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GLOBAL IGBP CHANGE

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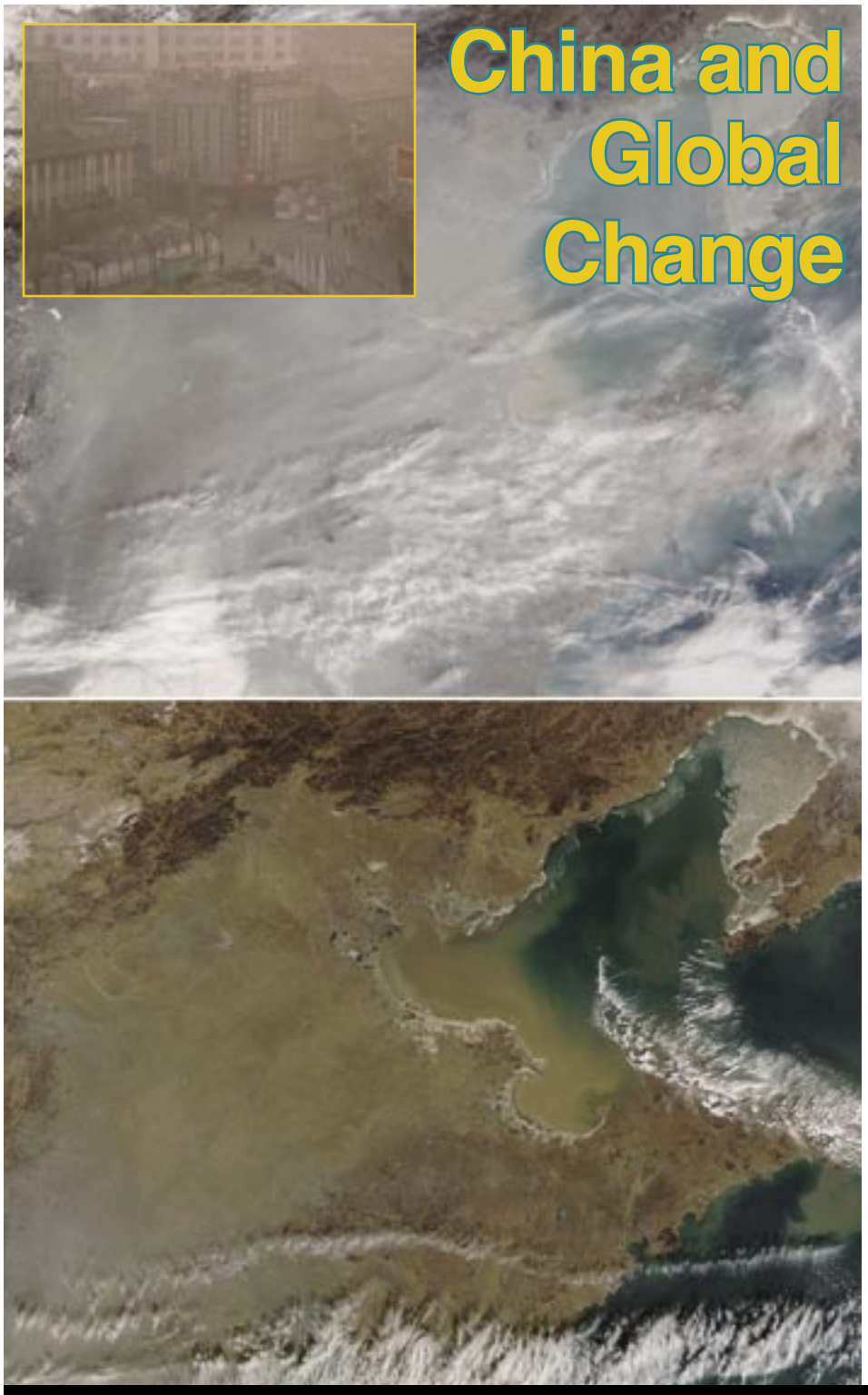
China and Global Change



The so-called Anthropocene is generally considered to have began in the mid-18th century with the start of the 80 year Industrial Revolution in Great Britain, which transformed a largely agricultural rural population into an urban society supported by industrial factories. This industrialisation spread across much of Europe and North America during the 19th century and through other nations such as Russia during the first half of the 20th century. This process is now transforming China, but on a scale far larger than 200 years ago and at a much faster rate.

The scale and pace of industrialisation and urbanisation in China is of course leading to rapid economic and social change, but is also having substantial environmental effects both regionally and globally. Water shortages, desertification, greenhouse gas emissions, particulate air pollution, and elevated sediment and nutrient fluxes to the coastal seas are but some of the side effects of the rapid growth. These and other changes are interacting with consequent climate and oceanic effects that are likely to reverberate throughout the Earth System.

In this issue of the Global Change Newsletter we present a series of articles highlighting aspects of current global environmental change research in China. These articles are based on presentations made at a workshop in Beijing, February 2005, on the occasion of the Annual Meeting of the SC-IGBP.

The images to the left from the Moderate Resolution Imaging Spectroradiometer (MODIS) on the NASA Terra satellite show an area of around 1,500 km x 1,500 km on China's eastern coastal plain which is surrounded by mountain ranges. This region of China is home to nearly 25 million people in Beijing and Tiajin alone, with a similar number in other major urban centres. The images from 12 February 2005 (top) and 2 February 2005 (bottom) contrast conditions when polluted air is trapped in the bowl-like topography with clear days when regional air pollution is advected into the North Atlantic by the wind. The sediment plume of the Yellow River is clearly visible in the lower image.

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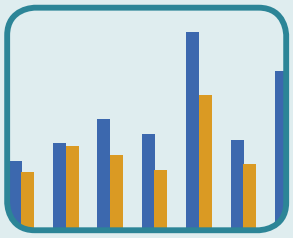

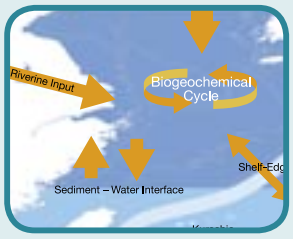

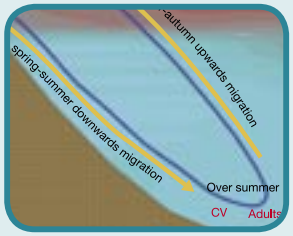

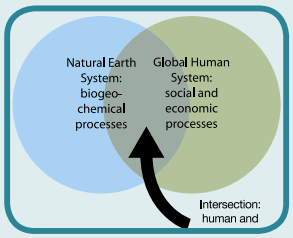

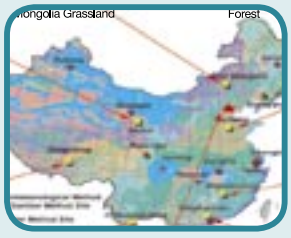

Guest Editorials

Monsoon Asia: Climate, Humans and the Environment

Monsoon Asia is a region characterised by change: civilisation here has a history of more than 5,000 years of change; in recent decades social, economic and environmental change in this region has been extremely rapid, and change will continue into the coming century. Currently, the region has the highest population density of any region in the world and is home to 57% of world's population. Human activities in the Monsoon Asia region have had, and will continue to have, significant environmental impacts, not only regionally but also globally. For example, rapid industrialisation and urbanisation in Asia are projected to lead to a doubling of greenhouse gas emissions in the next 20 years, and reach levels that exceed the combined emissions of OECD countries. Asian cities are the "dirtiest" in the world in terms of air quality, having double the global average pollutant levels. Growth in greenhouse gas emissions and aerosol loadings in the Asian region must therefore be carefully accounted for in global climate projections.

