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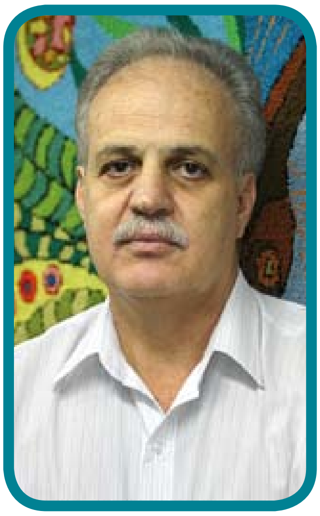
New Chair SC–IGBP



ICSU has appointed Carlos Nobre as the new Chair of the IGBP Scientific Committee for 2006–08. In this issue of the Global Change NewsLetter we introduce Carlos and in a Guest Editorial Carlos articulates his vision for global environmental change research and empowering developing countries.

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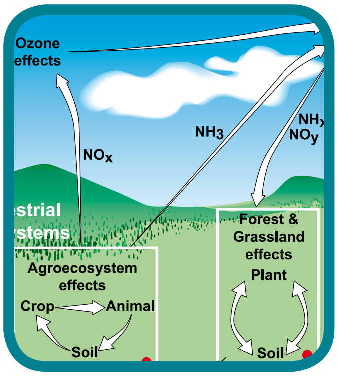
Global Nitrogen Cycle



From 2003–05 the International Nitrogen Initiative has been an IGBP Fast-Track Initiative. As it has concluded its work as a Fast-Track Initiative, we present key aspects of its synthesis of the global nitrogen cycle, including anthropogenic creation rates of reactive nitrogen, changes to the spatial patterns of total inorganic nitrogen deposition and riverine fluxes of reactive nitrogen from the land to the coastal zone.

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iLEAPS Science Plan and Implementation Strategy

The Science Plan and Implementation Strategy of iLEAPS is now published. The document can be downloaded from the IGBP and iLEAPS websites, and the centrefold of this NewsLetter provides a brief summary.

The illustration shown here – commissioned by iLEAPS and IGBP – shows the domain of iLEAPS research. This illustration adds to the family of IGBP illustrations, as featured on the covers of NewsLetter No. 60 (IGBP) and No. 61 (LOICZ).

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Empowering Developing Countries

The Millennium Development Goals (MDG) are ambitious targets. They aim to liberate over 500 million people from poverty by 2015 and integrate sustainable development into national and international agendas to reverse the loss of environmental resources. Are these objectives compatible? Historically, most developed countries moved out of poverty by progressing from subsistence agriculture to an industrial economy. If this process is repeated in pursuit of the MDGs, will it not inevitably add pressure to the natural resources of an already strained global environment? Many already see the objective of global environmental sustainability as just one more unrealistic burden, and as an impediment to much needed development in the poorest countries of the world.

Many of the challenges are political in nature. However, research on global, regional and local environmental change is also essential to meeting the challenges of combining development and sustainability in the context of global environmental change. Global environmental challenges and development issues have long been concerns of IGBP, which over the years, has engaged a growing number of developing country scientists in its research and capacity building activities. IGBP also promotes and facilitates Integrated Regional Studies (IRS) in regional 'hot spots' of environmental change. More recently, under ESSP, joint projects on food, water, energy and health were initiated to address questions of direct relevance for developing regions.

The Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA) is an example of both the promise and of the present limiting tendencies of international science to address the challenges of global environmental change (including human dimensions). LBA has conducted over 120 studies and contributed quantitative and qualitative understanding on the functioning of tropical ecosystems and their linkages in the Earth System. Moreover, LBA has trained hundreds of young scientists, mostly from Amazonia.

There are however, caveats. One of the goals of LBA was to contribute sound scientific understanding in support of sustainable development. On that count, the advances made by LBA have been small. Deforestation of the tropical forests of Amazonia has increased to clearly unsustainable levels at great environmental cost. Sustainable management of ecosystems needs appropriate public policies and regulatory frameworks, but translating the scientific knowledge created in LBA into public policies has proven to be far more difficult than anticipated. Key to overcoming these obstacles is the capacity to develop and disseminate appropriate technologies and methodologies for sustainable management of the environment.

Few developing countries are making substantial investment to develop this capacity, and building such knowledge and capacity is not high on their priority lists. Part of the solution to the environmental challenges posed by development is to enhance existing research institutions and to establish regional centres of excellence in developing regions. This is a particularly important first step for permanent, bottom-up societal transformation, and for making available a range of sustainable pathways grounded on robust knowledge. Regional centres of excellence must be of the highest quality, and must promote existing science agendas on global environmental change. They should however, push these agendas in new directions in order to fully address the science-related challenges associated with global, regional and local environmental change, including the development of sustainable management of ecosystems and natural resources, and research and development of appropriate technologies.

My career as a research scientist has been spent in Brazil, during a period of rapid economic and political development. Through this I have learnt the value of high quality research institutions as a key component of development. Only a small fraction of the flow of aid from industrialised nations to developing countries would be needed to create a network of such centres, and I believe IGBP and its ESSP partners have a role to play in making this happen. During my term as SC-IGBP Chair, I will be working to increase the capacity of the developing world to research environmental change and development issues. The overall objective is to empower developing countries to actively participate in the mitigation of, and adaptation to, global environmental change.

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Carlos A. Nobre Chair, IGBP Scientific Committee 2006–08

Following nomination by the IGBP Scientific Committee (SC-IGBP) at their 2005 meeting, Carlos Nobre has been appointed by ICSU as SC-IGBP Chair for the period 2006–08.

Carlos' research interests include biosphere-atmosphere interactions, climate modelling, tropical meteorology and global change. He is particularly involved with these issues in the Amazonian region, and since 1983 has largely pursued his research at the Brazilian Institute for Space Research (INPE), in São José dos Campos and Cachoeira Paulista, Brazil. He was a pioneer in establishing INPE's Center for Weather Forecasting and Climate Studies (CPTEC), where he was Director from 1991–2003. In addition to his time at CPTEC, Carlos has worked as a visiting professor in the Department of Atmospheric Sciences of the University of São Paulo (1991–93) and as a visiting scientist at the University of Maryland (1988–89).

Within the IGBP community Carlos is best known for his role in the Large Scale Biosphere-Atmosphere Experiment in Amazonia (LBA; www.lba.cptec.inpe.br/lba). He has been Scientific Coordinator since 1996 and was Chair of the LBA Science Steering Committee in 1997 and 2004. Additionally, Carlos has been a member of the SSCs of BAHC, GAIM and GEWEX, the Joint Scientific Committee of WCRP and the Brazilian IGBP and IHDP Committees. He participated in the 1st, 3rd and 4th IPCC assessments.

Carlos is an extremely active and influential scientific leader in Amazonian science, having started his professional carrier at the Brazilian Institute of Amazonian Research, in 1975. Currently, he is Chair of the International Advisory Committee of the Program to Protect the Rain Forests of Brazil and a member of the Scientific Committee of the Network for Geo-Environmental Modelling of Amazonia (GEOMA). Additionally, he is Chair of the Multidisciplinary Sciences Committee of the Brazilian Ministry of Education's Commission of Post-Graduate Programs.

Carlos is a member of the Brazilian Association for the Advancement of Sciences, the American Association for the Advancement of Science, the American Meteorological Society and the Brazilian Meteorological Society. He was elected as a permanent member of the Brazilian Academy of Sciences in 2003, and was awarded the Brazilian National Order of Scientific Merit Medal in 1997.

As expressed in his editorial in this NewsLetter, Carlos is not only committed to excellence in scientific research, but also to facilitating informed policy responses to global environmental change – especially in developing countries. We welcome Carlos to his new role in IGBP, and very much look forward to his leadership over the coming years.

The Global Nitrogen Cycle – How Is It Changing?

J. Galloway

Nitrogen – which is contained in amino acids, proteins and DNA – is essential for all life. While Earth has an abundance of nitrogen, almost all exists as unreactive gaseous nitrogen in the atmosphere which is unusable for most organisms. In the 19th century fertilisation of agriculture became necessary to feed the world's rapidly growing population. This was initially fuelled by the mining of guano and then nitrate. However, the natural supplies of reactive nitrogen proved insufficient to meet the growing global food demand, and since early in the 20th century global food production has relied on the Haber-Bosch process which synthesises ammonia from gaseous nitrogen and hydrogen. Over 40% of the world's current population is fed today because of this capability.

In spite of this major technological advance, there is a serious problem with the global distribution of reactive nitrogen: some regions have insufficient reactive nitrogen to sustain the regional population – resulting in hunger and malnutrition, while other regions have too much reactive nitrogen – resulting in human health and ecological problems. Excesses of reactive nitrogen are mainly due to inefficient incorporation of nitrogen into food products, but are also partly due to fossil fuel combustion. The rate of change of these problems is tremendous, since half of the total historical synthetic nitrogen fertiliser use has been in the last 15–20 years. There are multiple opportunities to reduce these problems, but a prerequisite is a sound scientific basis for discussing policy options.

The development of a sound scientific base has been occurring in the last decade with increasing scientific attention given to the biogeochemistry of nitrogen. The First International Nitrogen Conference (Netherlands, 1998) showcased the early advances. The Second International Nitrogen Conference (United States, 2001) was attended by over 400 scientists who unanimously recommended an international organisation be established to integrate scientific advances in nitrogen-related issues and to engage with the policy community. The conference recognised the challenge of optimising nitrogen use to sustain human life while minimising negative environmental and human health impacts.

Following on the recommendation of the Second International Nitrogen Conference, the International Nitrogen Initiative (INI, www.initrogen.org) was established in 2003 under the initial sponsorship of the Scientific Committee of Problems of the Environment (SCOPE). Shortly thereafter the INI was additionally sponsored by IGBP as a Fast-Track Initiative, which was successfully concluded in 2005. Within IGBP the INI is continuing to address nitrogen assessment and stakeholder issues–now under the umbrella of AIMES. This is part of the wider INI programme which includes not only assessment, but

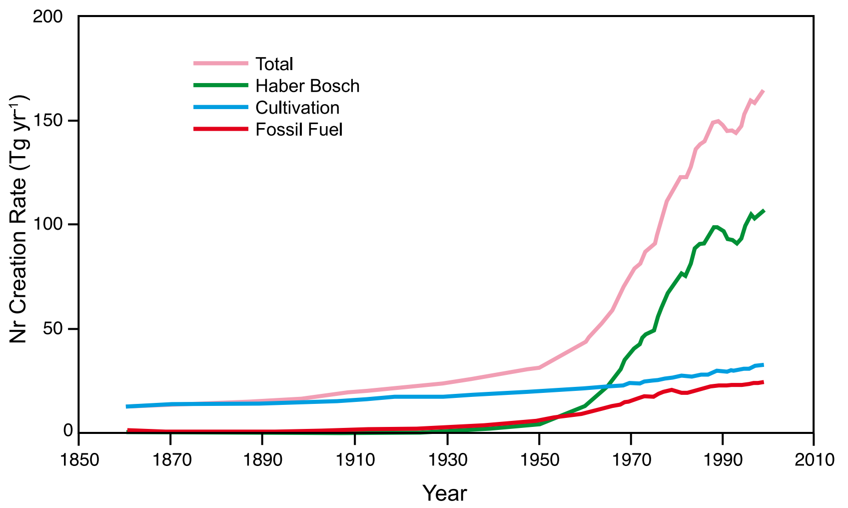

Figure 1. Global anthropogenic creation rates of reactive nitrogen by the Haber-Bosch process, biological nitrogen fixation associated with cultivation of agricultural crops and combustion of fossil fuels. From [1].

also identification of knowledge gaps and promotion of the necessary research to fill those gaps.

