperation with the Atmospheric Chemistry Education in Global Change (ACE) Activity of IGAC and with similar START and COSPAR initiatives.
5. Assimilation of network data from different instrument platforms: Ozonesondes and surface O_3 stations, aircraft (e.g. Measurement of Ozone on Airbus In-Service Aircraft MOZAIC Program), satellites (e.g., Global Ozone Monitoring Experiment, Scanning Imaging Absorption Spectrometer for Atmospheric Chartography/Chemistry, the Japanese ADEOS satellite), and ground-based remote sensing (e.g., O_3 lidar).
6. Development of data management procedures: Accessibility, archival, distribution (AES Canada, World Ozone Data Center).

ITOY, through cooperation with GAW and GLONET, will complete its Quality Assurance Plan, addressing these tasks and others, prior to and during the measurement phase. ITOY is complementary to and will be carried out in close cooperation with GAW and GLONET.

Optimum Distribution of Observing Stations

It was agreed that the principal technique will involve balloon borne ozonesondes. These measurements will be supported by surface O_3 and total O_3 measurements, as well as by special ground based systems (e.g., lidar). Observations from satellites will also be available. Although these other techniques can only give limited information on the vertical tropospheric O_3 distribution, they will be useful in filling the spatial and temporal gaps in the ozonesonde program. ITOY will also provide an extensive assessment of the accuracy of the satellite observations.

A preliminary summary of the distribution of ozonesonde stations (based main-

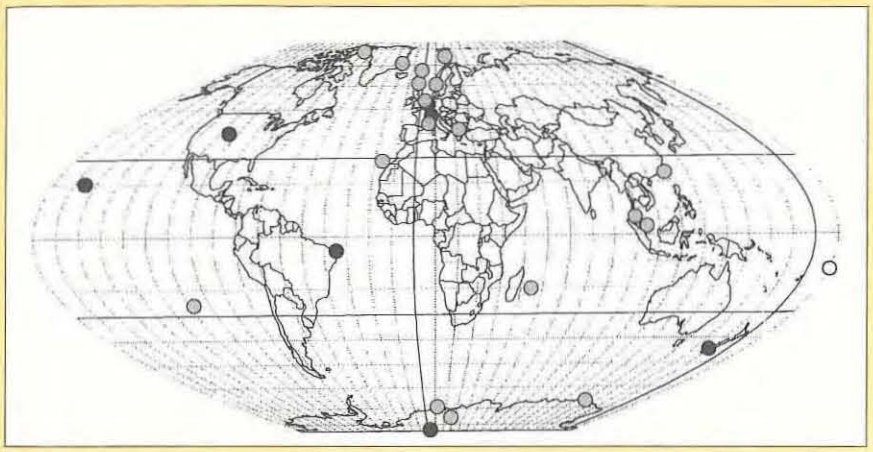


Figure 2. McBryde-Thomas equal-area projection map showing locations of ozonesonde stations that are not reporting or have not reported data to the World Ozone Data Center. Solid circles mark active stations for which >150 soundings have been taken. Shaded circles mark active stations for which <150 soundings have been taken or for which the number of observations was not available. The open circle marks the one station which is known to have discontinued observations. Data from Table 2

Table 2. Ozonesonde Stations: Data Not Available at WODC

Station	Lat	Lon	Alt (m)	Type	No.	Data record[1]
Thule Air Base	77°N	68°W				
Bear Island	74°N	19°E				
Scoresbysund	70°N	22°W				
Weathership (Norway)	66°N					
Gardermoen	60°N	11°E				
Lerwick	60°N	1°W				
de Bilt	52°N	5°E				
Uccle	51°N	7°E	100	BM	>2800	1/69-present
Payérne	47°N	7°E	491	BM	>3500	1/69-present
Haute Provence[2]	44°N	6°E	700	BM	140	10/84-12/90
Thessaloniki	41°N	23°E				
Boulder[3]	40°N	105°W	1743	ECC	360	12/84-12/93
Tenerife	28°N	16°W	~25	ECC	~50	11/92-
present						
Pa-Chao Tao	23°N	119°E				
Hilo[3]	20°N	155°W	11	ECC	400	12/84-12/93
Penang	6°N	100°E		ECC		94-present
Kuala Lumpur	3°N	104°E		ECC		93-present
Natal[4]	6°S	35°W	32	ECC	282	11/78-10/92
Samoa*[3]	14°S	170°W	5	ECC	115	4/86-1/90
Ile de la Reunion	21°S	55°E				
Easter Island	27°S	109°W				
Lauder[5]	45°S	170°E	370	ECC	>310	8/86-present
Dumont d'Urville	67°S	140°E				
Dakshin Gangotri	70°S	12°E		Ind		86-89
Maitri	71°S	12°E		Ind		90-present
Halley Bay	76°S	27°E				
Amundsen-Scott[3]	90°S	25°W	2810	ECC	480	86-12/93

1.Those stations marked with an asterisk (*) are known to have discontinued observations.
2.M. Beekman *et al.* (1994) *J. Geophys. Res.*, **99(D6)**, 12,841-12,853.
3.Data available from S. Oltmans, NOAA/CMDL, USA.
4.Data available from V. Kirchhoff, INPE, Brazil.
5.Data available from W.A. Matthews, NIWA, New Zealand.

ly on availability of data in the World Ozone Data Center in Canada, and on Appendix D of Report No. 32 of the WMO Global Ozone Research and Monitoring Project) has been prepared by A. Pszenny and J. Logan in consultation with V. Mohnen and S. Oltmans (see attached tables and maps). It is clear from the station distribution maps that the geographical coverage is inadequate, especially in the tropical countries and in the Southern Hemisphere. As a first approximation it was agreed that an optimum set up will involve some 50 additional stations distributed according to scientific/logistical criteria which still must be worked out in detail. Advice on this is requested from global atmospheric chemistry modeling groups and other interested scientists through the questionnaire attached.

Financial Support for ITOY

A proposal for financial support for the initial phase of ITOY (establishment and implementation of quality criteria, training) is being prepared by Pak Sum Low of UNEP for submission to GEF, probably in the December, 1994, to January, 1995 time frame. This will be done in close collaboration with the scientists involved in ITOY/IGAC and others.

Reference: *Report of the Second Meeting of the Ozone Research Managers of the Parties to the Vienna Convention for the Protection of the Ozone Layer*, Geneva, 10-12 March 1993, WMO Global Ozone Research and Monitoring Project, Report No. 32, available from the Environment Division/AREP, World Meteorological Organization, 41 Avenue Giuseppe Motta, C.P. 2300, CH-1211 Geneva 2, Switzerland, Fax: (+41-22) 740 09 84.

ITOY Questionnaire

Please answer as many of the following questions as possible:

1. Do you agree with the "science aims" of ITOY as defined here? Would you recommend any additional aim(s)?
2. The lists here of ozonesonde, lidar, and high-altitude surface monitoring stations are based on incomplete information. Can you update/verify the tabulated details for all stations in your country or operated by your organization?
3. Are there plans or willingness to increase the frequency of soundings at the ozonesonde stations in your country or operated by your organization?
4. For operating stations not currently doing so, are there plans or willingness to submit data to the World Ozone Data Center? When do you expect submission to begin?
5. What additional supporting measurements are available with the ozonesonde or lidar observations?
6. What is your opinion of the "critical number" of additional ozonesonde or lidar stations needed? Are 50 stations enough, too few, or too many? Where should the additional stations be located and what should be the scientific criteria for the selection of such stations?
7. Are there plans within your country or organization to establish any additional ozonesonde or lidar stations? If so, where and with what types of instruments?
8. Do you agree in general with the quality assurance requirements specified in the circular letter, and are you willing to adhere to them?
9. What are your relevant funding mechanisms and future plans? Would you be able to ensure continuity of soundings operations through 1998 and 1999 as well as adhere to the quality assurance procedures?
10. What are your present involvements in the Global Atmosphere Watch and Global Tropospheric Ozone Network programs?