The Asian monsoon climate plays a crucial role in the social and economic development of the region, and is also the primary determinant of the regional landscape and ecosystems. The Asian monsoon climate is characterised by strongly seasonal wind directions and air flows, distinct wet and dry seasons and high variability at inter-annual and decadal time scales. Meteorologically speaking, the Asian monsoon is a result of the combined forcings of seasonal variations in solar radiation, seasonal variations in land-ocean thermal contrasts and the dynamic/thermal dynamic effects of the Tibetan Plateau. The high variability of the Asian monsoon climate leads to frequent climate-related disasters including floods, droughts and heat waves, which have major social, economic and environmental impacts.

But can the Asian monsoon climate be significantly altered by the human activities? Evidence indicates that increasing greenhouse gases concentrations in the atmosphere are increasing the amount and variability of summer monsoon rainfall in South Asia, weakening the winter monsoon over continental Asia and causing an early onset of the Indian summer monsoon. Anthropogenic aerosols and large scale human-induced land cover change have also been shown to be affecting the Asian monsoon climate. However, these preliminary studies do not quantify the extent and scale of Asian monsoon climate alteration caused by human activities.

A Monsoon Asia Integrated Regional Study (MAIRS) is being established to advance the understanding of these regional-scale changes, in particular to investigate the extent to which human activities can alter the Asian monsoon climate, and to determine how this changing climate will

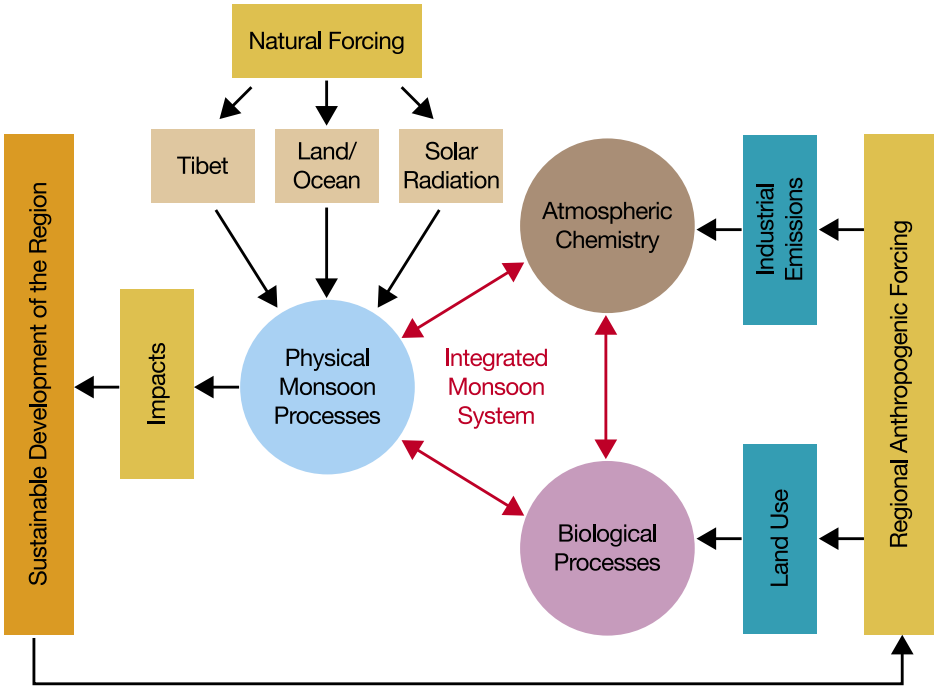

Figure 1. Conceptual model underpinning MAIRS

affect social and economic development in the Asian region. MAIRS will also study the extent to which humans can adapt regional climate change and achieve sustainable development via policy, legal and institutional change. The conceptual model that underpins MAIRS (Figure 1) adopts a coupled biogeochemical-social system approach, as is being increasingly widely used for Earth System science more generally. Chinese global environmental change research of the type reported on in this issue of the Global Change Newsletter, will contribute to MAIRS and to improved understanding of regional change, human-environment linkages and feedbacks, and options for sustainable development.

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China and the Challenge of Global Environmental Change

Global environmental change is now one of the biggest challenges facing humankind, and has captured the attention of scientists, policy makers and the wider public. As a developing country with rapid industrial and economic growth, China is experiencing widespread environmental pressure due to the escalating demands on its natural resources. Freshwater shortages, desertification, soil degradation and other environmental problems are becoming increasingly common. These issues are mostly related to human activities, especially industrialisation, and hence are likely to strongly affect social and economic sustainability in China. Importantly, these environmental issues are not only regionally but also globally significant. In recognition of this situation several global environmental change programmes and projects have been established in China, and are contributing to international global environmental change programmes of IGBP, WCRP, IHDP and DIVERSITAS. These include the East Asia Monsoon Study and the South China Sea Drilling programme.

In the face of global environmental change humankind is seeking to achieve sustainable development. Chinese scientists are making substantial contributions to the Chinese global environmental change research effort with more than 9,000 scientists from 42 institutions, financially supported (US$151.3 million from 1997–2003) primarily by the Chinese Academy of Sciences, the Chinese Ministry of Science and Technology, and the National Natural Scientific Foundation of China. The Chinese global environmental change programme is investigating important aspects of the interaction, between human society and the environment, such as the perturbations to the water cycle and water resources in China, changes to the carbon cycle in China, and palaeo-studies of the effects of environmental changes on Chinese civilisation. Many of these issues, their inter-relationships and feedbacks, are being considered in the Monsoon Asia Integrated Regional Study (MAIRS). Important global change research is also considering the environments of the Tibetan Plateau and the Loess Plateau in West China, which are not only of great interest from a natural science perspective, but also from a human society perspective.