The INI has three foci. The first is the assessment of basic knowledge on the creation and distribution of reactive nitrogen:

- Where is there insufficient nitrogen?
- Where is there too much nitrogen?
- What are the effects of decreases and increases in nitrogen abundance relative to societies' needs?

The second focus is development and identification of scientific, engineering and policy solutions for regions with nitrogen deficits or excesses, and the third is implementation of these solutions. Government-level policy makers must be involved in these latter steps if the problems of nitrogen supply are to be solved. Towards this end, the Third International Nitrogen Conference (China, 2004) and the INI jointly developed the Nanjing Declaration, which describes the major issues concerning nitrogen, and sets the stage for the continued development of an integrated, global approach.

Current understanding of human alteration of the nitrogen cycle can be summarised by the increased rate of reactive nitrogen formation (Figure 1), the extensive distribution via the atmosphere to unmanaged ecosystems (Figure 2) and the increased flux of reactive nitrogen to coastal areas (Figure 3).

Anthropogenic introduction of reactive nitrogen into the environment and its increased dispersion via rivers and the atmosphere has both positive and negative impacts on human and ecosystem health. Along nitrogen's biogeochemical pathway is a sequence of negative impacts: NO_x can increase atmospheric ozone concentrations, decrease atmospheric visibility, and increase

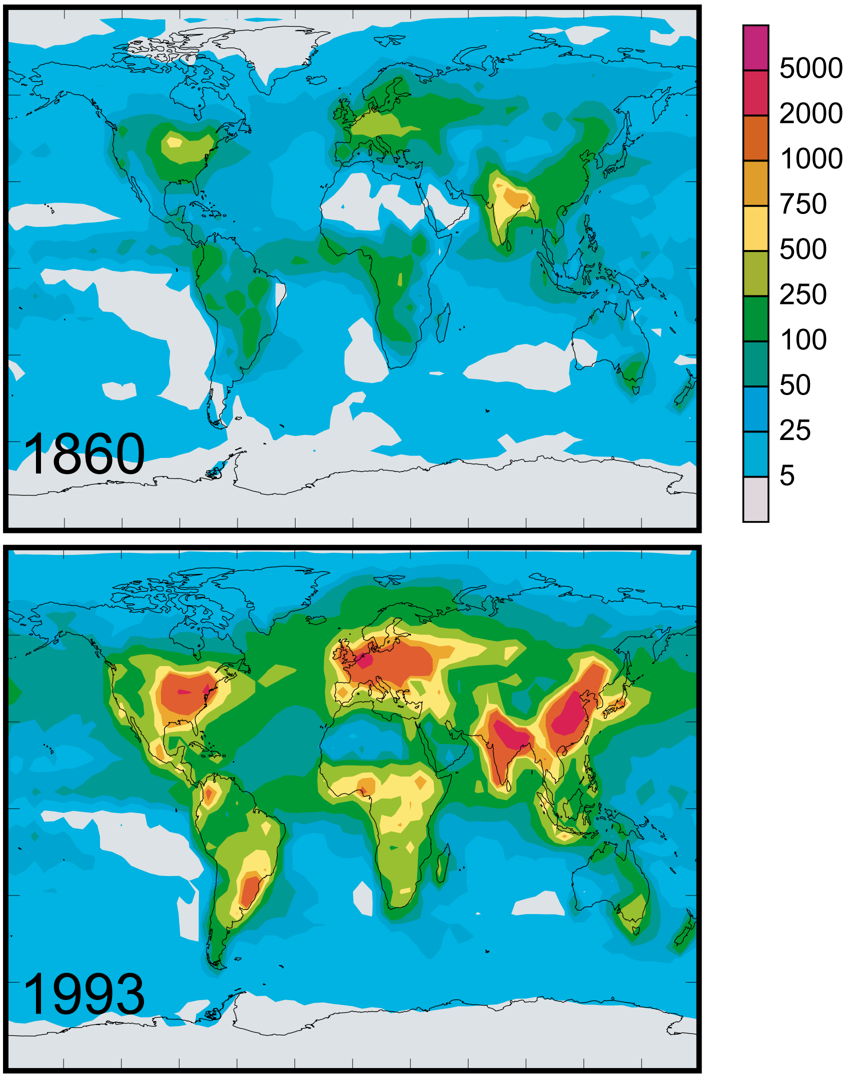

Figure 2. Spatial patterns of total inorganic nitrogen deposition (kg km^{-2} yr^{-1}) in 1860 (top) and 1993 (bottom). Reproduced from [2] with permission from Springer.

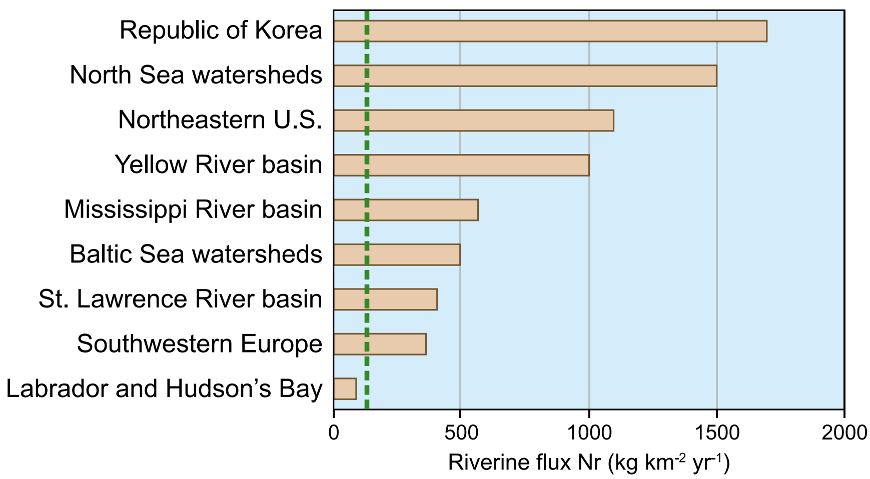

Figure 3. Riverine flux of reactive nitrogen from land to coastal oceans for key contrasting temperate zone regions. The green dotted line represents the natural background flux.

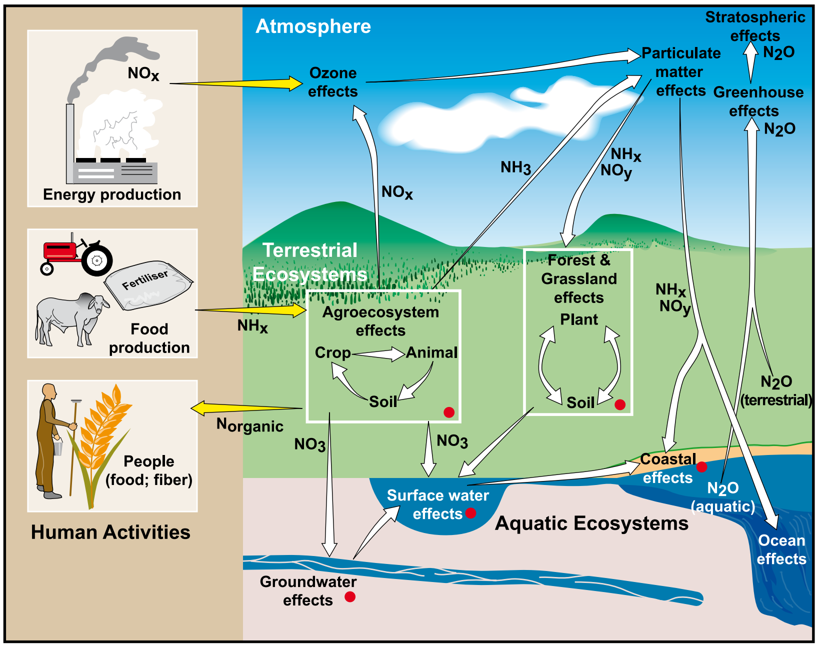

Figure 4. The "cascade" of nitrogen through the environment and the associated environmental impacts. The red dots indicate denitrification potential.

precipitation acidity; following deposition it can increase soil acidity, decrease biodiversity, pollute groundwater and cause riverine, estuarine and coastal eutrophication; and once emitted back to the atmosphere as nitrous oxide it can contribute to greenhouse warming and decrease stratospheric ozone levels. Because nitrogen is linked to so many of the current global and regional environmental challenges, nitrogen issues are extremely important in environmental policy.

The above sequence of impacts has been termed the "nitrogen cascade" (Figure 4). The extensive research that underlies the concept of the nitrogen cascade has revealed the linkages between various parts of the nitrogen cycle, and has begun to assess how changes in one part of the cycle can delay or enhance nitrogen transfers to other parts of the cycle. The cascade continues while nitrogen remains in active forms, ceasing only when nitrogen is converted to unreactive gaseous nitrogen, or when reactive forms of nitrogen are stored for very long periods.

Having driven the recent advances in understanding of the global nitrogen cycle, the INI now plans to focus on the development of policy-relevant solutions, which will be based on a thorough scientific assessment. However, a scientific assessment is only one important part of the development of policy-relevant solutions. Other assessments – including technological, social and economic – will also be required, which can guide the development of new technologies and socio-economic tools. The INI is therefore adopting a three-phased approach:

1. assessment of basic knowledge on the creation and distribution of reactive nitrogen, and problems related to nitrogen use;
2. identification of solutions to these problems for regions with a deficit or excess of nitrogen; and
3. implementation of scientific, engineering and policy solutions to identified problems.

The results of this assessment, and other topics will be presented at the Fourth International Nitrogen Conference (Brazil, October 2007).

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A Successful Decade of East African Lake Research

T.C. Johnson, M.R. Talbot, and E.O. Odada

IDEAL – the International Decade for the East African Lakes – is now complete, ten years after it began field work on Lake Victoria. IDEAL ended on a high note with the recovery of two impressive cores from the bed of Lake Malawi using state-of-the-art drilling technology (Figure 1) [1]. The cores were a 385 m sediment sequence from the central basin off Nkhata Bay (in water 600 m deep) and a 38 m triple sequence from the north basin (in water 350 m deep). The longer core is estimated to represent the past 1.5 million years, and the shorter core the past 75,000 years. Preliminary analyses – and near-shore sands at the base of both cores – have revealed fascinating evidence for major lowstands.

IDEAL generated 150 peer-reviewed publications including three major edited volumes [2–4]. The *IDEAL Bulletin*, providing updates on research and training, was published biennially and distributed to over 300 scientists around the world. A list of journal publications and electronic versions of the *IDEAL Bulletin* are available at www.d.umn.edu/llo/Ideal.

The large lakes of the East Africa Rift Valley are among the oldest on Earth, with some estimated to be 10–15 million years old. They are unique in terms of their sensitivity to climatic change, their rich and diverse populations of endemic vertebrate and invertebrate species, their circulation dynamics and water-column chemistry, and their long and continuous high-resolution records of past climatic change in the tropics.

The IDEAL palaeoclimate programme produced some fascinating new discoveries. Seismic reflection profiles and sediment cores showed that Lake Victoria dried up completely during the late Pleistocene [5], implying a climate that was 25% drier than present [6]. This discovery led to the conclusion that most of the 500 or more species of cichlid fish that are endemic to the lake must have evolved within the past 15,000 years, a claim that has subsequently engendered lively debate in the African cichlid literature [eg. 7,8].

Many palaeoclimate records from East Africa now demonstrate that the Younger Dryas was demonstrably windier, drier [eg. 9–12] and cooler [eg. 13] than present, implying a regional response to the thermohaline circulation of the North Atlantic Ocean. Yet coupled ocean-atmosphere general circulation models show no significant impact of a collapsed North Atlantic thermohaline circulation on the climate of East Africa [eg. 14]. Could this indicate a tropical cause for the Younger Dryas, for example, as modelled by [15], rather than a high-latitude cause?