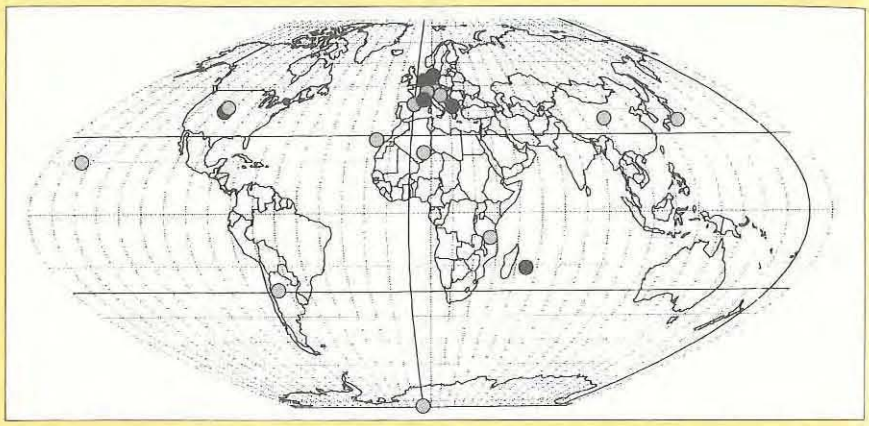


Figure 3. McBryde-Thomas equal-area projection map showing locations of present and planned tropospheric ozone lidar stations (solid circles) and high-altitude surface ozone monitoring sites which may, at times, sample free tropospheric air (shaded circles). Data from Tables 3 and 4

Table 3. High-altitude Surface Ozone Monitoring Stations*

Station	Lat	Lon	Alt (m)	Data record[1]
Zugspitze	48°N	11°E	2900	since 1972
Sonnblick	47°N	13°E	3000	since 1990
Jungfraujoch	47°N	8°E	3000	intermittent
Whiteface Mountain	44°N	74°W	1500	since 1974
Pic du Midi	43°N	0°	2700	1980-82; 1991-present
Niwot Ridge	40°N	105°W	2900	since 7/90
Mount Waliguan	36°N	102°E	3000	starting 1994
Mount Fuji	35°N	139°E	3776	since 8/92
Tenerife	28°N	17°W	2630	since 1986
Assekrem	22°N	6°E	2728	starting 1995
Mauna Loa	20°N	155°W	3380	csince 9/73
Mount Kenya	10°S	37°E	3600	starting 1995
Telaritos	29°S	66°W	~350	
South Pole	90°S		2840	since 1/75

*Stations from which free tropospheric air can be sampled at times. All (will) use continuous UV absorption techniques to determine O_3 mixing ratios.

Table 4. Ozone Lidar Stations

Station	Lat	Lon	Alt (m)	Institution	Data record
Hamburg	54°N	10°E		MPIM[1]	
Bilthoven	52°N	5°E		RIVM[2]	
Haute Provence	44°N	6°E	700	SA/CNRS[3]	
Thessaloniki	41°N	23°E			
Fritz Peak	40°N	105°W	2800	NOAA/AL[4]	5/93-present
Ile de la Reunion*	21°S	55°E		SA/CNRS[3]	

1. Max-Planck-Institut für Meteorologie (J. Bösenberg, V. Matthias, Th. Schaberl)
2. Rijksinstitut voor Volksgesondheit en Milieuhygiene (E.P. Visser, A. Apitauley, D.P.J. Swart)
3. Service d'Aeronomie du CNRS (G. Ancellet, M. Beekman, G. Mégie)
4. NOAA Aeronomy Laboratory (A. Langford)

*Instrument now at Haute Provence to be moved here.

Kindly send your replies as soon as possible to: Dr. **Alex Pszenny**, IGAC Core Project Office, Building 24-409, Massachusetts Institute of Technology, Cambridge, MA, 02139-4307, USA, Fax: (+1-617) 253-9886; E-mail: pszenny@mit.edu or

Dr. **John M. Miller**, Environment Division/AREP, World Meteorological Organization, 41 Avenue Giuseppe Motta, C.P. 2300, CH-1211 Geneva 2, Switzerland, Fax: (+41-22) 740 09 84; E-mail: j.miller.arl@omnet.com

river catchments where the possibility for model validation is very high according to the availability of measuring data and knowledge of land surface conditions and characteristics. In the modelling at this scale an even finer resolution is required (1 km or less). Therefore, non-hydrostatic atmospheric models are planned to be applied here, in addition to the meso-beta-scale mode as mentioned in B.

At all three levels (A, B, C) it is intended to define gauged river basins and, wherever possible, internal gauged headwater subbasins, for which

(i) hydrological and other required measurement data sufficient for scale-adequate modelling of key hydrological processes (water quantity and quality) are available,

(ii) area-distributed models for simulating hydrological processes and the connected biogeochemistry can be developed.

These models should use the same area discretisation scheme (grid) as the corresponding atmospheric model. These models are planned to be coupled with the corresponding atmospheric model so that the fluxes at the land surface-atmosphere interface are identical in both model components. The models should also be applicable in a decoupled form. Fluxes computed with both models may then be compared for validation purposes, namely for elementary grid units, or for the gauged river basins used in modelling, or for any other subareas of interest, e.g. forest sites, deforested sites, etc.

It is necessary to apply the hydrological models to all river-basin studies on a continuous basis for longer periods, at least one or two years, preferably several in order to identify time periods for which the initial and final amounts of total river basin water storages S (surface, soil, and ground water) are equal ($S_t = S_0$). Only for those periods can the water budget equation for the river basin area ($\Delta S / \Delta t = P - ET - R$) be simplified with $\Delta S \approx S_t - S_0 = 0$, and the time and area integrated total river basin evapotranspiration ET can be calculated simply as the difference between time and area integrated precipitation P, and time integrated total river basin discharge R ($ET = P - R$). This simplification is the key argument for calculating land-surface water budgets for the area of a gauged river basin, i.e., for the application of the drainage basin approach.

Whereas time integration of basin discharge and precipitation generally does not cause a problem, space integration of precipitation requires some efforts. Ground measurements with precipitation gauges, corrected for the generally occurring measurement errors, and combined with satellite and radar data for area inter- and extrapolation, need to be used to derive realistic estimates of P for the study river basins. Any error in precipitation directly propagates into the evapotranspiration estimates, and thus limits their usability for a rigorous testing and validating of evapotranspiration models.

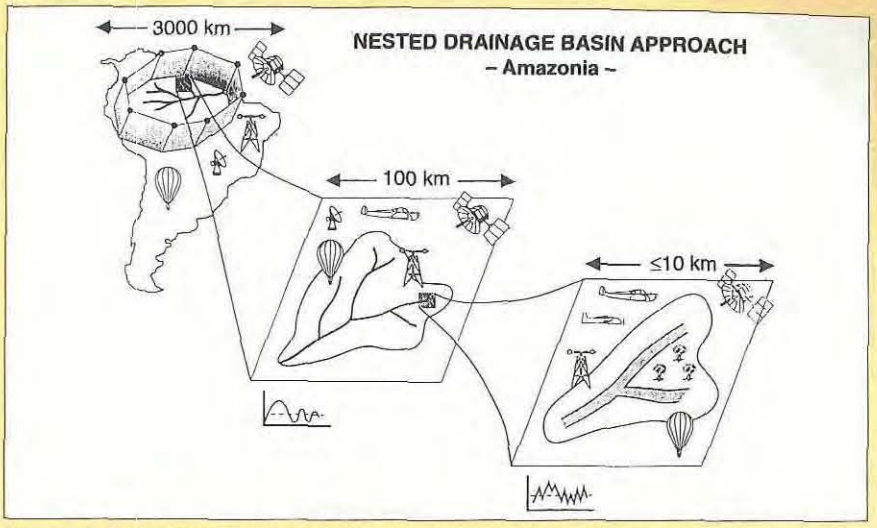


Figure 1: Schematic representation of the application of the nested drainage basin approach in Amazonia (after Vorosmarty, Becker and Bonnell, 1994)

It would be desirable to apply the atmospheric mesoscale models mentioned under A, B, C, for the same periods as the hydrological river basin models, so that atmospheric water budgets can be compared over the full time domain with those derived from the land surface water budgeting. However, due to several reasons, atmospheric models are often applied only in an episodic mode, i.e. over shorter periods. Therefore, land surface hydrological models must be run separately throughout the intermediate periods in a decoupled way since otherwise the longer-term depletion and refilling of water storages within the river basin cannot be simulated realistically. The large storage capacities of land-surface hydrological systems for surface, soil and groundwater, and the much longer residence times, compared to the atmosphere, are the main reason for this requirement.