The global change research effort in China has three major goals: (i) advancing the understanding of the mechanisms of global environmental change, (ii) providing advice to policy makers and environmental managers, and (iii) increasing public awareness of global environmental change. Chinese research mainly focuses on understanding the complex mechanisms of regional environmental change induced by human activities, including feedbacks and impacts. The new knowledge obtained from this research should help policy makers modify unsuitable environmental policies so as to achieve social and economic sustainability – a harmony between humankind and the environment. Recent investigations into "Environmental Questions of Exploitation in West China", "Water Resources", "Food Security" and "Human Health" have led to constructive policy advice to local and central governments. Additionally, at an international level China will endeavour to fulfill its obligations to implement the United Nations Framework Convention on Climate Change, the United Nations Convention to Combat Desertification and the Convention on Biological Diversity. To assist in meeting

these obligations recent global environmental change research priorities included: (i) potential public health crises associated with extreme climate change, (ii) issues of diplomatic negotiation on greenhouse gas reduction, and (iii) issues of economics and trade conflicts.

In comparison with developed countries public awareness in China of environmental management is low, suggesting Chinese scientists should not only study global environmental change, but also take the responsibility for helping to raise public awareness of conservation issues, global change advancing technologies and scientific research. If research programs obtain public recognition and support they are likely to maintain government funding, and thus ultimately achieve their goal of guiding sustainable development at the national, regional and global levels.

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Earth System Science Partnership Global Environmental Change Open Science Conference

Global Environmental Change: Regional Challenges

Beijing, China
9–12 November 2006

This Conference will present advances in our understanding of the natural and socio-economic aspects of global environmental change since the Amsterdam Conference, and will highlight the ESSP approach to study of the Earth System.

We invite scientists, policy makers, practitioners, scholars, private enterprise and journalists to participate in this conference and to submit abstracts. Prior to the main conference, the 2nd International Young Scientists Global Change Conference (7–8 November 2006) will provide an opportunity for selected young scientists to present and discuss their work.

Conference Themes

- **Advances in our understanding of the physical, biogeochemical, biodiversity, and human dimensions of global environmental change.**
- **Science in support of global sustainability with special sessions on global environmental change research as it relates to food, water, carbon and human health.**
- **Dynamics, interactions and feedbacks relating to natural and socio-economic systems at regional scales and how these interact with global-scale phenomena.**
- **Research concerning global environmental change in Monsoon Asia.**

Abstract submission will be available online in October 2005.

Earth System Science Partnership

DIVERSITAS GLOBAL CHANGE IGBP IHDP WCRP

www.essp.org/essp/ESSP2006/

Chinese Global Change Research: Progress and Prospects

P. Chen, Q. Ge and X. Zhang

Humankind currently faces significant global environmental problems including climate change, shortages of clean and accessible freshwater, ecosystem degradation, soil erosion and biodiversity loss. These problems all affect society and indeed are increasingly central to human affairs. Consequently, scientists around the world are researching the nature and severity of global environmental change (GEC) and the implications for our future.

China lies in the East Asian monsoon region and is undergoing a crucial period of very fast economic and population growth. As a result, anthropogenic environmental disturbance is considerable, providing many opportunities and challenges for Chinese GEC research. In this article the extent, scope and output of recent Chinese GEC research is assessed, and the prospects for the future are discussed.

Research Capacity

There are close to 9,300 GEC scientists in China, with around 85% based in scientific research departments and 15% based in universities. Research departments include those of the Chinese Association of Science and Technology, the Chinese Academy of Sciences (CAS), the Ministry of Science and Technology (MoST), the Ministry of Education, the Ministry of Agriculture (MoA), the National Natural Science Foundation of China (NSFC), the China Meteorological Administration (CMA) and the Chinese Environment Protection Agency (CEPA).

With generous support from these scientific departments, national committees for the GEC research programmes (IGBP, WCRP, IHDP, DIVERSITAS) have been established. These committees provide Chinese representatives to international GEC research activities, promote international exchange and cooperation, and organise and coordinate research and academic exchanges amongst relevant Chinese departments. In addition, 16 national academic societies and associations have made tremendous contributions to GEC research in China.

Recent investment in new research facilities has played an important role for GEC research in China, while GEC research has also greatly influenced how existing facilities are used. These research facilities include four components: (i) national and open laboratories equipped with modern instruments, (ii) a national spatial information system which provides data from space, (iii) ground-based observation networks, and (iv) computer databases.

In the last decade China has developed its network of national and open laboratories, and now has more than 40 key national and open laboratories closely related to GEC research. In recent years, China has developed a national spatial information system, which provides valuable data from space-based observations to support GEC research. Since the 1970s, China has successfully launched 17 returnable remote sensing satellites, five solar-earth synchronous-orbit meteorological satellites and two high-resolution Earth resource satellites. Additionally, ground-based receiving facilities have been developed with powerful data processing capabilities, and an air-based comprehensive Earth-observing platform has been established. Currently, more than five million multiple-period post-1950 aerial photos covering the entire country and half a million post-1970 satellite images are available.

There are five national observation networks. The first is the Chinese Ecosystem Research Network of CAS, with 36 field stations (representing different ecosystems), five research sub-centres and one synthesis centre. The other four networks are: (i) the Chinese Forest Ecosystem Research Network consisting of 15 stations run by the State Forestry Administration (SFA), (ii) the Oceanic Observing Network consisting of 14 stations run by the State Oceanic Administration (SOA), (iii) the National Meteorological Network con-

sisting of 640 stations run by the CMA, and (iv) the National Environmental Monitoring Network consisting of 120 stations under CEPA.

There are over 100 domestic databases available (30% from universities; 70% from the institutes under CAS, SOA, CMA, SFA and MoA), with data on population, energy sources, water resources, land-use, climate, forest, soil, vegetation and wetlands. In 1988 China joined the World Data Centre (WDC) of ICSU.

Research Activity

Since 1986, China has invested huge amounts of money in GEC research: incomplete statistics for 1997–2003 show expenditure of over US$151 million on 240 projects for researchers and project managers from over 50 research departments and universities (Figure 1). Funding allocation shows that the greatest investments were for research contributing to GLP (Figure 2). GEC research funding comes from national providers, with CAS (US$48.7 million), MoST (US$76.0 million) and NSFC (US$26.5 million) the three major providers.