A high resolution record from Lake Naivasha, Kenya [16], has become an icon of the African rainfall response to solar variability over the past 1,100 years,

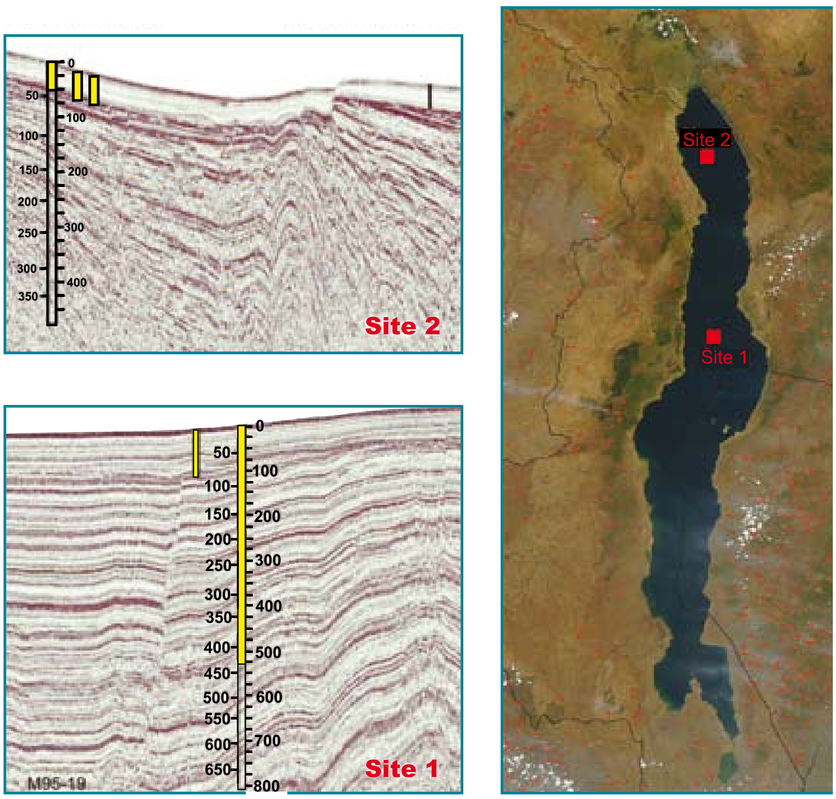

Figure 1. Seismic profiles from the two sites drilled in Lake Malawi in March 2005 with a satellite image showing the drill sites. Yellow bars indicate the recovered core intervals. The linear right hand scales on the cores are based on the travel time of sound through the sediment; the non-linear left hand scales are the estimated actual depths (m) based on an assumed velocity of sound in the sediment. Provided by CA Scholz.

Figure 2. Students and instructors work with the crew aboard the MV Maman Benita to deploy a piston corer on Lake Tanganyika.

including the important observation that this region has frequently suffered droughts that were far longer and more severe than those of the past century. Other high resolution records are emerging from tropical Africa, including from Cold Air Cave, South Africa [17], Lake Malawi [18] and Lake Edward [19], showing drought sequences associated with the "Little Ice Age," albeit with substantial regional variability and no consistent response to solar variability.

These droughts all pale into insignificance compared to the drought responsible for the near-shore sands at the base of the 350 m Lake Malawi core. At the time these sands accumulated the lake must have been reduced to two isolated basins. Furthermore, evidence for a contemporaneous lowstand in Lake Tanganyika [1] and complete desiccation of Lake Bosumtwi, Ghana [20], suggest a continental drought of extreme severity around 75,000 years ago. The apparent coincidence of this event with DNA-based dating of the origin of modern humans, raises the fascinating possibility of a strong climatic influence on human evolution and dispersion.

The reconstruction of the history of African climate with the spatial and temporal precision necessary to elucidate the pulse, pattern and cause of recurring drought across the landscape is still in its early stages. More high-resolution palaeoclimate records are needed from the region, and the quantitative interpretation of the various proxy signals of past climate will require improved biogeochemical models [eg. 21] and more modern process studies that link climate forcing to sediment composition in African lakes.

One of the great accomplishments of IDEAL has been to foster capacity building in the East African lakes community, and to establish meaningful collaboration between African and Northern Hemisphere scientists and students. Approximately one third of IDEAL peer-reviewed publications have African authors – approximately half of these as lead authors. Under the auspices of IDEAL, Andy Cohen (University of Arizona) established a highly successful six-week training programme in Tanzania on Lake Tanganyika, which is now in its sixth year of training African and American students (Figure 2). With assistance from IDEAL, Eric Odada (University of Nairobi) established the effective MacArthur Training Program in Tropical Freshwaters for African students, with instructors from Africa and the Northern Hemisphere.

IDEAL contributed significantly to advancing understanding of African palaeoclimates and modern biogeochemical processes of East African lakes. Our understanding, however, is in its infancy, and although the decade is over, the legacy of IDEAL will surely be continued collaboration between the hemispheres, and a new decade of cutting edge research and training on the magnificent East African lakes.

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Stable Boundary Layers and Land Surface Climate

B. Holtslag

The warming predicted by climate models seems to occur mostly during stable atmospheric conditions. During stable conditions the potential temperature increases with height, which means that the surface is colder than the over-laying atmosphere. These conditions prevail in the atmospheric boundary layer over the continental land and ice regions during night time, and may also occur during day time in winter. Modelling climate at the regional and global scales therefore requires a valid representation of the stable atmospheric boundary layer.

In spite of this requirement parameterisations of the stable boundary layer (SBL) are still rather poor and progress is slow [1–3]. Regional and global climate models are very sensitive to the representation of mixing processes in stratified conditions. For example, two runs of the ECMWF (European Centre for Medium-Range Weather-Forecasting) model of vertical mixing in stable conditions with the same forcing conditions, but slightly different stability functions in the mixing scheme, produced mean winter temperatures 2 m above the land surface that differed by as much as 10°C [4]. Similar results appear between model runs with different boundary layer mixing schemes for winter climate over Antarctica [5].

Climate models and weather forecasting models need to incorporate an overall representation of the small-scale boundary-layer and near-surface processes. The relevant small-scale processes in the SBL are: clear air radiation, drainage flow, generation of gravity waves and shear instabilities, fog and dew formation, the occurrence of a low-level jet and generation of discontinuous or intermittent turbulence [6]. In addition, SBLs are diverse in character, from shallow or deep boundary layers with continuous turbulence through most of their depth, to boundary layers with intermittent turbulence or even laminar flow. Small-scale processes influence the vertical and horizontal exchange of quantities between the surface and the atmosphere, and mixing in the atmosphere on a variety of scales. In addition, turbulent mixing in stratified flow is inherently non-linear

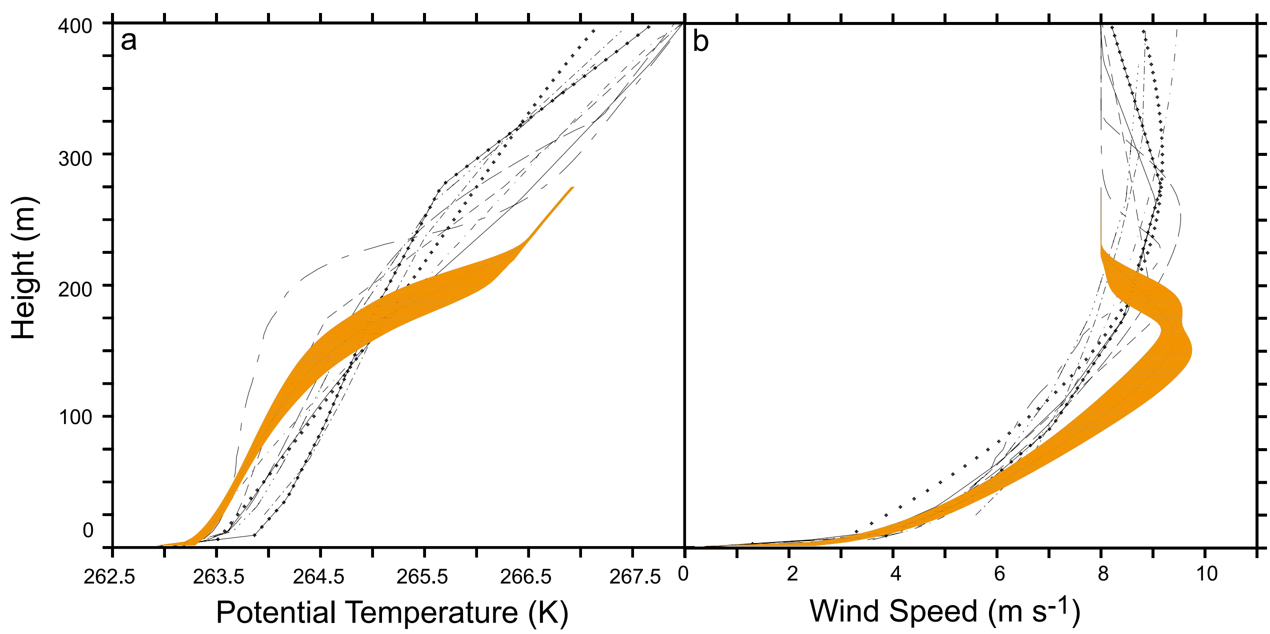

Figure 1. Mean profiles for potential temperature (a) and wind speed (b) for different one-dimensional models compared to the average results from large-eddy simulations (orange band). From [8–9].

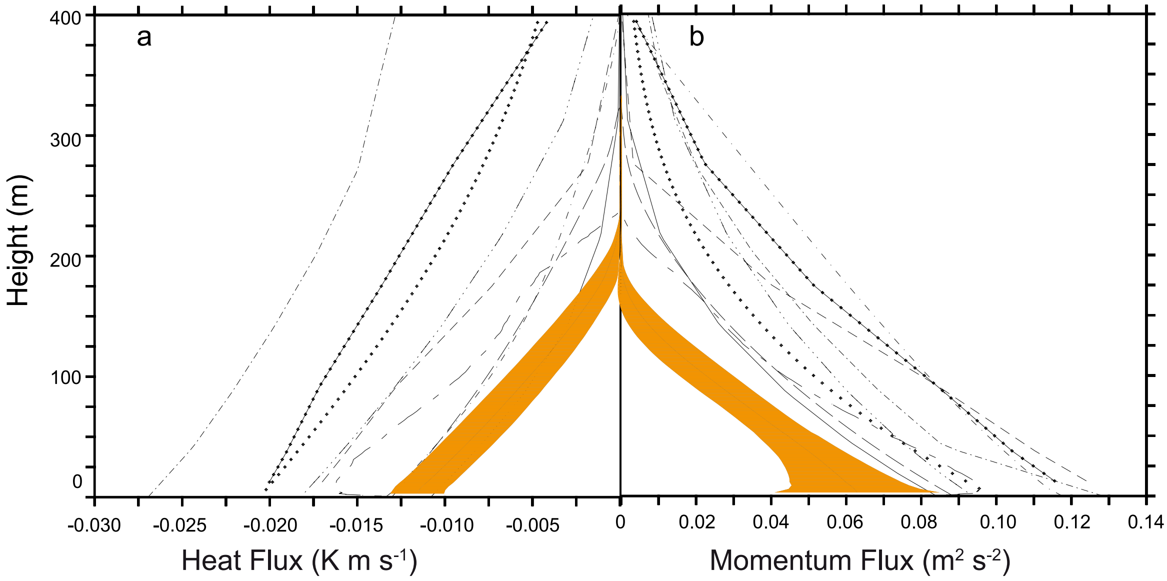

Figure 2. Mean profiles for heat flux (a) and momentum flux (b) for different one-dimensional models compared to the average results from large-eddy simulation results (orange band). From [8-9].

and may trigger positive feedbacks, which in turn, may cause unexpected transitions to totally different SBL regimes [6].