It should be emphasised that the drainage basin approach as explained above can be applied to any gauged river basin of any size. Therefore it can be applied in a nested manner as so-called multiscale "nested drainage basin approach". The three levels introduced in Table 1 (A, B, C) are an excellent case for a pilot application of HYNEST, with cross applications, intercomparisons, validations and evaluations of different scale related land surface models, including Soil-Vegetation-Atmosphere-Transfer models (SVATs), at adjacent scales (micro and mesoscale on one hand, and meso and macro scale on the other). The models may differ in their physical foundation, complexity, degree of simplification, spatial discretisation or otherwise. The application of HYNEST will provide required information on the performance capabilities of the different models at the considered scales, i.e. on given limits in their usability and efficiency. This includes the testing of any applied simplifications, upscaling and downscaling techniques (aggregation and disaggregation schemes) etc. HYNEST will also help to ensure a maximum possible use of data and information gathered in research areas, sites and river catchments (BATERISTA-type), in particular during the intensive measurement campaigns (HAPEX and FIFE type).

In summary, it should be said that the nested drainage basin approach (HYNEST) is conceived as a tool for testing and validating meso- and macroscale hydrological models, as well as the applied aggregation, upscaling and regionalisation techniques, and to derive conclusions on required improvements to overcome observed weaknesses of the applied models and approaches.

It needs some effort and intensive coordination of activities to ensure an appropriate application of HYNEST in the Amazon experiment. Therefore, a special planning meeting is prepared to be held from 30 November to 3 December 1994 in Piracicaba, Brazil. It will be co-sponsored by IGBP/BAHC and UNESCO/IHP, which together with WCRP/GEWEX/ ISLSCP, also sponsored the two earlier planning meetings.

Alfred Becker, *Potsdam-Institute for Climate Impact Research, Telegrafenberg, P.O. Box 601203, D-14412 Potsdam, Germany. Tel: (+49-331) 288 2541, Fax: (+49-331) 288 2600, E-mail: becker@pik-potsdam.de*

National News

Data Bases for Ongoing Global Change Research Projects

Scientific bodies, as well as national and international funding agencies, need – and have been requesting – information about ongoing global change research projects.

Over the past years requests for funding require an easily accessible and permanently updated database. These data are needed too for information, evaluation and improved coordination purposes on a national level. Such data bases would be of tremendous value for the upcoming Resource Assessment of the International Group of Funding Agencies (IGFA). The IGFA assessment (see *Global Change Newsletter* No. 17, March 1994) addresses the issue of the level of funding required to achieve the objectives of the IGBP Core Projects and Framework Activities. Defining a three-tier structure of core, regional and relevant research for each Core Project, was necessary before an estimation of research funding relevant to IGBP could be made.

National Projects for Core IGBP Research

A major conclusion of the first IGFA resource assessment was that although total amounts of funding available for biogeochemcial global change research may be approximately equivalent to IGBP needs, the amounts allocated to core research, as opposed to global change research in general, are in most instances totally insufficient. IGBP and IGFA agreed that this assessment is to be repeated in 1994. As a result, IGBP National Committees will compile a list of national projects in the first two categories (core research and regional research) of the IGBP three-tier structure of global change research. Several activities to meet this demand have been initiated since early 1994.

Multi-National Global Change Research Project Data Bank

At the 4th Meeting of National IGBP Committees in Bonn, March 13-16, 1994, it was agreed to set up a pilot project for listing national research projects. At the meeting Ichtiaque Rasool of IGBP-Data and Information System, Brian Walker and Will Steffen of Global Change and Terrestrial Ecosystems, Helmut Kühr, who is working on the next IGFA resource assessment on behalf of the German Federal Ministry for Research and Technology (BMFT), and Sabine Lütkemeier of the German IGBP Secretariat, discussed a coordinated strategy. They agreed on the implementation of a multi-national Global Change Research Project Data Bank which will be tested within a pilot study.

Over the past year Christoph Ritz from PROCLIM, an agency which represents IGBP, WCRP and HDP research in Switzerland, has developed a data bank for ongoing global change research in his country using commercial programmable data bank software for Apple computers. Dr. Ritz gave a demonstration of his programme at the Bonn meeting. Important features of a multi-national data bank have already been worked into his system and that it could serve as a starting point. Only moderate modifications to meet specific national or thematic needs will need to be implemented. Christoph Ritz presents a description of his data bank system in the following article.

At a second meeting held at the Potsdam Institute for Climate Impact Research (PIK) on July 6, 1994, Ichtiaque Rasool, Helmut Kühr, Christoph Ritz and Arne Spekat (German IGBP Secretariat, Berlin) worked on further steps towards the realisation of the pilot study for the German IGBP related research topics. Christoph Ritz presented an updated version of his programme, and the participants discussed necessary changes. Ichtiaque Rasool agreed that in accordance with the IGBP Global Modelling and Data Activities Strategy and Implementation Plan for 1994-1998 (*IGBP Global Change Report* No. 30, 1994) complementary and consistent IGBP-wide data about ongoing research are needed and that the implementation phase of the global data bank will be supported by IGBP-DIS.

Further steps of the pilot study are being planned with Will Steffen who is in Potsdam in September 1994 where this project is based. Status reports on both activities will be given by Helmut Kühr to IGFA at its next meeting in Vancouver at the end of September.

Arne Spekat *IGBP Sekretariat, Institut für Meteorologie, Carl-Heinrich-Bercker Weg 6-10, D-12165 Berlin, Germany. E-mail: as@edat.fu-berlin, or igbp@zedat.fu-berlin.de*

Swiss Pilot Project

PROCLIM Information System on Climate and Global Change

The Climate and Global change Information System is a central tool for PROCLIM (the Forum for Climate and Global Change of the Swiss Academy of Sciences). The information system was designed to provide rapid answers to a wide range of queries. Thus a relational database permitting a dynamic link between its elements was selected (Figure 1). The main information modules are:

- *Projects*, which contains for each project an abstract, leading questions, key words and a list of publications
- *Addresses*
- *Programmes/commissions/committees*, which includes a short description of the objectives and hierarchical dependencies to parent organisations.
- *Research areas*. Each project is identified with one or more of the following fields of research, as appropriate: Earth System, Human Dimension, Impact of Global Change, Response Strategies, Methods. These major fields are subdivided into narrower categories, which enables searches to answer specific queries.

Links between modules

The connection between the information modules described above is made through

programmes links such as the *ProjectPersonLink* (Figure 1). The *ProjectPersonLink* provides rapid access to information on scientists involved with a given project, for example, on principal investigators (PI), other research staff employed under a given grant, and external collaborators not directly involved with the project, but with whom the PI collaborates within the framework of the project. The *ProgramPersonLink* provides ready information on the membership of diverse institutions, such as the members of the Swiss National IGBP Committee or a scientific commission, as well as on the offices which a given researcher fulfils and the programmes with which he or she is associated.

The *ProjectProgramLink* contains project links to governmental and non-governmental programmes (such as the IGBP, the WCRP and the HDP). With regard to the IGBP, for example, it is possible to search for those projects that make a direct contribution to research programmes established by IGBP Core Projects.