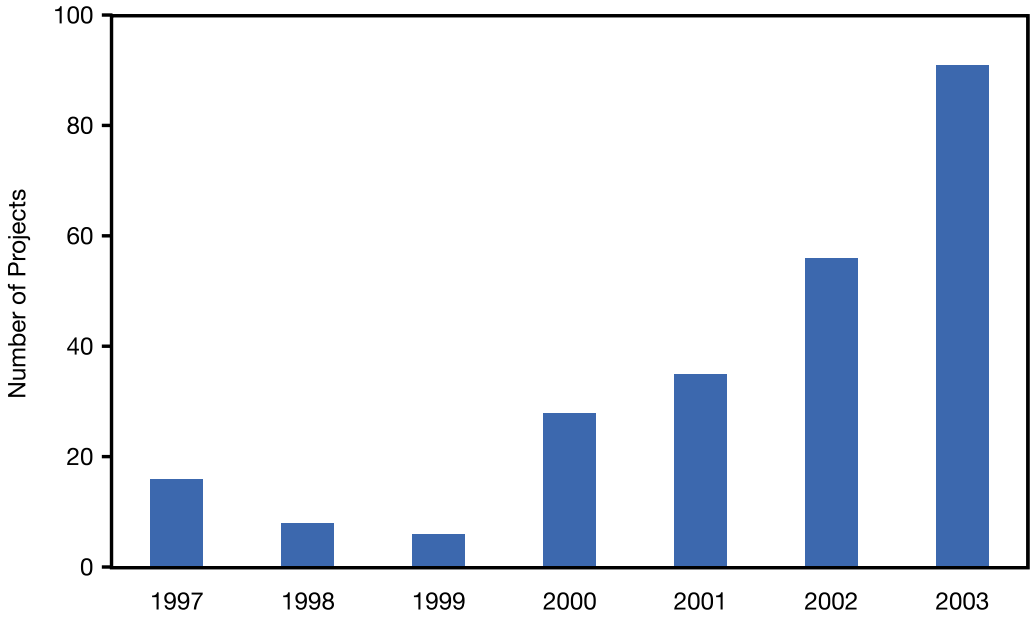

Figure 1. Number of global change research projects by year.

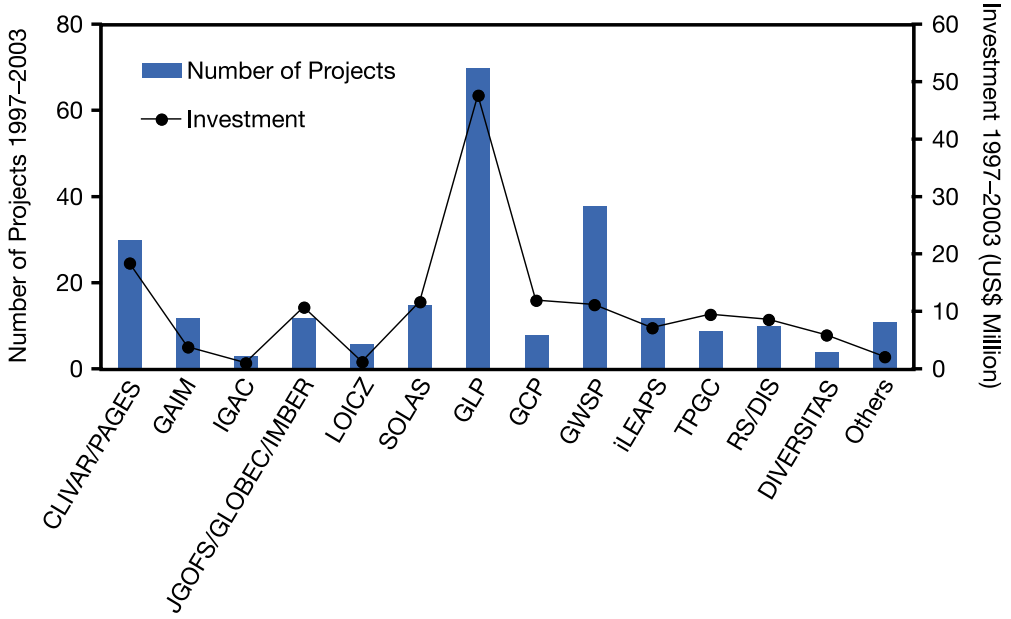

Figure 2. Number of global change research projects by IGBP/ESSP project and associated funding level.

Increasingly, Chinese GEC scientists are joining international organisations. For example, 26 Chinese scientists have served or are serving on committees of international GEC change programmes. China has participated in or is participating in 84% of the international GEC projects, and cooperates with 39 countries on GEC research, including via major partnerships with USA, Germany, France, UK, Netherlands, India, Japan, Brazil, Russia, Canada and Australia. The number of academic meetings held in China is continuously increasing, and across a widening range of disciplines. Over the last five years, the Chinese GEC research community has organised an average of seven international conferences related to GEC each year.

Major Achievements

Since 1997, Chinese scientists have published about 2,000 GEC research articles per year, covering most aspects of GEC. According to a literature index database (www.cqvip.com) 545 articles including the keywords "global change" were published by Chinese scientists in Chinese Journals between 1989–2004; for this period 378 articles have "global change" in the title (Figure 3).

Chinese scientists have translated international reports and books for Chinese GEC researchers, including a book series on international global change development [1–6] and the IGBP Science Series No.4 [7]. Five Chinese GEC reports have been published in English [8–12].

In the past five years, significant achievements have been made by Chinese scientists, across many GEC research fields. Major progress on past climate change includes: (i) climate series for the Loess Plateau (and mid-east China) from 2,500, 130 and 20 ka BP [13–21], (ii) high resolution time series of temperatures in China for the last 300, 1,000 and 2,000 years based on ice core data, tree-ring data and historical documents [22–38], and (iii) deep-sea stratigraphic sequences that have shed light on the evolution of the East Asian monsoon and on the evolution of the South China Sea [39–41]. Progress on contemporary climate dynamics has included: (i) development of the Monsoon Asia Integrated Regional Study (MAIRS), (ii) construction of a dynamic climate system model for East Asia, and (iii) discovery of a mechanism for some important climate abnormities which provided the scientific foundation for the UN Framework Convention on Climate Change [42–45].

In recent years several carbon cycle projects have been launched, including "Carbon Budget Research on the Terrestrial and Near-sea Ecosystems of China" and "Carbon Cycle and Driving Mechanisms Research on the Terrestrial Ecosystems of China". The "Chinese Terrestrial Ecosystem Flux Observational Research Network" (China FLUX) has also been established. Future carbon cycle research is expected to consider: (i) spatio-temporal carbon budget changes and their bio-geographical mechanisms in terrestrial and near-sea ecosystems, (ii) land-use and land-cover change impacts on carbon sequestration and cycling in terrestrial ecosystems over the last 300 years, and (iii) technologies for carbon sink promotion and emission reduction.

Hydrologic research has encompassed: (i) the quantity and the distribution of water resources in China [46–49], (ii) water-heat transmission and assimilation of CO_2 in the soil–plant–atmosphere system at site-scale [50–52], (iii) evolution and sustainability of water resources in the Yellow Basin [53–56], (iv) the complex mechanisms of drainage water-cycles in changing environments and water resource security [57–59], and (v) remote sensing parameters for quantitative inversion of land surface water/heat flux [60–64]. The history of spatial patterns of Chinese land-use and land-cover change since 1700 has been established [65], and land-use models for different regions are being developed – partly to study rapid urban expansion and economic growth.