The overall representation of the small-scale boundary-layer and near-surface processes, and the related spatial averaging, is highly non-trivial due to many non-linear processes and the heterogeneity of the environment at a variety of scales. This is normally a motivation to allow some 'enhanced-mixing' in models [1]; an additional motivation is to avoid having to run models in a decoupled mode, which can lead to instability in the modelling of near-ground characteristics [7].

An intercomparison of boundary-layer schemes for stable conditions has been undertaken to review the state-of-the-art and to compare the skills of one-dimensional models and large-eddy simulation models [8–9]. The inter-comparison considered a SBL driven by an imposed, uniform geostrophic wind, with a specified surface-cooling rate over homogeneous ice. With the same initial conditions and model forcings, the models yielded a large range of mean temperature and wind profiles (Figure 1) and corresponding heat and momentum flux profiles (Figure 2). The range in outputs is strongly related to the details of the boundary-layer mixing schemes [8].

Models used by weather forecasting and climate centres typically allow enhanced mixing, resulting in excessively deep boundary layers; research models typically allow less mixing. The latter approach is consistent with field data and with the fine-scale modelling results of the so-called large-eddy simulation [9].

The enhanced mixing in weather forecasting and climate prediction models over- predicts surface drag and boundary layer thickness, and underestimates wind turning in the lower atmosphere [10]. When models with enhanced mixing are coupled to a surface energy balance, they also produce excessively high surface temperatures [7]. However, decreasing the mixing and surface drag has a direct impact on the modelling of atmospheric dynamics [4], leading to an over-prediction of cyclone intensity.

There is therefore a clear need for improved understanding of atmospheric boundary layers and mixing processes under stable stratified conditions, and a more general description of these in atmospheric weather and climate models. These advances are also important for air quality and Earth System studies, since trace gas and pollutant exchanges are directly impacted by boundary-layer mixing [11].

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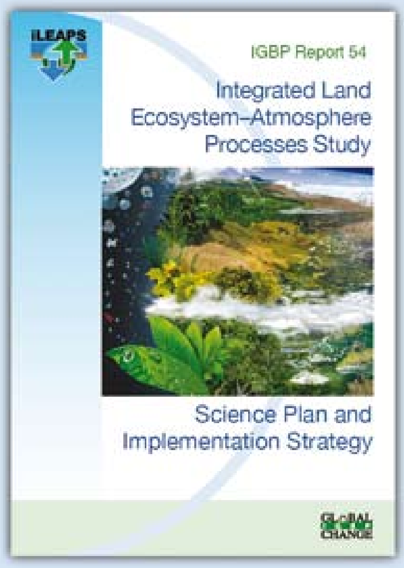
Integrated Ecosystem–Atmosphere Processes Study

Science Plan & Implementation Strategy



iLEAPS – the Integrated Land Ecosystem–Atmosphere Processes Study – investigates the implications of transport and transformation processes of the land-atmosphere interface for Earth System dynamics. Important questions are: (i) how did the land-atmosphere system function under pre-industrial conditions? (ii) how are human activities influencing the land-atmosphere system? and (iii) to what extent does terrestrial vegetation determine the physical and chemical environment on various temporal and spatial scales? The overall goal of iLEAPS is: to enhance the understanding of how interacting physical, chemical and biological processes transport and transform energy and matter through the land-atmosphere interface, particularly emphasising interactions and feedbacks at all scales, from past to future and from local to global.

The iLEAPS Science Plan and Implementation Strategy can be downloaded from www.atm.helsinki.fi/ileaps. Here, an overview of the scope of the iLEAPS science agenda is presented.

Focus 1: Land-atmosphere exchange of reactive and long-lived compounds: key interactions and feedbacks in the Earth System.

The land-atmosphere exchange processes of a variety of substances are tightly coupled, highly sensitive to climate change, and contribute to climate forcing through their effects on tropospheric chemistry and radiative flux. Long-lived gaseous compounds, such as carbon dioxide, methane, and nitrous oxide, as well as reactive volatile organic compounds and nitrogen oxides, are linked in the geochemical cycles of carbon and nitrogen. Of particular interest are the interactions between production, transport, transformation and deposition. Focus 1 spans biology, physics and chemistry (Figure 1).

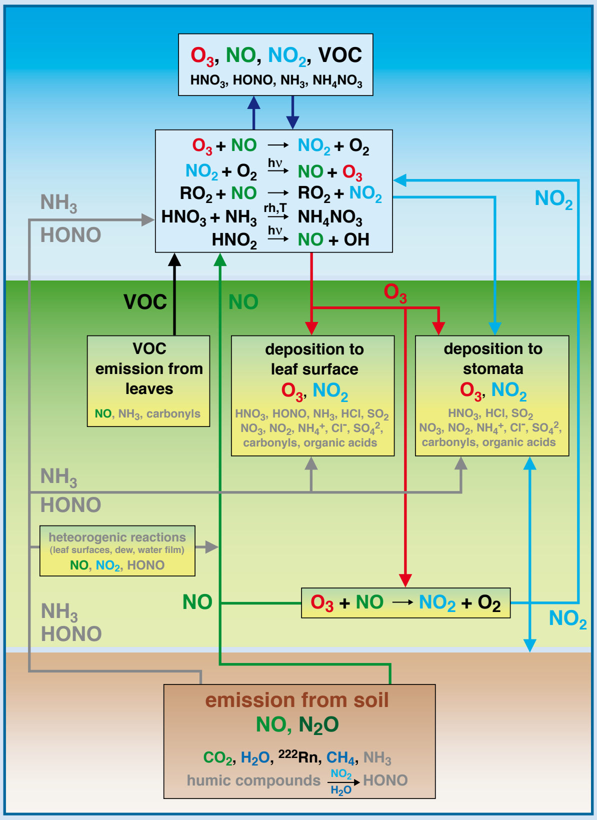


Figure 1. Interactions and feedbacks in the soil-canopy-surface air interface (Courtesy of Franz X. Meixner).

Focus 2: Feedbacks between land biota, aerosols, and atmospheric composition in the climate system.

Focus 2 considers the interaction of biogenic and anthropogenic aerosol particles with the climate system, and the coupling of biological and hydrological processes with atmospheric reactions to control the self-cleansing mechanism of the atmosphere. Focus 2 has a particular emphasis on the tropics. Studies under this focus will investigate direct emissions of natural and anthropogenic aerosols, as well as secondary aerosol formation and the production of cloud condensation nuclei. This research will contribute to the understanding of the direct and indirect effects of aerosols (including dust, bio-

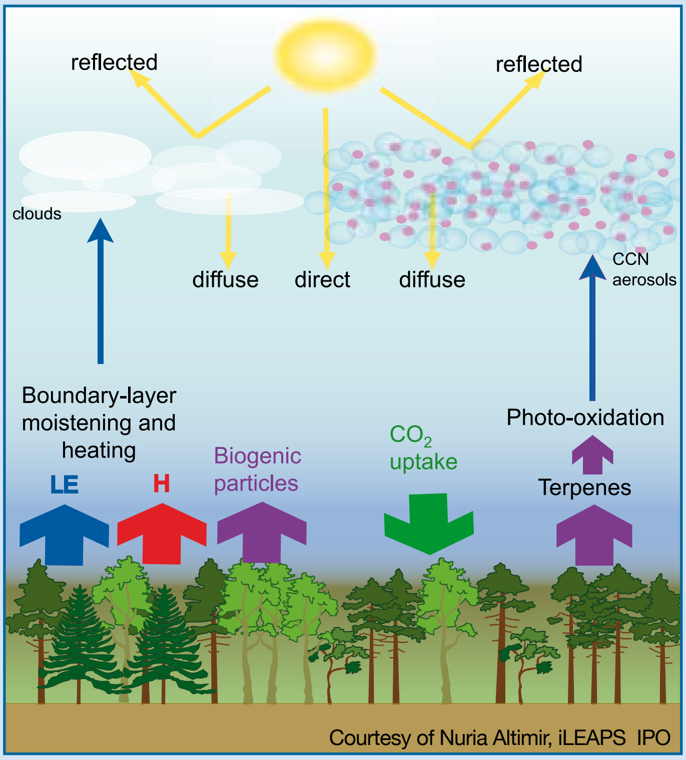


Figure 2. Aerosol-mediated feedback loop on forest carbon uptake.

mass smoke and biogenic particles) on radiative flux and cloud-precipitation processes. Surface-atmosphere exchange processes are important in determining the concentration of hydroxyl radical – the main oxidant determining the rate of chemical removal of compounds from the atmosphere. Changes in land use and cover directly or indirectly affect the oxidising capacity of the atmosphere and surface removal processes. Hence, surface-atmosphere exchanges, as well as mixing and transport, play a key role in regulating chemical transformations (e.g. Figure 2). Changes in gas-phase chemistry also affect aerosol formation and growth processes. Vegetation promotes the formation of aerosols by oxidation of emitted VOCs and the formation of clouds through the combined control it exerts on evaporation. In turn, aerosols and clouds affect the light regime received by vegetation.

Focus 3: Feedbacks and teleconnections in the land surface-vegetation-water- atmosphere-system.

To examine the magnitude of the exchange of various compounds, and the control exerted on these fluxes by land-atmosphere interactions, both hydrological and biogeochemical cycles have to be studied together. These studies must extend from small stream scale to continental basin scale. The ecosystems of high-latitudes are particularly important due to rapid present and future climate change in these regions, and potentially strong feedbacks on atmospheric methane and carbon dioxide concentrations. Landscape changes as a result of human influence can lead to large changes in the spatial redistribution of heat, moisture and energy. Multiple equilibria, thresholds and surprises in the climate system must be considered.

Focus 4: Transfer of material and energy in the soil, canopy, boundary-layer system: Measurements and modelling.

Focus 4 investigates the types of measurements needed to study the various processes, interactions and feedbacks considered in Foci 1–3. Because of the complexity of the interactions between the numerous processes, measurements and modelling activities need to be explicitly linked. The measurement methods include surface flux measurements, boundary-layer budgets, aircraft-based measurements and remote sensing techniques (Figure 3). The integration of measurements and modelling include, for example, scaling from local observations to estimates of regional exchange, and sensitivity studies with fully coupled surface-atmosphere models.

Figure 3. Example iLEAPS measurement methods to measure fluxes along flight paths (aircraft), local-scale fluxes (enclosures) and entire planetary boundary-layer fluxes (eddy covariance towers).

iLEAPS implementation strategies include strategic modelling and multi-parameter sensitivity studies to focus measurement activities and to select representative sites for field research. Research tasks may be chosen based on geographical boundaries to address regional issues, or according to common environmental factors in order to address key scientific uncertainties. Research themes can also be selected to develop iLEAPS tasks based on key processes or phenomena in the land-atmosphere system. iLEAPS will link with other relevant projects including IGAC, SOLAS, GLP, AIMES and GEWEX.

iLEAPS activities will include networks of process studies to elucidate specific iLEAPS scientific questions, field campaigns, modelling (tool development, validations and intercomparisons), long-term integrated field studies, international interdisciplinary mega-campaigns, synthesis studies, databases, as well as conferences on specific scientific questions and synthesis meetings.

The Earth is a complex system regulated by physical, chemical and biological processes, all of which are subject to human impacts. To understand such a system requires a holistic study of the natural and anthropologically induced changes occurring to the system and the implications of these changes for global sustainability. Human perturbations and their mitigation are important research topics, and are issues governed by legally binding international conventions, including the United Nations (UN) Framework Convention on Climate Change (UNFCCC) and its protocols, the UN Convention to Combat Desertification (UNCCD), the UN Convention on Biological Diversity (UNCBD) and the Ramsar Convention on Wetlands.