Finally, quick access to projects in a given research field is provided by the *ProjectResearch AreaLink*.

The graphical user interface (Figure 2) facilitates data entry, browsing the various information modules and links and searches to provide outputs needed to answer specific queries. Both pre- and user-defined listings can be either printed within the database or exported to a mail merge document for use in a word processing environment. Thus form letters and complex reports can be generated in only a few steps.

The engine of the information system is the client-server software 4th Dimension, which currently runs within the Macintosh environment. The company plans to expand to the platforms DOS Windows, UNIX, and Sun by the end of 1994. It will then be possible to use the same database in a mixed environment.

The PROCLIM Information System currently contains more than 400 Swiss projects on climate and global change research, more than 100 mostly international programmes/commissions, and addresses of about 800 persons with key functions in programmes or projects. The information system has proven to be instrumental for PROCLIM to facilitate both integrated research activities and the necessary linkages among scientists, policy makers and the public at home and abroad.

Christoph Ritz *PROCLIM–Forum for Climate and Global Change, Bärenplatz 2, 3011 Bern, Switzerland. Fax. (+41-31) 312 55 37, E-mail: ProClim@ubeclu.unibe.ch*

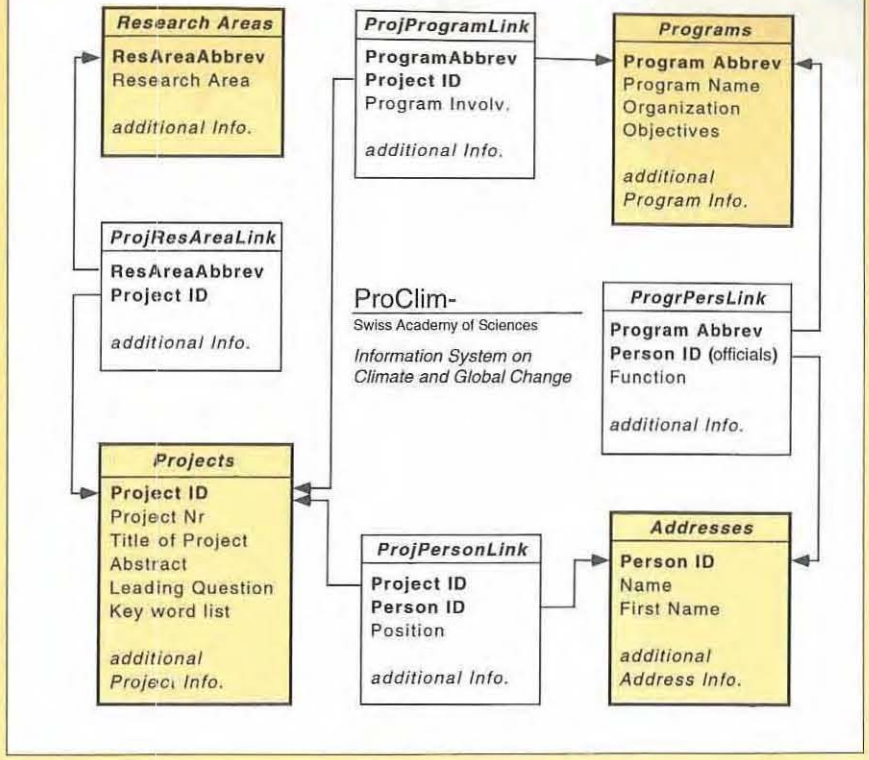
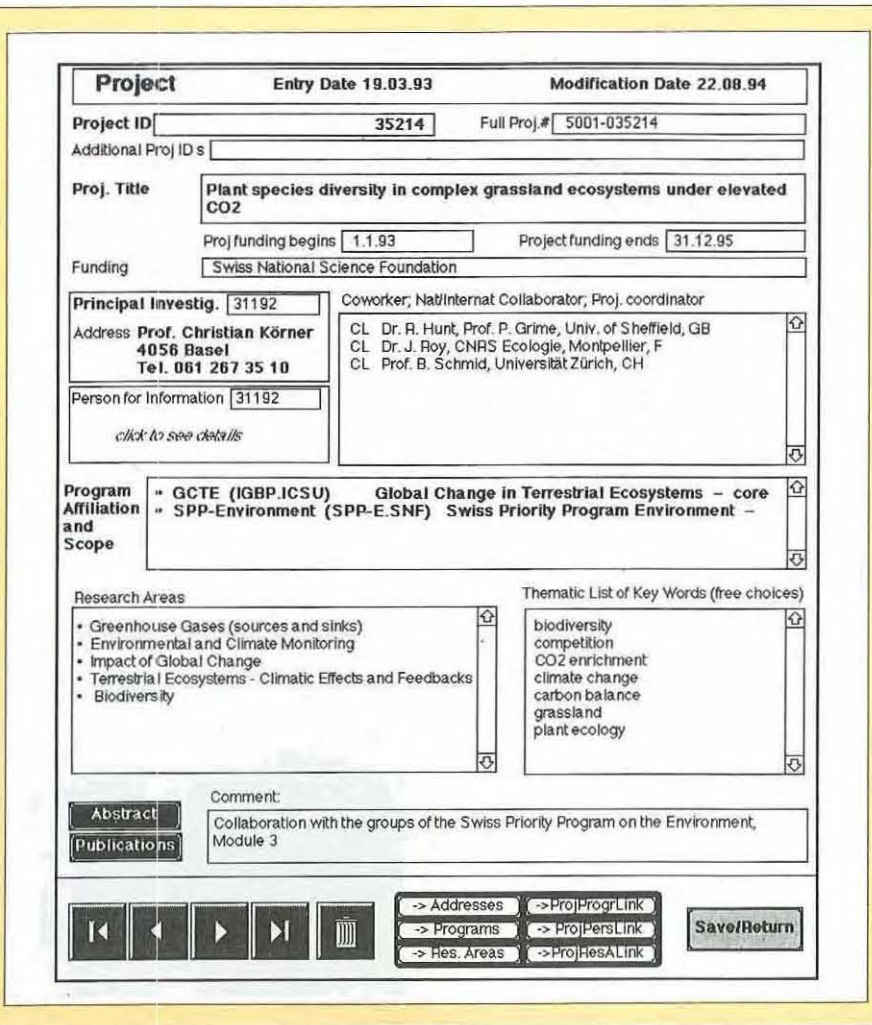


Figure 1. Simplified structure of the PROCLIM Information System. The main elements are coloured



People with the IGBP

Dork L. Sahagian

Executive Director named for the GAIM Task Force

Dork Sahagian has been appointed Executive Director of the Global Analysis, Interpretation and Modeling Task Force of IGBP. With the GAIM Task Force Chair, Berrien Moore, he will maintain the GAIM administrative office at the University of New Hampshire to support the GAIM scientific program which is presented in the recently released IGBP Report #30.

Dr. Sahagian comes to IGBP/GAIM from Ohio State University, where he has been a Research Scientist at the Byrd Polar Research Center. He has a background in Geophysics, with his PH.D from the University of Chicago. He has made contributions to several fields including global change and environmental geology, hydrology, paleogeography/paleoclimatology, and sea level change. In accepting the position, Sahagian stated:

"Global environmental degradation (and society's growing concern) has raised many new and important problems that must be addressed by interdisciplinary research programs. The IGBP is in a strong position to contribute to the understanding of the complex interactions between global systems necessary to establish the most effective national and international environmental, agricultural, industrial, and social policies. GAIM's mission is to support biogeochemical modelling efforts which may predict the effects of various aspects of global change occurring at present and in the future. This may be accomplished by initiating biogeochemical model development and helping to tie together the related research programs underway in the Core Projects. As such, it must act as a medium for enhanced communication between modelers, data collectors, and interpreters. Working together with the Core Projects and IGBP-DIS, GAIM must ensure that modelers have access to necessary input data in a format they can use, that model results are compatible throughout the IGBP Core Projects, and that results are disseminated to regions of pivotal environmental impact through efforts such as START. In this way, a comprehensive synthesis of the biogeochemical aspects of global change may someday evolve from models of individual subsystems. This interdisciplinary approach is surely the most effective way to understand the causes and effects of global change, and I am happy to help support IGBP/GAIM in its efforts toward that end."