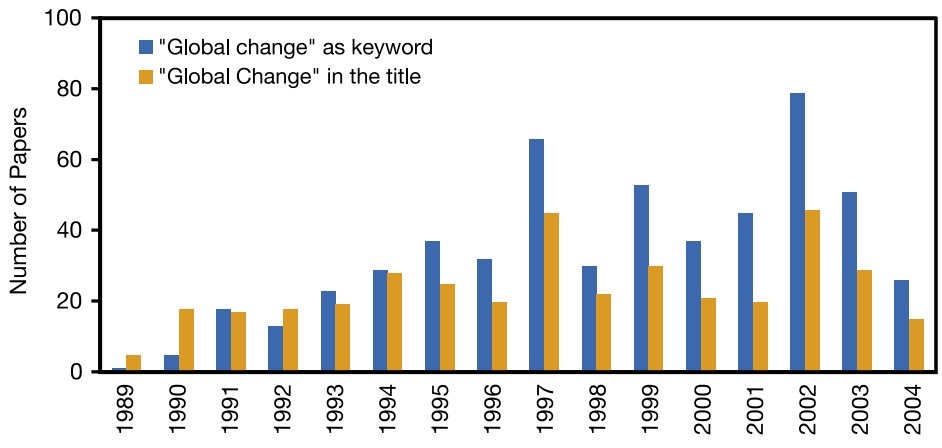

Figure 3. Numbers of global change research articles in Chinese publications by year.

China is significantly affected by GEC, with observations [66–70] showing that: (i) during past decades changes in temperature and precipitation have made (a) northern China warmer – pushing the rice belt northward, (b) southwest China cooler, (c) the climate of the northwest change from warm-dry to warm-wet – with droughts affecting the North China Plain, (ii) anomaly climate events have increased in the last 20 years, especially in the Yangtze Basin which has experienced increased flooding, and (iii) historical environmental changes have greatly influenced the evolution of Chinese civilisation [71].

Research Prospects

The future GEC research strategy in China will be based on: (i) promoting inter-disciplinary studies under ESSP, (ii) establishing in the near future a joint GEC committee from the Chinese IGBP, IHDP, WCRP and DIVERSITAS committees, (iii) engaging social scientists in GEC research, (iv) promoting public awareness of GEC, especially amongst policy makers and young people, and (v) strengthening regional and international cooperation.

Research priorities for the coming years include:

A. Water cycle issues: (i) water cycle variations due to human activities and environment factors, (ii) mechanisms of human impact on the water cycle, and (iii) responses and adaptation of the water cycle to GEC.

B. Carbon cycle issues: (i) terrestrial and marginal sea ecosystems, (ii) uncertainties in observations, processes, models, source reduction and sink promotion, and (iii) theory and synthesis studies. This work will be underpinned by development of an integrated framework including biogeochemical factors, biophysical factors and human dimensions, to provide synthesised information to the public.

C. Monsoon Asia Integrated Regional Study (MAIRS). An ESSP activity led by Chinese scientists, for which key issues include: (i) Asian environmental change by 2050, (ii) the regional impacts of these changes, and (iii) the global significance of these changes.

D. Land-use and cover change and terrestrial ecosystems: (i) cause, nature and impacts of land system change and (ii) integrated analysis and simulation of land sustainability.

E. Human activities and aerosols. Anthropogenic aerosols are rapidly increasing in China and may already have deeply influenced the climate and air quality. The source, distribution and impacts of aerosol including their climatic effects require serious research based and international cooperation.

F. Impacts and human adaptation. Integrated evaluation of GEC mitigation and adaptation options for East Asia is required, including consideration of the effects on China's development. Research on regional responses and adaptation is an emerging field [72], and promotion of adaptation is important both for developing the research on the impacts of global and regional change, and for guiding the responses of China to GEC [73–75].

G. Marginal seas and the coastal zone. Research on Chinese marginal seas and the land–ocean interface will include: (i) marine biogeochemical cycles, (ii) marine food webs and their interactions, and (iii) impacts from climate change and human activities.

H. Palaeo-environment changes and Chinese civilisation. Research will focus on: (i) historical environment changes in China, (ii) environmental impacts on Chinese society and the evolution of civilisation [71], and (iii) historical adaptation patterns.

I. Policy relevance. GEC science must support the development of national policies that underpin social well-being and guide diplomatic negotiations on greenhouse gas emission reductions and other global environmental issues.

J. Humans in the Earth System. An information platform for studying the interactions between human activities and the Earth System must be developed, including: (i) improved basic research facilities, (ii) an integrated observation system for natural and social factors, (iii) sharing of data between natural and social science disciplines, and (iv) numerical Earth System models that include human activities and decisions, and their impacts and feedbacks.

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GLOBEC-China: Nutrient Dynamics in the Yellow and East China Seas

J. Zhang

GLOBEC (Global Ocean Ecosystem Dynamics) research began in China in the 1990s with the "Ecosystem Dynamics of the Bohai" project funded by the Natural Science Foundation of China from 1996–2000 [1], and the "Ecosystem Dynamics and Sustainable Use of Living Resources in the Yellow Sea and East China Sea" project (GLOBEC-China II) funded by the Chinese Ministry of Science and Technology from 1999–2004. More recently, both the OCEANS Open Science Meeting (Paris, 2003) and the 228th Xiangshan Forum (Beijing, 2004) have helped to establish national-level links between GLOBEC and the new IMBER project of IGBP and SCOR. A specific focus of the GLOBEC-IMBER linkages in China will be a study of "Sustainable Ecosystem and Biogeochemistry in the Coastal Ocean" with the interactions between biogeochemistry and end-to-end food-web as its core. In this article, some of the chemical aspects of the GLOBEC-China investigation are described.

One of the four foci of GLOBEC-China II was "Cycling and Regeneration of Biogenic Elements", which can summarised as (Figure 1): (i) how do cross-boundary chemical transfers affect the ecosystems of the East China and Yellow seas, including via altered elemental cycling and nutrient budgets?; and (ii) to what extent do biogeochemical processes affect the carbon cycle and fisheries, for example, by altering food web structure, by changed nutrient limitation or by new and recycled production?