Global Environmental Change and Earth Observation – An IGBP-ESA Initiative

However, to understand the Earth System and to enforce the above conventions requires substantial efforts in research and monitoring, which in turn requires appropriate data. To date, while there have been dedicated efforts in data compilation, these have been rather *ad hoc,* in that data availability has been considered at individual project level rather than holistically, as befits ESSP or the needs of a given convention.

This problem is currently being tackled by the Integrated Global Observing Strategy Partnership (IGOS-P, www.igospartners.org) – of which IGBP and WCRP are members. Recently, IGOS-P has been complemented by the creation of the Group on Earth Observations (GEO, www.earthobservations.org). Defining a comprehensive global system that would, in a single step, satisfy all the needs for environmental information is not practical. Hence in IGOS, separate components – or "themes" – were tasked with assessing existing structures and suggesting procedures for developing a comprehensive thematic observing system, taking into account other themes. For example, the Integrated Global Carbon Observation (IGCO) theme aims to build integrated approaches that bring together observational strategies in the terrestrial, oceanic and atmospheric realms, and to build close collaboration with the international carbon cycle research community (Figure 1). A central component of IGCO (and all other IGOS themes) is Earth observation, since imagery from space can provide repetitive and spatially comprehensive measurements of many carbon-related variables. However, generating the data products identified in Figure 1 requires significant processing of the actual observations of surface reflectance, temperature and backscatter. To achieve this, space agencies must develop and launch satellites with sensors tailored to the needs of both global environmental change research and convention enforcement, and they must engage with the research community to transform the raw data into the necessary data products.

In 1996 the European Space Agency (ESA) created the Data User Programme (DUP), which by 2003 had evolved into the Data User Element (DUE). The objective of DUE is the establishment of a close and long-term relationship between ESA and data user communities, to guide development of Earth observation data products and services. The definition, implementation, integration, validation and qualification of data products and services in accordance with user standards and practices are all important. DUE has spawned several projects including:

- GLOBCARBON (in collaboration with IGBP and the Global Carbon Project);
- GLOBICE (in collaboration with WCRP);
- GLOBAEROSOL (in collaboration with the European Centre for Medium Range Weather Forecasting and the European Monitoring and Evaluation Programme for the Convention on Long-range Trans-boundary Air Pollution);

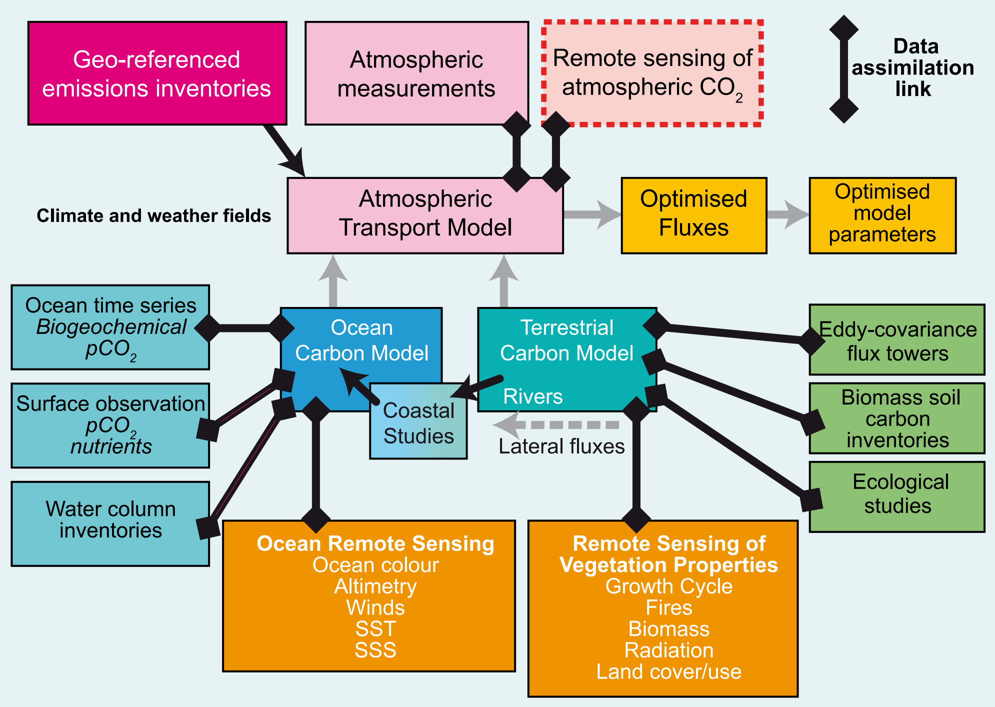


Figure 1: Information flow in a global carbon cycle data assimilation system. From [1].

- GLOBCOVER (in collaboration with the UN Food and Agriculture Organisation and the UN Environment Programme; and
- GLOBCOLOUR (in collaboration with the International Ocean Carbon Coordination Project).

In addition, direct links have been established with the convention secretariats for UNFCCC, UNCCD and Ramsar in the development of the KYOTO INVENTORY, DESERTWATCH and GLOBWETLAND projects. Details of all these projects can be found on the DUE website (dup.esrin.esa.int).

ESA has also interfaced more directly with key organisations; for example, by placement of an IGBP scientist at the ESA-ESRIN facility in Frascati, Italy, and by co-funding (with the UK Meteorological Office) the Global High Resolution Sea Surface Temperature International Project Office in Exeter, UK. These joint initiatives seek to symbiotically align relevant research programmes and ESA's satellite development and data exploitation projects, so as to improve the use of the limited resources of partners and to strengthen the process of satellite sensor development and deployment.

The GLOBCARBON EXAMPLE

The IGBP-ESA initiative is focused on contributing to the Global Carbon Project through the activities of GLOBCARBON. This involves processing approximately 50 terabytes of Earth observation data to generate global data products for the dynamic vegetation growth and atmospheric chemistry modelling communities. The data products include estimates of leaf area index (LAI), fraction of absorbed photosynthetically active radiation (f_{APAR}) and vegetation leaf-on, vegetation leaf-off and burned area. The data products will be at a range of spatial and temporal scales consistent with model resolutions, but will also contain information on spatial heterogeneity.

The algorithms used in the project are based on widely tested methods from the research literature, derived in collaboration with the original method proponents. Thus, for example, the burned area product comprises a merged algorithm based on the collective experience of the GLOBSCAR and GBA-2000 global burned area products. These products were generated independently for the year 2000 by ESA and the European Commission Joint Research Centre [2,3] and the World Fire Atlas [4] (Figure 2). The vegetation products are the result of the development and global extension of the algorithm for estimating LAI, f_{APAR} and vegetation phenology in Canada [5,6] (Figure 3). GLOBCARBON is currently delivering estimates of LAI, f_{APAR}, vegetation growth cycle and burned area for the period 1998–2007.

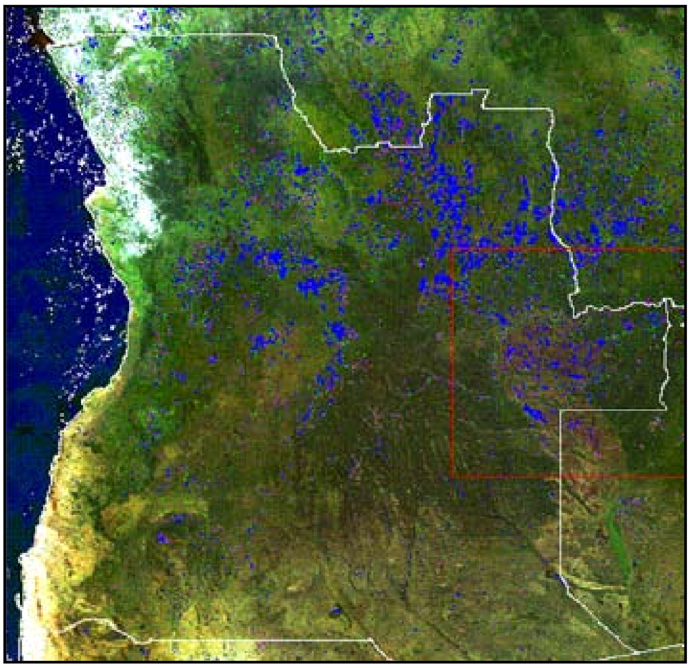


Figure 2: Probability of detection of burned area in Angola, August 1998. Blue represents 90–100%, green 75–90% and pink 65–75%.

Where Next

GLOBCARBON represents the sentinel in the IGBP-ESA initiative and has provided a template for the development of other 'GLOB' projects. While the other 'GLOB' projects have been loosely connected with parts of the global change research programmes, these links should be strengthened in a coordinated fashion. In addition, a major issue with Earth observation data and derived data products is their subsequent use. In GLOBCARBON the emphasis has been on development of data products specifically for the dynamic global vegetation and atmospheric chemistry modelling communities.

The amalgamation of data products can follow a variety of paths, but increasingly the emphasis is on data assimilation. ESA is fully aware of these developments having organised data assimilation summer schools and is familiar with the Data Model Fusion activity of the Global Carbon Project (which it partly funds).

The IGBP-ESA initiative is also active at the interfaces between ESA and other space agencies, IGOS-P and the Global Carbon Project. For example, the initiative organised the first implementation team meeting for the IGCO theme. One of the principal outcomes of this meeting was the suggested development of a Coordinated Enhanced Observing Period (CEOP) – a period of dedicated measurements of all aspects of the carbon cycle in support of the launch (in late 2008) of the first satellites dedicated to the measurement of atmospheric carbon dioxide.

Together with GCP, IGCO and other space agencies (JAXA, NASA), the IGBP-ESA initiative organised a conference at ESRIN (June, 2005) on the measurement of carbon gases in the atmosphere and the consequent attribution of terrestrial carbon sources and sinks [7]. Currently, ESA is organising a symposium on the Global Environment and Conventions (to be held in October, 2006) where it will seek to broaden the collaborations under DUE, and formulate its satellite and application development strategy more coherently and effectively. This requires an active interface with the four international global change research programmes (DIVERSITAS, IGBP, IHDP and WCRP) and with international convention representatives.

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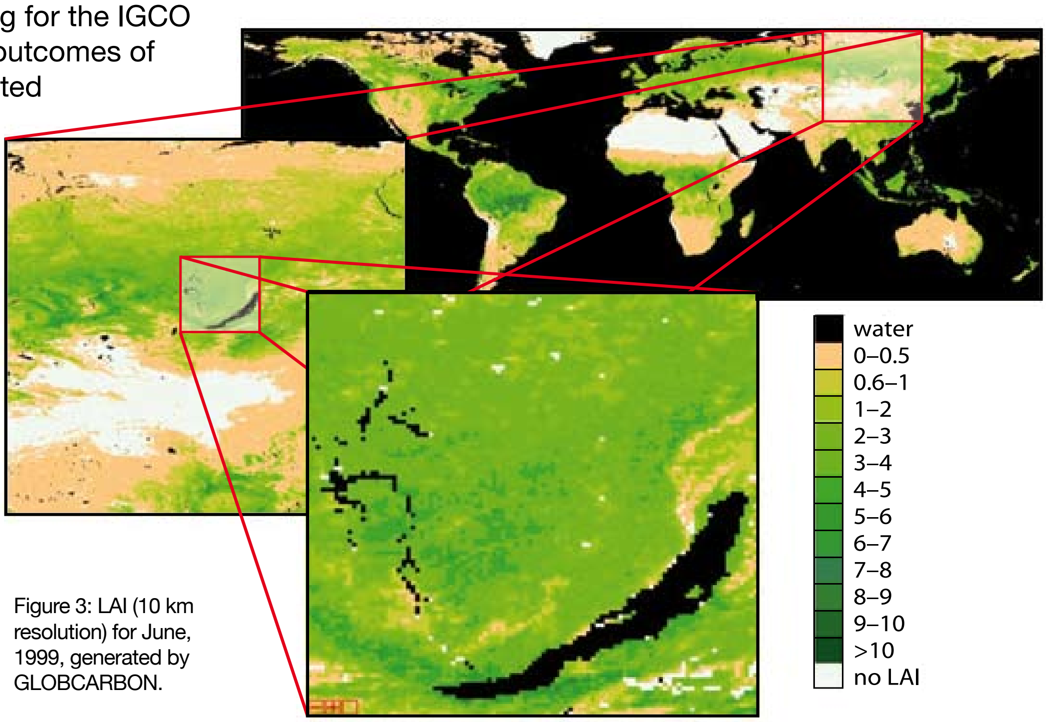

Figure 3: LAI (10 km resolution) for June, 1999, generated by GLOBCARBON.