New Head of the BAHC Core Project Office

Helen Lee has accepted the position of Manager of the BAHC Core Project Office located at the Potsdam Institute for Climate Impact Research, and will begin her work at the end of October.

Dr. Lee is a biologist whose scientific interests range from the cellular to the whole forest level, with working experience in Britain, Germany, Venezuela, Jamaica and the Virgin Islands. Her Ph.D. thesis was on the mechanism of flowering and the involvement of phytochrome, after which she received a fellowship at Newcastle University to examine the induction of Crassulacean Acid Metabolism (CAM) in response to light and temperature.

Between 1986 and 1989 Dr. Lee undertook cooperative ecological research at the University of Darmstadt, and with IVIC (Venezualan Centre for Ecology and Environmental Science) in Caracas into CAM, mangroves and halophytes in Venezuela.

Helen Lee at field research site.

This was later pursued in the Virgin Islands (with UCLA), involving gas exchange, water relations and biochemical work. This research was followed by a senior lectureship at the University of Northumbria, and later work with the Forestry Commission to head a project on the effects of air pollution on trees. For a short time she also ran an environmental consultancy in London.

Since 1991 she has been a senior research fellow at the University of Edinburgh, working on a European Community project on the effects of climate change on European trees and forests. This project is coordinated by Paul Jarvis and involves twelve groups throughout Europe. "It has been an exciting and fruitful collaboration, and I look forward to new and even more varied and exciting collaborations in my new position", said Dr. Lee to us.

New Standing Committee Members for START

Global Change System for Analysis, Research and Training

Gisbert Glaser is the Director of the Bureau for Coordination of Environmental Programmes of the United Nations Educational, Scientific and Cultural Organisation (UNESCO) since January 1993. His is responsible for coordinating UNESCO's many scientific and educational programmes in environment and sustainable development, especially as regards the follow-up to the United Nations Conference on Environment and Development. He is also UNESCO's focal point for cooperation within the UN system and with ICSU – in this function he has been a collaborator with the IGBP since 1990 when the science plan was published. He is a member of ICSU's Advisory Committee on the Environment since 1993.

Dr. Glaser served as the Deputy Director of the Bureau of Environmental Programmes from 1990 to 1992, prior to which he was Senior Programme Specialist UNESCO's man and the Biosphere Programme, with specific responsibility for the arid lands and mountains sub-programme areas.

Gisbert Glaser Reuben J. Olembo

Dr. Glaser, of German nationality, holds a doctorate in agricultural geography from the University of Heidelberg. He was professor of geography of natural resources development at Heidelberg University for six years, and has done several years of field research, specifically in Brazil.

He is a member of several national and international professional societies, and is the author of numerous publications in geography, integrated ecological research and international environmental science.

Reuben J. Olembo, a citizen of Kenya, is Assistant Executive Director of UNEP, with responsibility for overall coordination of the Environment Programme.

Professor Olembo's fields of expertise are in botany, chemistry and genetics. After a distinguished scientific and academic career, during which he became full Professor of the Department of Botany at the University of Nairobi, Professor Olembo was invited by Maurice Strong, the first Executive Director of UNEP, to join the initial staff being put together to implement the results of the Stockholm Conference on the Human Environment, with particular regard to the field of natural resources. His initiative in establishing modalities for cooperation in this field within the UN system, and with professional bodies outside the system, resulted in the establishment in 1975 of the Ecosystems Conservation Group, comprising the Food and Agricultural Organisation, UNESCO, the International Union for the Conservation of Nature, the World Wildlife Fund, and UNEP. He participated in the plan of action to combat desertification during the preparations for the UN Conference on Desertification.

In 1986 he became the first Director and Coordinator of Environmental Management

Reuben J. Olembo

of the technical component of UNEP's organisation with environmental programmes covering oceans, freshwater, terrestrial ecosystems, technology and the environment, human settlements and health, environmental law, education and training. In laying the scientific and technical foundation for international cooperation in Biodiveristy, he directed a series of inter-governmental *ad hoc* experts whose work became the basis for the Intergovernmental negotiating Committee for the convention on Biodiversity, which was concluded and opened for signature at the Rio Earth Summit.

Tutorial Course on Climate Change and General Circulation Modelling
Southeast Asia Regional Committee for START (SARCS)

This course, which ran from 2-13 May 1994, was organised by the CSIRO Division of Atmospheric Research in Mordialloc, Victoria, Australia in conjunction with the ASEAN Specialised Meteorological Centre (Singapore), and with the World Climate Research Programme. The course was part of the original proposal from START to the Global Environmental Fund as one of the series of workshops designed to improve regional capacity in studying global change effects, especially in relation to land use and land cover. The participants, from Singapore, Malaysia, Indonesia, the Philippines and Thailand, covered a spread of universities, environmental protection agencies, and other government departments, including research institutes.

The tutorial was specifically designed to enable non-meteorologists to understand the strengths and limitations of general circulation models and their output in providing prediction of climate change. This understanding is especially important for scientists studying impacts of global change, but is also relevant to policy makers who have to implement aspects of the Framework Convention on Climate Change.

The tutorial course was held at the laboratories of the CSIRO Division of Atmospheric Research, near Melbourne. It consisted of lecture courses, projects and practical work, and site visits. Sixteen participants - nominated by SARCS - attended. Each participant received lecture notes and a copy of the recent book "Modelling Change in Environmental Systems" which as used as a textbook for the course. Each one completed a project during their attendance at the course, and received an attractive certificate of completion following presentation of their project report. The project covered a wide range of topics including drought, agriculture, atmospheric gases, volcanic effects, land use change, storm surges, and others.

The students were appreciative of the laboratory facilities, the access to library resources, the introduction to computer networking, and the access to supercomputers, work stations and personal computers. They also enjoyed the introduction to Australian fauna and Australian cultural life. The participants put forward several recommendations. One was for SARCS to support the training of participating scientists in the use of the Internet, and for setting up the infrastructure for access to e-mail in countries that do not already have such facilities.

In addition, the participants felt the need for a funding mechanism that would allow scientists in the region to undertake similar studies, further training, or formal research in climate change and general circulation modelling. A Climate Change Fellowship Programme was proposed as a means of satisfying this need. A full report on the course is available from the course director, Dr. Tom Beer, CSIRO, Private Bag 1, Mordialloc, Vic. 3195, Australia.

The editor's corner

A small round logo representing a swan appears for the first time in this issue. It marks Scandianvian environmental approval on paper production.

For the past three years the *Global Change NewsLetter* has been printed by Bergs Grafiska in Stockholm on chlorine-free paper. The paper weight is 90 grams, which means that a sheet measuring one square meter of paper weighs 90 grams. This one square meter can give 32 pages totally of this size (16 leaves of A4 paper).

The paper is made from a totally chlorine-free (TCF) mixture of birch and pine pulp supplied by Södra Cell. It is produced by the Håfreström paper mill in south-west Sweden, and its product name is "Arctic Book".

The mill also fulfils environmental standards as regards its use of water. During the production cycle, 95% of water is released from the pulp as the paper rolls to its finished product. This water is channelled, and in a closed cycle flows back under the mill to where it is treated and reused for processing new pulp.

The amount of paper produced by each mill in Sweden is limited in relation to the environmental disturbances that mills can create. As a result of Håfreström's high environmental standards, the mill is allowed to produce 130 000 tonnes of paper per year.

And speaking of water: south-west Sweden is full of forests, lakes and rivers. The name Håfreström in Swedish means "fish-net stream", referring to the nets that were stretched across the river to catch salmon.