During GLOBEC-China II implementation, nutrient species were monitored in the lower reaches of the Yangtze River, and were investigated in the adjacent coastal waters to estimate the fluxes from land-based activities. Atmospheric dry and wet depositions were determined for nutrients and major components on the islands of the Yellow and East China seas, together with ship-board observations. Sediment-water interface nutrient fluxes were estimated both by *in situ* incubation and pore-water measurements, and the effects of shelf-Kuroshio Current interactions on nutrient transfers were evaluated by model simulations using field data. Nutrient dynamics in the Yellow and East China seas were studied using data from moorings and transects across the shelf, together with mesocosm

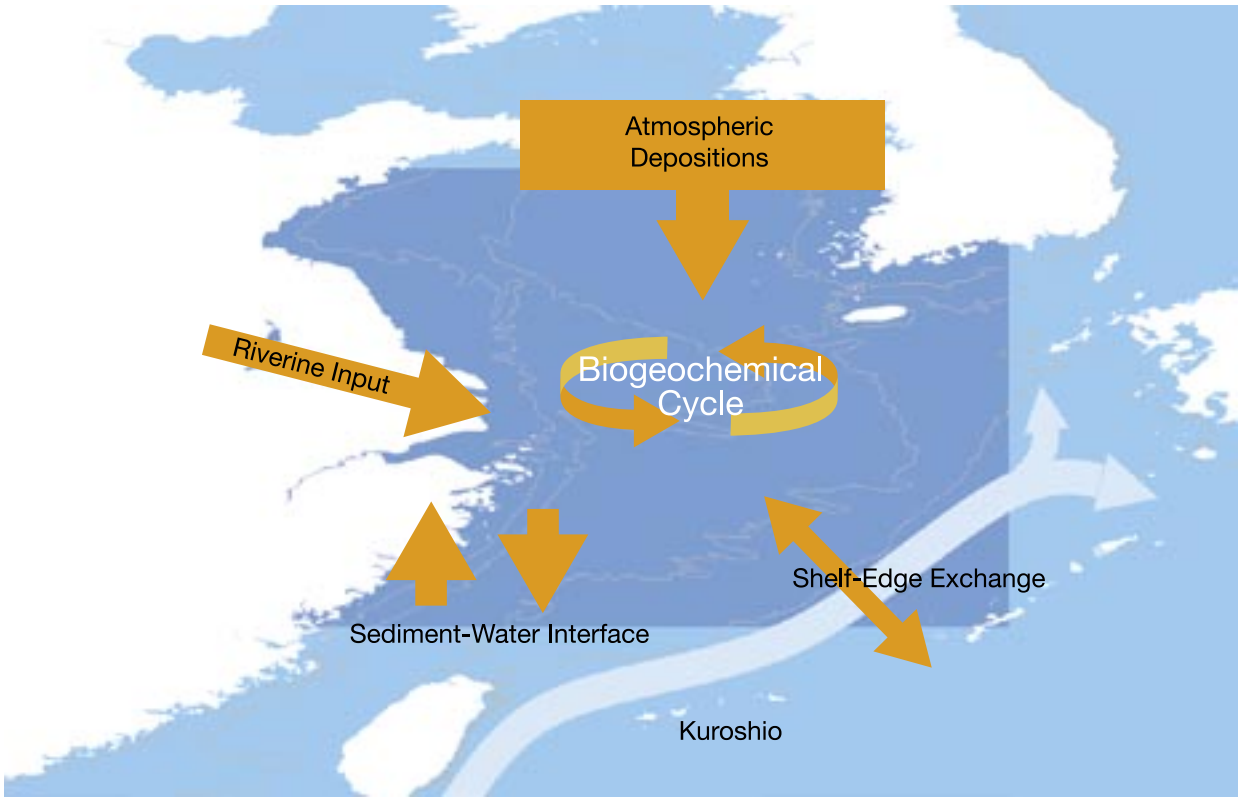

Figure 1. Biogeochemical aspects of GLOBEC-China II (1999–2004).

and tracer-spike experiments in various cruises during 1999–2004.

Sediment-water interface fluxes show the patchy nature of the Yellow and East China seas. For example, the sediment to water diffusion flux for dissolved silicate is 0.02–0.7 mmol m^{-2} d^{-1} outside the Yangtze Estuary, 1.8–2.6 mmol m^{-2} d^{-1} in the coastal upwelling and 0.4–1.9 mmol m^{-2} d^{-1} in the mid-shelf at water depths of 80–100 m, with considerable seasonal variations. Similarly, the water-soluble fraction of nutrients in aerosols demonstrate monthly variability in deposition flux, with ammonia exceeding nitrate and phosphate, which in turn exceeds dissolved silicate. Moreover, the concentrations of the water-soluble fraction of nutrients in aerosols from the Yellow Sea are 0.05–0.25 nmol m^{-3} for phosphate and dissolved silicate, and 10–80 nmol m^{-3} for ammonia and nitrate plus nitrite. In the East China Sea aerosol concentrations of water-soluble ammonia and nitrate plus nitrite can be double these values.

The concentrations of dissolved inorganic nitrogen have dramatically increased in the major rivers emptying into the Yellow and East China seas; notably the Yangtze River, which skews N:P ratios in the adjacent coastal waters with strong phosphorus-limitation of photosynthesis [2]. The dispersal of terrestrial particulate organic matter can be traced from the Yangtze Estuary over a distance of approximately 300–400 km across the East China Sea (Figure 2), with a strong nutrient gradient in surface waters from eutrophic coastal waters to oligotrophic open shelf waters where photosynthesis is nitrogen-limited [2]. Using the phosphorus isotopes ^{32}P (half-life 14.3 days) and ^{33}P (half-life 25.3 days) it is estimated that the phosphate assimilation rate decreases from 0.03 d^{-1} in the coastal area to 0.01 d^{-1} in the mid-shelf, with a water-column residence time increase from 34 days to 10–15 days. This induces a particulate organic carbon export of approximately 70 mmol m^{-2} d^{-1} from the Yangtze Estuary and 10 mmol m^{-2} d^{-1} from the mid-shelf [4].

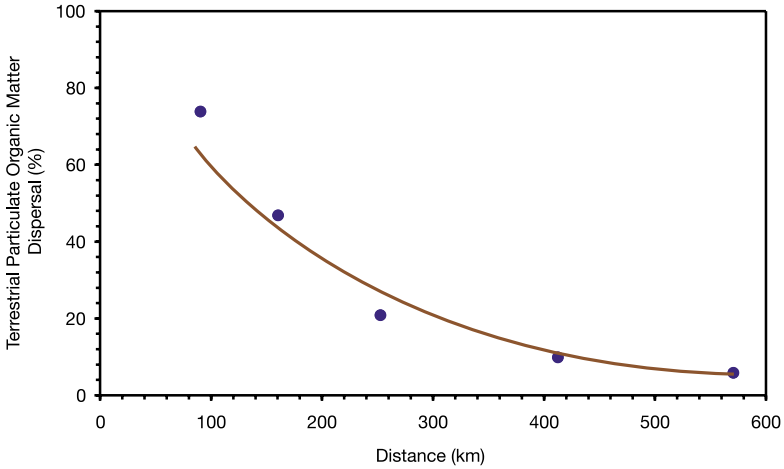

Figure 2. Dispersal of terrestrial particulate organic matter based on $\delta^{13}C$, $\delta^{15}N$ and particulate organic carbon/nitrogen data from the Yangtze River in the East China Sea along the PN Section from Changjiang to the East China Sea. [3]

GLOBEC-China II results also improve our knowledge of nutrient budgets for the rim of the Yellow and East China seas [5,6]. For example, the flux of dissolved inorganic nitrogen between the Yellow Sea and the East China Sea is 0.040–06 kmol s^{-1}. Atmospheric dry and wet deposition of dissolved inorganic nitrogen into the East China Sea is approximately 12 kmol s^{-1} in comparison to the sediment-water exchange of approximately 1.0 kmol s^{-1}.