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Humanity is facing an increasing number of global-scale problems including climate change, resource depletion, terrorism, intractable poverty and possible pandemics. As these problems become more evident, there are increasing calls for a change in how we manage our affairs and our relationship with the environment – the move towards sustainability. At the same time, there are scenarios projecting the collapse of the rapidly globalising world [for example, 1]. So where are we headed in the 21st century?

Sustainability or Collapse? – Society in the 21st Century

Human history has traditionally been cast in terms of the rise and fall of great civilisations, wars and specific human achievements. This history, however, leaves out the important environmental – including climatic – context which shaped and mediated these events (e.g. Figure 1 and [2]). However, answering the above question requires an understanding of the changing relationship between humans and their environment. The new IHOPE – Integrated History and Future of People on Earth – project seeks to provide this understanding.

The primary goal of IHOPE is to produce an integrated history of the Earth – of climate, atmospheric chemistry and composition, material and water cycles, ecosystem distribution, species extinctions, land use systems, human settlement patterns, technological changes, patterns of disease, patterns of language and institutions (including political and religious institutions), wars and alliances and other variables. These will be described using existing and several new data sources, which together will provide a far richer picture of the nature and reasons for past changes on Earth. An example of one style of approach to this problem at the regional scale is shown in Figure 2.

Figure 1. Ruins in Palenque, a city of the ancient Mayan civilisation of meso-America, the collapse of which is thought to have been partly due to prolonged droughts following abrupt climate change.

This integrated history will also provide a better basis for studies – from various perspectives – of Earth's history and its possible futures. It will be used as a core data set to test integrated models of humans in natural systems at multiple time and space scales, from regional to global.

The major objectives of IHOPE are to:

1. Map the integrated record of biophysical and human system change on Earth over the last 10,000 years, with higher spatial and temporal resolution for the last millennium and the last century.

2. Understand the connections and dynamics of human history by testing human-environment system models against the integrated history. For example, how well do models of the relationships between climate, agriculture, technology, disease, language, culture and war explain the historical patterns of human migration, settlement and population?

3. Project with greater confidence and skill, the options for the future of humanity, using models and understanding that have been tested against the integrated history and with the participation of all stakeholders.

IHOPE is developing a science plan that will articulate the research challenge, define the key research questions, outline the strategy for implementation and provide the framework for building an international IHOPE community.

The Research Challenge

To achieve the ambitious goals of IHOPE multiple research challenges must be met, for example, integrating the different perspectives, theories, tools and knowledge of many disciplines across the social and natural sciences and the humanities.

The need to understand why some societies succeed and others fail in the face of environmental challenges is a fundamental rationale for IHOPE – particularly the consideration of longer time scales. Now, the relationship between humans and their environment is more complex: we influence, and are influenced by the environment at all scales. The insight, data and models of environmental historians, archaeologists, ecologists and modellers within IHOPE will allow alternative hypotheses and explanatory frameworks to be tested, and allow Earth System models containing hypotheses on human-environment interactions to be calibrated and tested.

IHOPE research will be organised around three key research questions:

- How can we use integrated knowledge of past and present human perceptions of, and behaviour in, the environment, for understanding the future?
- What are the complex reasons for the emergence, sustainability or collapse of coupled human-environment systems?
- How do we evaluate alternative explanatory frameworks (including complex systems models) against observations of highly variable quality and coverage?

IHOPE research will be guided by the following operational principles:

- Research will span multiple time and space scales, and will consider the role of scaling in determining human-environmental interactions.
- Causality may be problematic, hence the use of concepts from complex system theory (linear and nonlinear dynamics, feedbacks, thresholds, emergence, historical contingency and path dependence) will be encouraged.

The Dahlem Workshop

The first significant progress in IHOPE research occurred at a Dahlem Workshop in Berlin, June 2005. An interdisciplinary group of 42 scholars spanning the natural and social sciences assembled to identify mechanisms and develop generalisations of how humans have responded to and impacted their environment on millennial, centennial and decadal scales. The future of the human-environment system was also considered. During the workshop scholars formed four working groups, one for each of the above three time scales and one for the future, and explored the rich range of human-environment interactions, in particular the responses of societies to environmental stresses.

The workshop concluded that human societies respond to environmental signals through multiple pathways, including collapse or failure, migration and creative invention through discovery. Extreme drought, for instance, has probably triggered both social collapse and ingenious water management. Results from the IHOPE Dahlem Workshop will be published [4].

Asian Island Sustainability Workshop

In October 2005, following the IHOPE Dahlem Workshop, the Japanese Ministry of Environment and Technology sponsored an international symposium through the Environment, Economies, Civilization and Global Change Program on sustainability of islands and resource-recycling societies in Japan. The symposium discussed sustainability and failure of past and present Mayan, Monsoon Asia, Pacific Island and Atlantic Island civilisations, as well as models for sustainability and technologies for future resource recycling.

A concept discussed at the symposium is the ethos of a civilisation, which is deeply rooted in its people. The characteristics of this ethos are critical in determining how a civilisation interacts with the environment. For example, the strong resource-exploiting and nature-dominating ethos of modern civilisation is the fundamental driver of contemporary global change. The symposium was a precursor to a larger, Asian IHOPE conference to be held in Japan, November 2006.

Next Steps in Implementation

The highly interdisciplinary nature of IHOPE means that significant implementation challenges are yet

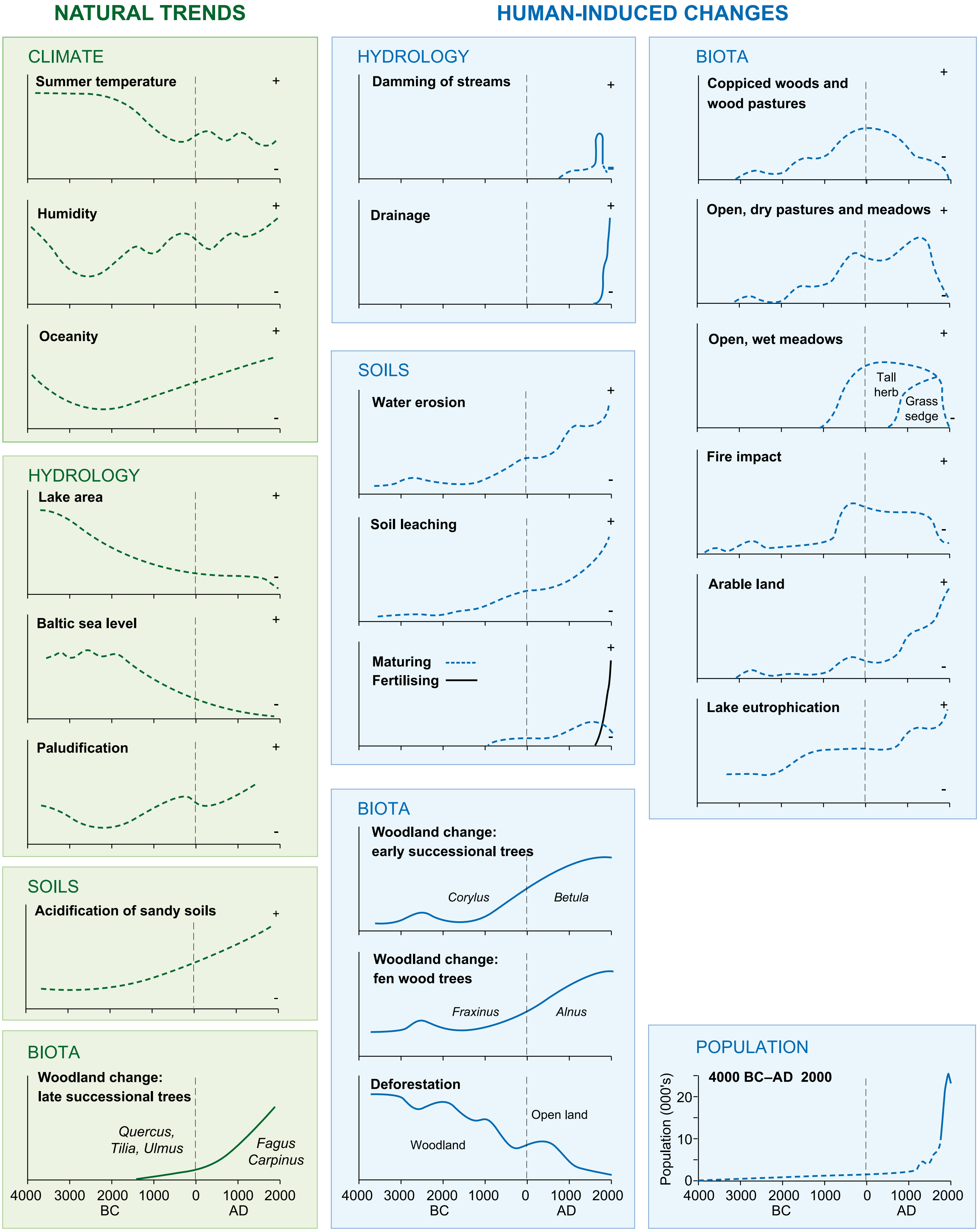

Figure 2. Trajectories of human actions and environmental conditions over the past 6,000 years for southern Sweden. Reproduced from [3] with permission from Blackwell Publishing.

to be overcome. For example, the scholars who will contribute to IHOPE have different perspectives, worldviews and language. Development of mechanisms to harmonise these different perspectives and to interconnect different worldviews is required.

IHOPE must integrate and synthesise data from a huge range of sources of highly variable quality. Ways to communicate the full range of data quality are required: from statistically quantified estimates to informed guesses, and from historical narratives to computer simulations. Discipline-specific approaches to analysis, synthesis and modelling need to be compared, by cross-checking and testing hypotheses and explanations using multiple lines of evidence based on a complementary suite of models and observations.

Short- and long-term strategies and activities have been identified to meet these implementation challenges. The short-term strategies are:

1. Authentic engagement with a range of communities. IHOPE requires multi-disciplinary, interdisciplinary and transdisciplinary efforts. A consultative approach will be taken to bridging and connecting the necessary range of research cultures, biases, jargons and methodologies.

2. Integrated human-environment timelines. Carefully selected chronologies of continental-scale indicators of human population, human activities and environmental variation will be assembled. These will reveal synchrony, or lack thereof, thus helping to improve questions and refine hypotheses of human-environment interactions.

3. Spatially explicit global databases. Global databases of human activities will be required. While complete global coverage of human activities such as land use or emissions is not immediately feasible, in the short-term, global databases of available historic observations will enable regional and global analyses and hindcasting.

4. Integrated history case studies. Integrated histories for specific regions, where much anthropological, historical and environmental information has already been collected, will be the first comprehensive IHOPE studies. Planned initial case studies include Australia, Meso-America, China, India, the Mediterranean and Southwest USA.