IGBP Meetings

1994

3-5 October, Paris, France
GAIM Task Force Meeting. Berrien 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, Internet: B.(H) Moore@unh.edu

4-6 October, Boulder, CO, USA
Joint ISLSCP-BAHC Workshop on the Global Soil Wetness Data. Piers Sellers, NASA/Goddard Space Flight Center, Greenbelt, MD, USA. Fax: (+1-301) 286 9200, E-mail: piers@imogen.gsfc.nasa.gov

11 October, Wellington, New Zealand
START Oceania Global Change Planning Meeting. *Jane Soons*, Dept. of Geography, University of Canterbury, Private Bag 4008, Christchurch, New Zealand. Fax: (+64 3) 364 2907, Internet: a.moloney@scs.canterbury.ac.nz

12-14 October, Victoria, BC, Canada
JGOFS Scientific Steering Committee (JGOFS-9). Hugh Ducklow, Virginia Institute of Marine Sciences, The College of William and Mary, PO Box 1346, Gloucester Point, VA 23062 USA. Tel: (+1-804) 642 7180 (direct line) (+1-804) 642 7332 (secretary) Fax: (+1-804) 642-7097, E-mail duck@back.vims.edu

17-19 October, Jakarta, Indonesia
Asia-Pacific Network for Global Change Research, Working Group 1 on the Scientific Agenda. Kazuhiko Takemoto, Interim APN Secretariat, c/o Global Environmental Forum, 1-9-7 Azabudai, Nimato-ku, Tokyo 106, Japan. Fax: (+81-3) 5561 9737

23-27 October, Bermuda
LOICZ Focus 2 Workshop on Biogeomorphology of Carbonate Shorelines (in collaboration with the International Oceanographic Commission and IUCN-The World Conservation Union). John Pernetta, *LOICZ Core Project Office*, Netherlands Institute for Sea Research, PO Box 59, 1790 AB Den Burg, Texel, Netherlands. Fax: (+31) 2220 69430, Internet: pernetta@nioz.nl

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

25-30 October, Potsdam, Germany
GCTE-BHAC Workshop on Plant Functional Types in Global Modelling. Wolfgang Cramer, Department of Global Change and Natural Systems, Potsdam Institute for Climate Impact Research (PIK), Telegraphenberg, PO Box 601203, D-14412 Potsdam, Germany. Fax: (+49-331) 288 2600, Internet: Wolfgang.Cramer@pik-potsdam.de

26-28 October, Paris, France
IGBP-DIS Standing Committee.

28-30 October, Montréal, Québec, Canada
LOICZ Workshop to Develop Canadian Science Plan. Grant Ingram, Department of Atmospheric and Oceanic Sciences, McGill University, 805 Sherbrooke St. West, Montreal, Québec H3A 2K6, Canada. Fax: (+1-514) 398 6115, Internet: LOICZ@bathybius.meteo.mcgill.ca

31 October-1 November, Stockholm, Sweden
3rd Core Project Officers Meeting. IGBP Secretariat

Oct/Nov, Warsaw or Prague
IGAC-TRAGEX (Trace Gas Exchange between Mid-Latitude Terrestrial Ecosystems and Atmosphere) European Network Planning Meeting. K. A. Smith, Edinburgh School of Agriculture, West Mains Road, Edinburgh *EH9 3JG, UK*. Fax: (+44 31) 667 2601

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, Lyneham ACT 2602, Australia. Fax: (+61-6) 241 2362, Internet: wls@cbr.dwe.csiro.au

7-8 November, Tokyo, Japan
JGOFS Data Management Task Team. Dr. Roy Lowry, British Oceanographic Data Centre, Proudman Oceanographic Laboratory, Bidston Observatory, Birkenhead, Merseyside L43 7RA, UK. Tel: (+44-516) 538 633; Fax: (+44-516) 536 269; or Dr. Toshiro Saino, Ocean Research Institute, University of Tokyo, 1-15-1 Minamidai, Nakano-ku, Tokyo 164, Japan. Omnet: T.Saino

14-15 November, Venice, Italy
PAGES Executive Committee. Suzanne Leroy, PAGES Core Project Office, Bärenplatz 2, CH 3011 Bern, Switzerland. Fax: (+41-31) 312 31 68. Internet: pages@ubeclu.unibe.ch

14-16 November, Beijing, China
PAGES Workshop on Reconstruction of Climate from Documentary Sources: Methods and Analysis. Peiyuan Zhang, Institute of Geography, Chinese Academy of Sciences, 100101 Beijing, China. Fax: (+86-1) 491 1544

14-16 November, Salvador, Brazil
GCTE Cassava Network Announcement and Initial Planning Meeting. John Ingram, CGTE Focus 3 Project Officer, Dept. of Plant Sciences, University of Oxford, South Parks Road., Oxford OX1 3RB, UK, Fax: (+44 865) 275 060, E-mail: 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, Bukyo 3, Matsuyama 790, Japan. Tel: (+81-899) 24 7111, Fax: (+81-899) 27 5852, Internet: yanagi@chimegw.dpc.ehime-u.ac.jp

14-18 November, Bangalore, India
START Regional Committee for South Asia (SASCOM) Planning Workshop on Climate Variability and its Implications, in conjunction with GCTE and CLIVAR (WCRP). Sulochana Gadgil, Centre for Atmospheric Sciences, Indian Institute of Science, Bangalore 560 012, India. Tel: (+91.80) 3340 450: 3344 411, ext. 2505, Fax: (+91-80) 3346 376, E-mail: sulo@cas.iisc.ernet.in

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

16-20 November, Venice, Italy
PAGES-CLIVAR (Climate Variability and Predictability) Joint Meeting on a palaeoclimate perspective on climate vairability and predictability. Roberto Frassetto, Instituto di Grandi Masse, CNR, *1364 San Polo, I-30125*, Venezia, Italy. Tel: (+39-41) 521 6828, Fax: (+39-41) 2609 2340, Internet: frasse@ocean.isdgm.ve.cnr.it.

21-22 November, New Delhi, India
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

30 Nov-3 Dec, Piracicaba, Brazil
IGBP/BAHC-UNESCO/IHP 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, Reno, NV, USA
GCTE CO_2-Stress Interactions. Jeff Seeman and Tim Ball, Desert Research Institution, Biological Sciences Center, 7010 Dandini Blvd. Reno, NV 89512, USA.

November/December, Alexandria, Egypt
2nd START Regional Committee for the Mediterranean (MEDCOM) Meeting. Professor Mohamed Ayyad, University of Alexandria, Alexandria, Egypt. Fax: (+20-3) 545 7611

3-4 December, San Francisco, CA, USA
PAGES Workshop on multi-proxy mapping (MPM). Eric Grimm, Illinois State Museum, 1011 East Ash Street, Springfield, IL 62703, USA. Fax. (+1-217) 785 2857, Internet: grimm@museum.state.il.us

5-8 December, Durham, New Hampshire, USA
BAHC-LOICZ-PAGES Workshop on Waterborne Transport of Terrestrial Materials to Freshwater and Coastal Ecosystems: Implications for Ecosystem Function and Water Quality. Annette Schloss, Complex Systems Research Center, Morse Hall, 39 College Rd., University of New Hampshire, Durham, NH 03824-3525, USA. Fax: (+1 603) 862 0188, Internet: ag@ecos.unh.edu

6-9 December, Australia
BAHC Focus 4-GAIM/Regional Interactions of Climate and Ecosystems - MECCA/Programme of Intercomparison of Land-surface Parameterisation Schemes (PILPS) Workshop on Incorporating Uncertainty in Modelling and Decision Making. 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

9-11 December, Bangkok, Thailand
SARCS Workshop on Socio-Economic Research Agenda for Global Change. Beverly Goh, SARCS

Secretariat, Institute of Environmental Research, Chulalongkorn University, Thailand.