The future collaborative work of GLOBEC and IMBER in China will investigate how biochemical aspects of the Yellow and East China seas – such as those described above – affect and interact with marine food-webs.

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Over-summering Strategy of *Calanus sinicus*

S. Sun and G.T Zhang

Calanus sinicus is an ecologically important copepod species found over shelf waters of the west North Pacific from Japan to Vietnam. It is the main food source of many commercially important fishes such as anchovy and mackerel. In the Bohai, Yellow and East China seas, it is the dominant zooplankton species accounting for 80% of the total zooplankton biomass. Calanus sinicus is the target species in the China-GLOBEC activity "Marine Ecosystem Dynamics and Sustainable Utilisation of Biological Resources in the Yellow Sea and the East China Sea". Intensive research has been conducted on the Calanus sinicus life cycle and population dynamics, especially on its over-summering strategy in the Yellow Sea [1,2].

The Yellow Sea is a marginal sea between China and Korea, with an average depth of 44 m. It is greatly affected by climatic and geographical conditions. Freshwater is input from the west, the Yellow Sea Warm Current and the Kuroshio Current invade from the south, and the Yellow Sea Cold Water Mass (YSCWM) exists in central areas in the summer for almost four months.

Low water temperatures and a strong thermocline are the main features of YSCWM, which becomes established from July and dissipates after November. During this period surface-water temperatures increase from 23˚C (July) to 27˚C (August), and then decrease again to 23˚C (September). Bottom-water temperatures remain constant at 9–12˚C throughout this period. A very strong thermocline is found above the YSCWM with a maximum temperature gradient of about 6˚C m^{-1}. Bottom-water temperatures outside the YSCWM are usually 16–20˚C, and surface-water temperatures are 26–28˚C. Vertical mixing in the south of the YSCWM most possibly results from the upward invasion of the Kuroshio Warm Current and tidal mixing in shallow coastal areas [2,3].

From 2001 to 2004 twelve cruises were conducted to investigate the life cycle and over-summer strategy of *Calanus sinicus* in the Yellow Sea. These cruises revealed that during March, the *Calanus sinicus* population begins to develop in the Yellow Sea coastal shallow water along the Shandong Peninsula and the Sudong Bank. April–May is a crisis period for *Calanus sinicus* reproduction, and the number of the female adults, their body size, and egg production and hatching rates all affect reproduction. In June peak abundance is attained [4]. During July, when surface-water temperatures exceed 23˚C in coastal areas, the *Calanus sinicus* distribution centre begins to move towards the deeper central part of the YSCWM. By August, *Calanus sinicus* are no longer present in the shallow coastal surface-waters where temperatures exceed 27˚C. The distribution centre is in the central part of the YSCWM, where water temperatures are low and food concentrations very low. Here, a special life strategy is adopted: diurnal vertical migration almost ceases – occurring only for a few female adults, and not beyond the thermocline. Most of the ani-

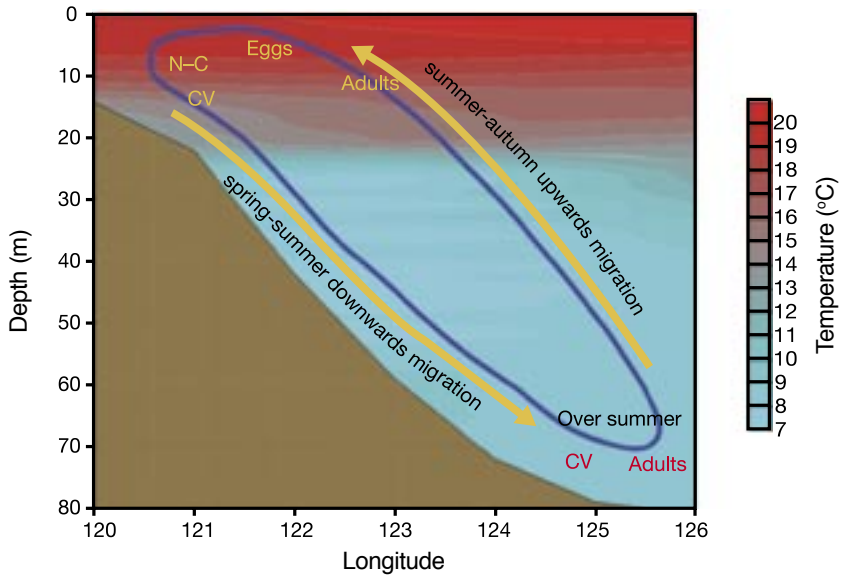

Figure 1. Annual migration cycle of Calanus sinicus in the YSCWM. The colour gradient indicates water temperatures in June when the thermocline forms.

mals are distributed above the bottom, and the fifth life stage copepodite (CV) is the dominant life stage in the population. *In situ* experiments demonstrate that the combination of the low temperatures and low food concentrations limit *Calanus sinicus* to the CV stage, inducing a diapause. The abundance of *Calanus sinicus* on the deep water side of the YSCWM is much higher than in the shallow coastal areas. At the marginal edge of the YSCWM diurnal vertical migration still occurs, and CV develop to adults and produce eggs; but mortality is high and egg production hatching rates low, because of low food supply and quality [2–5]. From September the distribution centre begins to move to the coastal areas (China side). In October and November the thermocline weakens, *Calanus sinicus* migrate to the coastal areas, and the current system transports them to other areas. The annual cycle is summarised in Figure 1.

Comparing the life histories of *Calanus sinicus* and *Calanus finmarchicus*, shows that both of pass though a diapause, and during this time, CV is the dominant life stage in the population [6]. The difference is that *Calanus finmarchicus* over-winter in the deep water, while *Calanus sinicus* over-summer in the deep water.

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Ecological Capital Assessment and Land Use Adjustment: the Path to Sustainability

S. Peijun, Y. Tao and C. Jing

The ultimate goal of global environment change studies is to understand the interactions of humans and their global environment so as to achieve sustainable development. There are two sayings in ancient Chinese philosophy which can assist in understanding sustainable development; the first saying considers “sky, earth, humans and harmony”, and the second considers “syncretising humans and nature”.