IHOPE will require contributions from thousands of scholars around the world, and a networking approach is therefore essential. The growing number of interdisciplinary research centres around the world will provide an infrastructural underpinning, particularly for cross-discipline integration

IHOPE in the Global Change Research Community

AIMES, which seeks to not only improve global modelling of biogeochemistry and biophysical processes, but to also incorporate human processes in Earth System models, is appropriately the programmatic host for IHOPE. However, IHOPE intersects the goals of many global change projects and programmes, and IHOPE will work to maximise its synergies across the ESSP community. Particularly strong linkages are envisioned with PAGES and GLP, and with many activities within IHDP. IHOPE will also connect to important activities being undertaken by other research communities, including activities in environmental history, archaeology and others. The latest information about IHOPE is available at the project website: www.aimes.ucar.edu/activities/ihope.shtml.

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New Roles and Faces

GLP Co-Chairs

In mid-2005 the SC-IGBP and SC-IHDP appointed Dennis Ojima and Richard Aspinall as Co-Chairs of the joint IGBP-IHDP Global Land Project (GLP), for a term that will last until the first meeting of the full SSC – an event scheduled for February 2006.

Dennis is Interim Director/ Senior Research Scientist in the Rangeland Ecosystem Science Department, Colorado State University. He has been active in IGBP for many years, especially with the now-complete LUCC. Dennis has developed international networks related to land use/cover change, trace gas fluxes and ecosystem changes. His research activities address ecological issues related to global and regional land use and climate changes on ecosystem dynamics, the interaction between terrestrial ecosystems and the atmosphere, the impact of changes in land management on trace gas exchange and the development of a global ecosystem model. He has conducted research in the US, the Mongolian steppe and Kazakhstan.

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Richard is Chair of the Department of Geography at Arizona State University. Previous positions include Director of the Geography and Regional Science Program of the US National Science Foundation, Professor of Geography in the Department of Earth Sciences and Director of the Geographic Information and Analysis Center at Montana State University. His research focuses on methodologies for environmental modelling and spatial analysis. He is well known for his work on using GIS and remotely sensed data in the analysis of environmental issues. Richard is incoming Editor of the Environmental Sciences section of the Annals of the Association of American Geographers and Editor of the new Journal of Land Use Science.

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New IPO Staff

Two new senior staff have joined our International Project Offices (IPO): Sophie Beauvais has been appointed as the Deputy Executive Officer of IMBER (IPO at the European Institute for Marine Studies, Brest, France), and Emily Brévière has been appointed as Project Officer for SOLAS (IPO at the School of Environmental Sciences, University of East Anglia, Norwich). We welcome them both to the IGBP community.

Sophie has a PhD from Paris VI University (Laboratoire d'Océanographie de Villefranche), based on investigations of the role of transparent exopolymeric particles (TEP) in different marine ecosystems. Her research improved the understanding of how this pool of organic matter becomes integrated into the microbial trophic web, and evaluated its potential contribution to ocean carbon cycling. Subsequently, Sophie undertook postdoctoral research at the University of Quebec (Montreal) on the dynamics and functional role of TEP in lakes based on a large-scale comparative study. Her expertise focuses on biogeochemical and physical processes controlling the phytoplanktonic extracellular production, and how to integrate this pool of organic matter into aquatic carbon budgets.

E-mail: sophie.beauvais@univ-brest.fr

Born in Provence, Emily obtained her engineering diploma in chemistry and chemical engineering from the more northern Ecole Nationale Supérieure de Chimie in Mulhouse. Subsequently she pursued oceanographic sciences, and in 2005 obtained her PhD from the Université Pierre et Marie Curie (Paris), for research on the temporal variability of air-sea carbon dioxide fluxes in the Southern Ocean. Her picture – and that of the Adelie Penguin – comes from Adelie Land near Dumont d'Urville (the French Antarctic base).

Email: e.breviere@uae.ac.uk

In the *Profile of a Scientist* section we aim to feature "early-career" scientists who making important contributions to Earth System science and to IGBP. We strive to achieve gender, discipline and developed/developing country balances in this section. The Editor welcomes suggestions from readers for scientists to profile in the Global Change NewsLetter.

Profile of a Scientist: Salvador Lluch-Cota

Salvador is a fisheries oceanographer working in the Fisheries Ecology Program at the Northwest Biological Research Centre, Mexico. He proudly lays claim to being the first Doctor of Science whose entire education has been undertaken in Baja California Sur – Mexico's newest state – where he grew up and still resides. Salvador received his undergraduate degree in marine biology from the Autonomous University of Baja California Sur, his Master's degree from the Interdisciplinary Centre for Marine Sciences and his doctorate from the Northwest Biological Research Centre.

Because he always admired his father and brother – both fisheries oceanographers – and their colleagues, Salvador was exposed to oceanographic research throughout his childhood: "I grew up listening to discussions of fluctuations in fish populations, climate change, El Niño and so on." During his Master's programme, Salvador undertook analyses of satellite data under the guidance of Saul Alvarez-Borrego, and interacted with the Climate and Fisheries group at the Northwest Biological Research Centre where he has worked for the last ten years. For his doctorate, he insisted that Andrew Bakun be his advisor: "convincing him to supervise me was one of the hardest tasks at that time, as then he was a FAO scientist and extremely reluctant to take on students."

In the 1990s, Salvador co-authored an FAO circular on linkages between fluctuations in small pelagic fish populations and low frequency climate variations, a topic he still researches. "Because this scale of variability controls, or underlies, large ecological changes, we must understand it and incorporate it into decision-making as soon as possible" he says: "we cannot afford to ignore this variability any longer – we are rapidly running out of time." Optimistically, he states that, "this is a problem that has been studied for several years by scientists in highly regarded organisations – such as SCOR, IGBP, GLOBEC and PICES–so I expect to see important results in the next few years. I believe we are making great progress in recognising and understanding low-frequency variability, and I'm confident I'll be alive to see this knowledge incorporated into fisheries management."

Part of Salvador's current research involves linking atmospheric and ocean dynamics to ecological models, in order to study scenarios of climate change in the Gulf of California, and to develop adaptation strategies for marine fishing and tourism. Salvador is deeply committed to coastal fisheries research, especially the coupling of marine ecological models to socio-economic models of local fisheries. In his work he is constantly exposed to, and interacting with, physical oceanographers, climatologists, ecologists, sociologists, anthropologists and economists, as well as the managers, fishermen and others in the local fishing industry.

Salvador combines his research with teaching, participating in working groups, and an amateur musical career: "I'm glad I am paid for my technical and scientific work, because I'm a dreadful musician and could never make a living from music."

IGBP and Related Global Change Meetings

A more extensive meetings list is held on the IGBP web site at www.igbp.net.

4th World Water Forum

16–22 March, Mexico City, Mexico

Contact: www.worldwaterforum4.org.mx

1st Lusophone Earth System Science Conference

22–23 March, Lisbon, Portugal

Contact: igbp-portugal.org or secretariado@igbp-portugal.org

Dissertations Initiative for the Advancement of Climate-Change Research Symposium

26 March–02 April, California, United States

Contact: aslo.org/phd.html or disccrs@whitman.edu

Workshop on Tropical Cyclones and Climate

27–29 March, Palisades, NY, United States

Contact: iri.columbia.edu/outreach/meeting/TropicalCyclones/index.html

EGU General Assembly

02–07 April, Vienna, Austria

Contact: hmeetings.copernicus.org/egu2006

International Symposium on Groundwater Resources Assessment Under the Pressures of Humanity and Climate Change

03–04 April, Kyoto, Japan

Contact: www.gwsp.org/Upcoming_events.html#gwsp

PICES-GLOBEC Symposium: Climate variability and ecosystem impacts on the North Pacific: a basin-scale synthesis

19–21 April, Honolulu, United States

Contact: www.pices.int/meetings/international_symposia/Honolulu2006 or secretariat@PICES.int

17th Global Warming International Conference and Expo

20–21 April, Miami, United States

Contact: gw17@globalwarming.net

8th International Conference on Southern Hemisphere Meteorology and Oceanography

24–28 April, Foz de Iguacu, Parana State, Brazil

Contact: www.cptec.inpe.br/SH_Conference

Open LUCIFS Workshop

12–14 May, Frankfurt-Geisenheim, Germany

Contact: web.uni-frankfurt.de/fb11/ipg/lucifs/2006

A Future with Zero CO_2 Emissions

15–17 May, Stockholm, Sweden

Contact: www.iclei-europe.org/index.php?id=1734

Assessment of Climate Change for the Baltic Sea Basin

22–23 May, Gothenberg, Sweden

Contact: dvsun3.gkss.de/bacc

AGU/GS/MB/MSA/SEG Joint Assembly

23–26 May, Marlyand, United States

Contact: www.agu.org/meetings/ja06

Climate Changes and their Impact on Boreal and Temperate Forests

05–07 June, Ekaterinburg, Russia

Contact: ecoinf.uran.ru/conference

20 Years of Nonlinear Dynamics in Geosciences

11–20 June, Rhodes, Greece

Contact: www.aegeanconferences.org

HOLIVAR Open Science Meeting

12–15 June, London, United Kingdom

Contact: www.holivar2006.org

6th International Symposium on Advanced Environmental Monitoring

27–30 June, Heidelberg, Germany

Contact: ademrc.gist.ac.kr or sympo@ademrc.gist.ac.kr

EcoMod 2006

28–30 June, Hong Kong, China

Contact: www.ecomod.net

International Geographical Union Conference

03–07 July, Brisbane, Australia

Contact: www.igu2006.org

Asia Oceania Geosciences Society

10–14 July, Singapore

Contact: www.asiaoceania-conference.org

Euroscience Open Forum 2006

15–17 July, Munich, Germany

Contact: www.esof2006.org

WMO Climate Risk Conference

17–21 July, Espoo, Finland

Contact: www.livingwithclimate.fi

3rd ENVISAT Summer School on Earth System Monitoring and Modelling

31 July–11 August, Frascati, Italy

Contact: envisat.esa.int/envschool

Summer School: Monitoring of Natural Hazards from Space

25 July–03 August, Alpbach/Tyrol, Austria

Contact: michaela.gitsch@ffg.at

International Conference on Regional Carbon Budgets

16–18 August, Beijing, China

Contact: www.icrcb.org.cn

5th International NCCR Climate Summer School

27 August–01 September, Grindelwald, Switzerland

Contact: www.nccr-climate.unibe.ch

Carbon Management at Urban & Regional Levels

04–08 September, Mexico City, Mexico

Contact: www.gcp-urcm.org or gcp-urcm@nies.go.jp

Joint IGAC/CACGP/WMO Symposium: Atmospheric Chemistry at the Interfaces

17–23 September, Cape Town, South Africa

Contact: www.atmosphericinterfaces2006.co.za

Biohydrology 2006

20–22 September, Prague, Czech Republic

Contact: www.ih.savba.sk/biohydrology2006 or lichner@uh.savba.sk

Workshop on Sustained Indian Ocean Biogeochemical and Ecological Research

03–06 October, Goa, India

Contact: www.ian.umces.edu/siber

Lysimeters for Global Change Research

04–06 October, Neuherberg-Munich, Germany

Contact: www.gsf.de/lysimeter-workshop

57th International Astronautical Congress: Session B.1.6 Global Earth Observation Initiatives

05 October, Valencia, Spain

Contact: www.iafastro.com

Water, Ecosystems and Sustainable Development in Arid and Semi-arid Zones

09–15 October, Urumqi, China

Contact: www.ephe.sorbonne.fr/watarid/watarid_en.htm

Rapid Climate Change International Science Conference

24–27 October 2006, Birmingham, United Kingdom

Contact: rapid.nerc.ac.uk/rapid2006

2nd International Young Scientists' Global Change Conference

07–08 November, Beijing, China

Contact: ysc@agu.org

ESSP Open Science Conference

09–12 November, Bejing, China

Contact: www.essp.org/essp/ESSP2006

International Conference: the Humbolt Current System

27 November–01 December, Lima, Peru

Contact: www.uea.ac.uk/env/solas/meetings.html

IDGEC Synthesis Conference

06–09 December, Bali, Indonesia

Contact: fiesta.bren.ucsb.edu/~idgec/science/synthesis.html

2007

International Dialogue on Science and Practice in Sustainable Development

23–27 January, Chiang Mai, Thailand

Contact: www.sustdialogue.org

SOLAS Open Science Conference

06–09 March, Xiamen, China

Contact: www.uea.ac.uk/env/solas/meetings.html

17th International Union for Quaternary Research Congress

28 July–03 August, Cairns, Australia

Contact: INQUA2007@aqua.org.au

Earth Systems Feedbacks: Vulnerability of the Carbon Cycle to Droughts and Fire

06–09 August, Canberra, Australia

Contact: pep.canadell@csiro.au

PAGES 2nd Open Science Meeting

The PAGES 2nd Open Science Meeting (OSM) was held in Beijing, 10–12 August 2005, with over 370 scientists from 45 countries assembling to consider "Palaeoclimate, Environmental Sustainability and Our Future". The meeting addressed four key questions: (i) what is the pre-industrial historical context of present and future global change? (ii) how did land, ocean and ice interrelate during climate transitions? (iii) in the past, how did people interact with environment and climate? and (iv) what specific answers do Asian regional-scale studies provide?