12-15 December, Canberra, Australia
9th Meeting of the Scientific Committee for the IGBP. IGBP Secretariat and Brian Walker, CSIRO, Divison of Wildlife and Ecology, PO Box 84, Lyneham ACT 2602, Australia. Fax: (+61-6) 241 3343 or 241 1742

December, Abidjan, Ivory Coast
Third Meeting of the START Regional Committee for Northern Africa (NAFCOM). Amoin 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 Workshop on Desertification, Deforestation and Vegetation Change: Impacts on and from Climate and Climate-Driven Land Cover Change, Including Biomass Burning, in cooperation with IGAC-DEBITS (Deposition of Biogeochemically Important Trace Species). Amoin 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 1913, D-52425 Jülich, Germany. Fax: (+49 2461) 61 5346, Internet: ICH302@zam001.zam.kfa-juelich

End 1994-early 1995, US 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@mailer.uni-marburg.de; conrad@papin.HRZ.Uni-Marburg.de

1995

10-12 January, Cape Town, South Africa
JGOFS Executive Committee. John Field, University of Cape Town, Zoology Department, 7700 Rondebosch, Cape Town, South Africa, Tel: (+27-21) 650 3612, Fax: (+27-21) 650 3726, OMNET: J.FIELD, Internet: jgfield@ucthpx.uct.ac.za

19-21 January, Albuquerque, NM, USA
PAGES-PEP I Workshop on Past Changes in Western North America. Roger Y. Anderson, Department ofo Earth and Planetary Sciences, University of New Mexico, Albuquerque, NM 87131, USA. Fax: (+1.505) 277 8843

30 Jan-2 Feb, Copenhagen, Denmark
GCTE Open Workshop on Soil Biology and Global Change. Sten Struwe, Department of General Microbiology, University of Copenhagen, Solvgade 83H, DK-1307 Copenhagen K, Denmark. Fax: (+45) 35 32 20 40; 33 14 50 58

6-9 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

13-25 February, Nairobi, Kenya
START International School on "Africa and Global Change" in cooperation with MEDIAS/Centre National d'Etudes Spatiales (France).

February, Sydney, Australia
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)

February, Canton, China
4th START-TEACOM (Regional Committee for Temperate East Asia) Meeting. Fu Congbin, Laboratory of Climate Research (LCR), Institute of Atmospheric Physics, Chinese Academy of Sciences, PO Box 2718, Beijing 100080, China. Tel: (+86-1) 256 2458, Tlx: 22474 aschi cn, Fax: (+86-1) 256 2347; 256 2458

February, Kaoshiung, Taiwan
6th START-SARCS (Southeast Asia Committee) Meeting. Beverly Goh, SARCS Secretariat, Institute of Environmental Research, Chulalongkorn University, Thailand.

February, Hawaii, USA
IGAC Acrosol 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 5-9, La Thuile, Italy
BAHC Focus 3 Workshop on Strategies for Monitoring and Modelling CO_2 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

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, Lyneham 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. Mohnen, 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, in conjunction with the Chapman Conference on Biomass Burning and Global Change. 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@dianc.mpch-mainz.mpg.de

17-26 March, Mendoza, Argentina
PAGES Scientific Steering Committee. Suzanne Leroy, PAGES Core Project Office, Bärenplatz 2, CH 3011 Bern, Switzerland. Fax: (+41-31) 312 31 68. Internet: pages@ubeclu.unibe.ch

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, 818 208 and John Ingram, CGTE Focus 3 Project Officer, Dept. of Plant Sciences, University of Oxford, South Parks Road., Oxford OX1 3RB, UK, Fax: (+44 865) 275 060, E-mail: ingram@vax.ox.ac.uk

27-28 March, Berlin
3rd National IGBP German Symposium. Sabine Lütkemeier, IGBP Sekretariat, Freie Universität, Carl-Heinrich-Becker Weg 6-10, 12165 Berlin, Germany. Fax: (+49-30) 8387 71217

27-29 March, Philippines
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

27-31 March, Reading, UK
GCTE Wheat Network: Experimentation and Modelling Workshop. John Ingram, CGTE Focus 3 Project Officer, Dept. of Plant Sciences, University of Oxford, South Parks Rd., Oxford OX1 3RB, UK, Fax: (+44 865) 275 060, E-mail: 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

2-7 April, Kathmandu, Nepal
PAGES Workshop on International Himalayan-Tibetan Plateau Palaeoclimate. Cameron Wake, Glacier Research Group-EOS, University of New Hampshire, Durham, NH 03824-3524, USA. Fax: (+1-603) 862 2124

3-7 April, Hamburg, Germany
First BAHC Science Conference, in conjunction with the EGS General Assembly. Pavel Kabat, Winand Staring 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

24-27 April, Quezon City, Philippines
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

27-28 April, Pretoria, South Africa
4th START-SAFCOM (Southern African Regional Committee) Meeting. Bruce C. Hewitson, Department of Environmental & Geographical Sciences, University of Cape Town, Rondebosch 7700, South Africa. Tel: (+27-21) 650 2785, Fax: (+27-21) 650 3791, E-mail: hewitson@uctvax.uct.ac.za

29-30 April, Qingdao, China
4th LOICZ Scientific Steering Committee. John Pernetta, LOICZ Core Project Office, Netherlands Institute for Sea Research, PO Box 59, 1790 AB Den Burg, Texel, 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, 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, CNRS, F-66650 Banyuls-sur-Mer, France. Fax: (+33) 68 88 10 69.

May, Bergen, Norway
JGOFS North Atlantic Planning Group Meeting. Mike Fasham, James Rennell Centre, Gamma House Chilworth Research Centre, Chilworth, Southampton SO1 7NS, United Kingdom. Tel: (+44-703) 766 184, Fax: (+44-703) 767 507, OMNET: via RENNELL.CENTRE,
Internet: mjf@ub.nso.ac.uk

May, Toulouse, France
IGBP Officers Meeting

22-24 June, Ireland
BAHC Focus 4 Downscaling Workshop, in conjunction with the Sixth Interantional meeting on Statistical Climatology (6IMST). 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

3-7 July, Boulder, CO, USA
BAHC Symposium on Clouds, Convection and Land-Surface Processes, in conjunction with the meeting of the International Union of Geodesy and Geophysics. 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

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, Lyneham ACT 2602, Australia. Fax: (+61-6) 241 2362, Internet: wls@cbr.dwe.csiro.au

3-10 August, Berlin Germany
One day PAGES session during the XIV Interntional Congress of INQUA. Suzanne leroy, PAGES CPO, Bärenplatz 2, CH-3011, Bern, Switzerland. Fax: (+41-31) 312 3168,
Internet: pages@ubeclu.unibe.ch

6-12 August, Tampere, Finland
GCTE Session at the International Union of Forestry Research Organisations XX World Congress.

14-18 August, Moscow, Russia
PAGES Multiproxy Mapping Session at the International Geographical Union Summit Conference on Global Changes and Geography. 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

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

August, Novosibirisk, Russia
START-TEACOM Meeting (Regional Committee for Temperate East Asia).

18-20 September
BAHC Focus 4 Joint Meeting, in conjunction with the NATO Workshop on the Evaluation of Soil Erosion Models. 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

22-23 September, Maynooth, Ireland
Symposium on IGBP-Related Research Relevant to Ireland. John Sweeney, Irish Committee for IGBP, The Royal Irish Academy, 19 Dawson Street, Dublin 2, Ireland. Fax: (+353-1) 676 2346, Internet: jsweeney@vax1.may.ie

25-29 September, Garmisch Partenkirchen, Germany
First GAIM Science Conference. Berrien 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

Sept-Oct, 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

14-16 October, Beijing, China
IGAC Scientific Steering Committee/Council. 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

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.ARI., 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

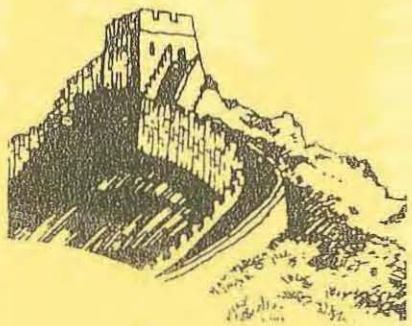
23-27 October, Beijing, China
SAC IV: Fourth Scientific Advisory Council for the IGBP. IGBP Secretariat

28 October, Beijing, China
10th Meeting of the SC-IGBP (continued)

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

Note: Meetings marked in colour are open. All interested scientists are invited to attend.