Scientific highlights included excellent presentations by invited speakers and younger scientists. Young research talent was acknowledged by the selection of three posters for plenary presentation and prizes for five student posters. Other highlights included a remarkable harmony between modelling and reconstruction approaches, with several presentations directly comparing data and models. There was strong discipline convergence amongst studies of human aspects of past global change, with many papers including humans as a component of the Earth System.

The OSM culminated in a lively plenary discussion on the future of PAGES which generated suggestions for closer study of southern hemisphere changes and the palaeo water cycle, and a call for improved data synthesis and accessibility and greater communication of the importance of palaeoscience.

The OSM was a great community-building success, with attendance and integration of many early career scientists and many developing country scientists. This was supported by funding from START, APN, TWAS, the Indian Department of Science and Technology, the Chinese Academy of Sciences and the National Natural Science Foundation of China.

The OSM abstract book can be downloaded from www.pages-igbp.org/products, and an online poster exhibition can be accessed at www.pages2005.org/posters.html. A collection of the plenary lectures will be published in the new open-access EGU journal "Climate of the Past". Rather than waiting seven more years, PAGES is planning its 3rd OSM for 2009 in the United States.

PAGES PAST GLOBAL CHANGES

Pin Board

Note: Correspondence

The Pin Board is a place for short announcements and letters to the Editor. Announcements may range from major field campaigns, new websites, research centres, collaborative programmes, policy initiatives or political decisions of relevance to global change. Letters to the Editor should not exceed 200 words and should be accompanied by name and contact details.

WCRP Publication

WCRP has published a new brochure to mark the 25th Anniversary of the programme. The brochure summarises highlights of the enormous contributions WCRP has made to climate science in the last quarter of a century.

The brochure can be downloaded from www.wmo.ch/web/wcrp.

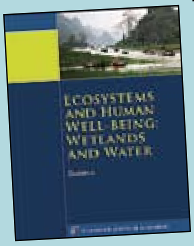
WCRP

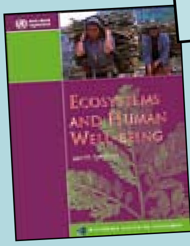
DIVERISTAS Publication

The Science Plan and Implementation Strategy of the DIVERSITAS Cross-Cutting Network agroBIODIVERSITY is now available at www.diversitas-international.org. For a hard copy email secretariat@diversitas-international.org. The Science Plan establishes the scientific basis for addressing the trade-offs between food production, biodiversity conservation, ecosystem services, and human well-being in agricultural landscapes.

DIVERSITAS

Millennium Ecosystem Assessment





The Millennium Ecosystem Assessment has released its final two Ecosystems and Human Well-being synthesis reports: the Health Synthesis (released on 9 December 2005 by the World Health Organization during the Scientific Conference on Asia Pacific Environmental Health in Thailand) and the Wetlands and Water Synthesis (released on 8 November 2005 at the Ramsar Convention on Wetlands 9th Conference of Parties in Uganda). The other four reports in the synthesis series are the overall Synthesis, the Biodiversity Synthesis, the Desertification Synthesis, and Opportunities and Challenges for Business and Industry. All reports can be downloaded or ordered at www.maweb.org.

IMBER IPO Opening

The IMBER IPO in Brest (France) was officially opened on 25 October, 2005, by Paul Tréguer – Director of the host institution Institut Universitaire Européen de la Mer and representative for IPO co-sponsor Centre National de la Recherche Scientifique – and Jean-Claude Bodéré the President of the Université de Bretagne Occidentale which also co-sponsors the IPO. The opening was attended by the IMBER SSC Executive and the project sponsors were represented by Wendy Broadgate (IGBP) and Ed Urban (SCOR). The IMBER IPO is now fully operational and is actively coordinating and promoting project activities.

The IPO staff – from left to right in the back row of the photograph taken at the opening – are Sophie Beauvais (Deputy Executive Officer, sophie.beauvais@univ-brest.fr), Sylvie Roy (Executive Officer, sylvie.roy@univ-brest.fr) and Elena Fily (Administrative Assistant, elena.fily@univ-brest.fr); in the front is IMBER SSC Chair Julie Hall.

IMBER

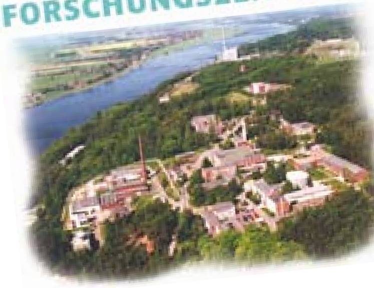
LOICZ IPO Moves to Germany

LOICZ

From 1 January 2006 the LOICZ IPO will be based at the Institute for Coastal Research at GKSS in Geesthacht, Germany.

LOICZ International Project Office
GKSS-Forschungszentrum
Institute for Coastal Research
Max-Planck-Straße 1
D-21502 Geesthacht
Germany
Phone: +49 4152 87-2009
Fax: +49 4152 87-2040
E-mail: loicz.ipo@loicz.org

GKSS FORSCHUNGSZENTRUM



New email addresses for the IPO staff are:

hartwig.kremer@loicz.org
martin.letissier@loicz.org
hester.whyte@loicz.org
maike.paul@loicz.org

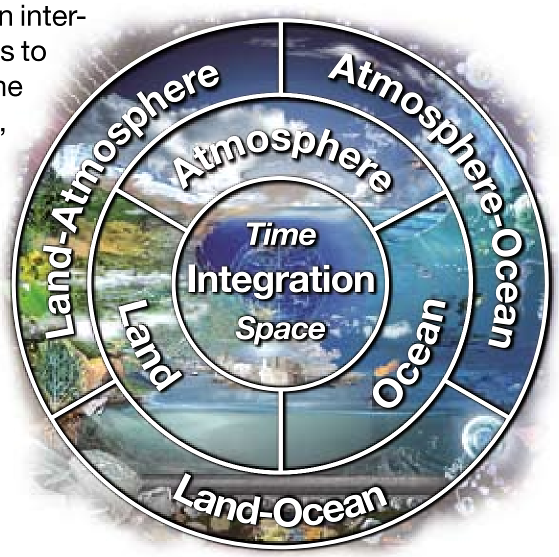
LOICZ and IGBP thank everyone at the Royal Netherlands Institute for Sea Research (NIOZ), the Dutch Science community and the Dutch funding agencies for their support and contributions to the LOICZ project over the last 13 years.

Lake Basin Management

The report "Managing Lakes and their Basins for Sustainable Use: A Report for Lake Managers and Stakeholders" was launched at the 11th World Lakes Conference in November in Kenya, and was distributed at the 9th Conference of Parties to the Ramsar Convention in Uganda the same month. The report is the main output of the GEF project "Towards a Lake Basin Management Initiative: Sharing Lessons and Experiences from GEF and non-GEF Lake Basin Management Projects". The report drew upon 28 "experience and lessons learned" briefs and 17 "thematic papers" that were commissioned by the project. Input to this work from the IGBP community included Eric Odada's (Director, Pan-African START Secretariat) contributions to four African lake lessons learned briefs, and thematic papers by Shem Wandiga (Kenyan IGBP Committee) on "Lake Basin Management Problems in Africa" and by Bill Young (IGBP Secretariat) on "Water Allocation and Environmental Flows in Lake Basin Management". The report can be accessed at www.ilec.or.jp/lbmi and the experience briefs and thematic papers at www.worldlakes.org.

The International Geosphere-Biosphere Programme

IGBP is an international scientific research programme built on interdisciplinarity, networking and integration. The vision of IGBP is to provide scientific knowledge to improve the sustainability of the living Earth. IGBP studies the interactions between biological, chemical and physical processes and human systems, and collaborates with other programmes to develop and impart the understanding necessary to respond to global change. IGBP research is organised around the compartments of the Earth System, the interfaces between these compartments, and integration across these compartments and through time.



IGBP helps to

- develop common international frameworks for collaborative research based on agreed agendas
- form research networks to tackle focused scientific questions and promote standard methods
- guide and facilitate construction of global databases
- undertake model inter-comparisons
- facilitate efficient resource allocation
- undertake analysis, synthesis and integration of broad Earth System themes

IGBP produces

- data, models, research tools
- refereed scientific literature, often as special journal editions, books, or overview and synthesis papers
- syntheses of new understanding on Earth System science and global sustainability
- policy-relevant information in easily accessible formats

Earth SystemScience

IGBP works in close collaboration with the International Human Dimensions Programme on Global Environmental Change (IHDP), the World Climate Research Programme (WCRP), and DIVERSITAS, an international programme of biodiversity science. These four international programmes have formed an Earth System Science Partnership. The International Council for Science (ICSU) is the common scientific sponsor of the four international global change programmes.

Participate

IGBP welcomes participation in its activities – especially programme or project open meetings (see meetings list on website). To find out more about IGBP and its research networks and integration activities, or to become involved, visit our website (www.igbp.net) or those of our projects, or contact an International Project Office or one of our 78 National Committees.

Contributions

The Global Change NewsLetter primarily publishes articles reporting science undertaken within the extensive IGBP network. However, articles reporting interesting and relevant science undertaken outside the network may also be published. Science Features should balance solid scientific content with appeal to a broad global change research and policy readership. Discussion Forum articles should stimulate debate and so may be more provocative. Articles should be between 800 and 1500 words in length, and be accompanied by two or three figures or photographs. Articles submitted for publication are reviewed before acceptance for publication. Items for the Pin Board may include letters to the Editor, short announcements such as new relevant web sites or collaborative ventures, and meeting or field campaign reports. Pin Board items should not exceed 250 words.

Photographs should be provided as tiff files; minimum of 300 dpi. Other images (graphs, diagrams, maps and logos) should be provided as vector-based .eps files to allow editorial improvements at the IGBP Secretariat. All figures should be original and unpublished, or be accompanied by written permission for re-use from the original publishers.

The Global Change NewsLetter is published quarterly – March, June, September and December. The deadline for contributions is two weeks before the start of the month of publication. Contributions should be emailed to the Editor.

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