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.

Publications

IGBP Report No. 32

International Global Atmospheric Chemistry (IGAC) Project. The Operational Plan (1994). 134 pp.

The goals of IGAC are to: develop a fundamental understanding of the processes that determine atmospheric composition; understand the interactions between atmospheric chemical composition and biospheric and climatic processes, and predict the impact of natural and anthropogenic forcings on the chemical composition of the atmosphere. The Operational Plan describes the seven Foci, their related Activities and Tasks, including for each the scientific rationale, the goals, strategies.

Core Project Publications

Biospheric Aspects of the Hydrological Cycle

Reports:

#3 Climate Change, Uncertainties and Decision Making. (Toronto, 20-22 February, 1994)

#4 The Weather Generator Project. (Karlsruhe, Germany, 26-28 June 1994, and Wallingford, UK, 14-16 July 1994)

IGBP-Data and Information System

IGBP-DIS Satellite Fire Detection Algorithm Workshop Technical Report, edited by Chris Justice and Peter Dowty. Workshop held at NASA/GSFC, Greenbelt, Maryland, USA, February 25-26, 1993. (Working Paper No. 9, April 1994)

IGBP-DIS Office, Université de Paris 6, 4 Place Jussieu, Tour 26, 4e étage, Boîte 97, F-75252 Paris Cedex 05, France. Fax: (+33-1) 44 27 61 71

International Global Atmospheric Chemistry Project

Global Atmospheric-Biospheric Chemistry, edited by Ronald G. Prinn. New York; London: Pelnum Press. 261 pp. (Environmental Science Research, 48).

Contains the invited papers and a transcript of the final panel discussion in the First Scientific Conference of the International Global Atmospheric Chemistry (IGAC) Project, April 18-22, 1993, Eilat, Israel. The conference was a landmark event in the area of global atmospheric-biospheric chemistry. Plenum Publishing Corporation, 233 Spring Street, New York, NY 10013, USA

IGAC Directory 1994. 51 pp.

The IGAC Directory, published by the IGAC Core Project Office in companion with IGBP Report 32, lists the names and addresses of the Convenors and Co-ordinating Committees of current IGAC Foci and Activities, Task Teams and Working Groups. Alex Pszenny, IGAC Core Project Office, Building 24-409, Massachusettes Institute of Technology, Cambridge, MA 02139, USA. Tel: (+1-617) 253 9887, Fax: (+1-617) 253 9886, Internet: pszenny@mit.edu

National Research

China (Taipei)

The China (Taipei) IGBP Report (1994). Research Activities Relevant to Global Change in Taiwan. Taipei, National Science Council. 68 pp.

Chen-Tung Arthur Chen, Institute of Marine Geology, National Sun Yat-sen University, Kaohsiung, Taiwan. Fax: (+886-7) 521 4633, Internet: ctchen@cc.nsysu.edu.tw

France

Lettre PIGB-PMRC France/IGBP-WCRP France Newsletter. Director, Jean-Claude Duplessy; Editor, Marie-Antoinette Mélières. Laboratoire de Glaciologie et Géophysique de l'Environnement du CNRS, St Martin d'Hères, France.

To receive the newsletter write to: M. Revillon, Institut National des Sciences de l'Univers, 3, rue Michel Angel, BP 287-16, F-75766 Paris Cedex 16, France. Fax: (+33-1) 44 96 49 65

Netherlands

The Netherlands Contribution to the International Geosphere-Biosphere Programme. State of Affairs January 1994. Koninklijke Nederlandse Akademie van Wetenschapapen (1994). 30 pp.

Alice M. de Gier, Royal Netherlands Academy of Arts and Sciences, P.O. Box 19121, NL.1000 GC, Amsterdam. Tel (+31-20) 551 0732, Fax: (+31-20+) 620 4941

UK

Biogeochemical Ocean Flux Study Community Research Project (1994). March 1987-March 1993. UK JGOFS/Natural Environmental Research Council. Final Report. 48 pp.

BOFS Office, Plymouth Marine Laboratory, Citadel Hill, Plymouth PL1 2PB, UK.

USA

Our Changing Planet. The Fiscal year 1995. U.S. Global Change Research Program (1994). A Report by the Committee on Environmental and Natural Resources Research of the National Science and Technology Council. A supplement to the President's Fiscal year 1995 Budget.

Mea Culpa

Important information was omitted in the description of the Biosphere-Atmosphere Field Experiment in Amazonia, pp. 3-4, by Carlos Nobre in *Global Change NewsLetter*, No. 18, June 1994. The author apologises for not mentioning the contribution of the UNESCO International Hydrological Programme (IHP) in the LAMBADA/BATERISTA September 1993 Workshop in São José dos Campos, Brazil. The IHP supported the participation of five experts in the workshop, who prepared, in collaboration with IGBP-BAHC, a proposal to encourage a more drainage basin perspective across scales through a nested approach, in contrast to the strong emphasis on vertical terrestrial atmospheric water transfer exchanges in the previous HAPEX-type experiments. More information on the development of the HYNEST proposal is given by Alfred Becker on pp. 12-13.

GLOBAL CHANGE NEWSLETTER

Edited by Suzanne Nash

NewsLetter requests and change of address information should be sent to:

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INTERNATIONAL GEOSPHERE-BIOSPHERE PROGRAMME
OF THE INTERNATIONAL COUNCIL OF SCIENTIFIC UNIONS

PROGRAMME OFFICER FOR SOCIAL SCIENCES

The International Geosphere-Biosphere Programme (IGBP) invites applications for the position of Programme Officer in the IGBP Secretariat. The IGBP is an international research programme, dealing with the causes and effects of global environmental change. The Programme Officer will work closely with the Human Dimensions of Global Environmental Change Programme (HDP). The HDP is a companion programme concerned with the human activities that contribute to global environmental change, the consequences of global environmental change for human beings, and the ways in which human behaviour may be influenced to mitigate and adapt to global change.

The Programme Officer will

- serve as liaison between the IGBP and the HDP. The Programme Officer will foster linkages between these two programmes and other international and regional efforts, particularly the emerging European Network for Research in Global Change (ENRICH) and relevant research activities of the European Commission,
- serve as Programme Officer for joint IGBP-HDP working groups or Core Projects, such as that on Land Use and Cover Changes (LUCC),
- represent human dimensions aspects of global change research in IGBP Core Projects,
- encourage interdisciplinary research on global change.

The successful candidate will

- have a PhD in a relevant field
- have proven interest in research on human impacts of global environmental change, and an ability and interest in fostering interaction between researchers in the natural and social sciences,
- be well acquainted with international scientific collaboration, including organisational and policy aspects,
- possess complete command of both written and spoken English; knowledge of other languages is an advantage.

As a member of the IGBP Secretariat, the Programme Officer will be based at The Royal Swedish Academy of Sciences in Stockholm, and will answer to the Executive Director of the IGBP. The contract period is two years, with the possibility of extension. The salary, which is paid in Swedish Crowns, is based on the level of a senior scientist in Sweden and is dependant on the qualifications of the successful candidate. The targeted start date for the position is January 1, 1995.

Letters of application *describing past relevant experience, with a curriculum vitae and the names of three references, should be sent no later than 1 November, 1994, to the IGBP Secretariat, The Royal Swedish Academy of Sciences, Box 50005, S-10405 Stockholm, Sweden; fax +46 8 166405, tel +46 8 166448, Internet: sec@igbp.kva.se. For more information please contact Ms. Suzanne Nash at the same address.*

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