In the first of these sayings “sky” refers to the atmosphere and “earth” to the Earth surface – the land and oceans. “Sky” and “earth” constitute the space in which humans live, and humans are the most active players in this space influencing land-atmosphere, land-ocean and ocean-atmosphere interactions. “Harmony” is an ideal state in which all creatures on Earth live harmoniously; for humans there would be less conflict, both between the humans and the environment and amongst humans. Achieving this “harmony” requires understanding how humans affect the functioning of the Earth System.

The second saying expresses the need to “syncretise” (that is, to reconcile and unite) humans and nature. This recognises that humans are part of the environment and thus development is bound by natural laws; it suggests economic growth should be decoupled from the related environmental degradation while maintaining social cohesion. The saying thus implies that resource development and the environment must be dynamically balanced. On one hand human health and ecosystem health both improve (Figure 1) [1,2], while on the other

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Integrated Marine Biogeochemistry & Ecosystem Research

Science Plan and Implementation Strategy

IMBER (Integrated Marine Biogeochemistry and Ecosystem Research) is a new IGBP-SCOR project focussing on ocean biogeochemical cycles and ecosystems. IMBER will build on the successes of the now-complete JGOFS and the ongoing GLOBEC project. The IMBER vision is to provide a comprehensive understanding of, and accurate predictive capacity for, ocean responses to accelerating global change and the consequent effects on the Earth System and human society. The IMBER Science Plan and Implementation Strategy can now be ordered or downloaded from www.imber.info. Here, an overview of the scope of the IMBER science agenda is provided.

Human activities are rapidly altering Earth System processes that directly and indirectly influence society. Informed decisions require an understanding of which parts of the Earth System are most sensitive to change, and the nature and extent of anticipated impacts. This requirement underlies the IMBER goal: to investigate the sensitivity of marine biogeochemical cycles and ecosystems to global change, on time scales ranging from years to decades.

To achieve this IMBER will identify key interactions between marine biogeochemical cycles and ecosystems, and assess how these interactions respond to complex natural and anthropogenic forcings. Important forcings include large-scale climate variations, changing physical and biological dynamics, changing carbon cycle chemistry and nutrient fluxes, and widespread marine harvesting. The major drivers of change considered are physical dynamics, seawater CO_2 (controlling ocean pH), nutrients (with changing inputs to the euphotic zone from the subsurface waters, sediments and land), and intensive fish harvesting. This research will fill the critical gap between short-term climate events (seasonal scale) and anthropogenic global change (century scale). To address its goal IMBER is structuring its research around four themes as follows:

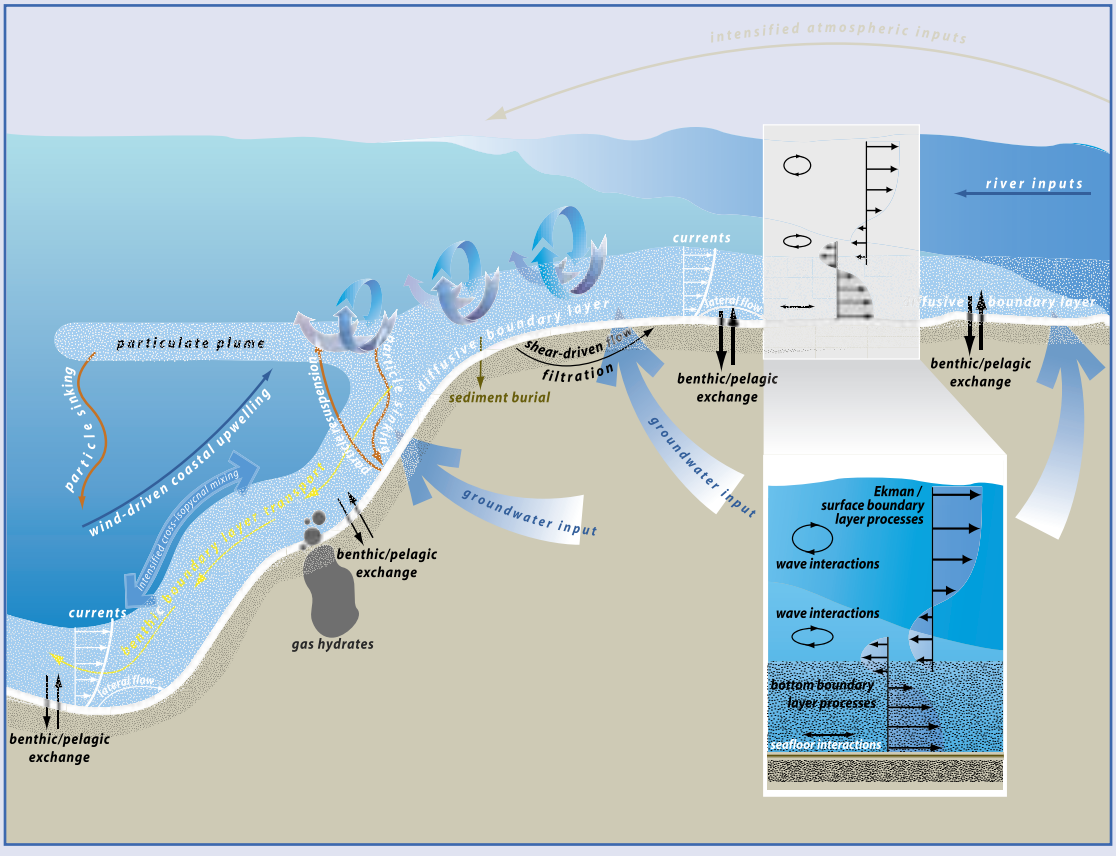

Figure 1. Depiction of processes that are unique to, or intensified at, ocean-continental boundaries. Many of these processes are sensitive to global change, with both local- and global-scale consequences for biogeochemical cycles and foods webs.

Theme 1: Interactions Between Biogeochemical Cycles and Marine Food Webs

Key issues: (i) the transformation of organic matter in food webs, (ii) transfers of matter across ocean interfaces, and (iii) material flows in end-to-end food webs. Interactions between biogeochemical cycles and food webs are expected to differ between environments such as continental margins associated with coastal upwelling (Fig.1), high latitude and polar regions, and tropical and subtropical oligotrophic gyres. Comparison of different systems will provide new insights for identifying and understanding fundamental interactions between marine biogeochemical cycles and ecosystems.

Theme 2: Sensitivity to Global Change

This theme will advance understanding of how marine biogeochemical cycles and ecosystems respond to the complex suite of forcings associated with global change. Identifying components that respond directly to global change is a primary concern. In this theme responses are partitioned into four major issues: (i) effects of climate-induced changes in the physical dynamics of the ocean, (ii) effects of increasing CO_2 levels and decreasing pH, (iii) effects of changes in macro- and micronutrient inputs to the ocean, and (iv) impacts of marine harvesting. For example, decadal climate modes and related teleconnections are likely to introduce signals into the ocean system, such as variations in heat content (Fig. 2).

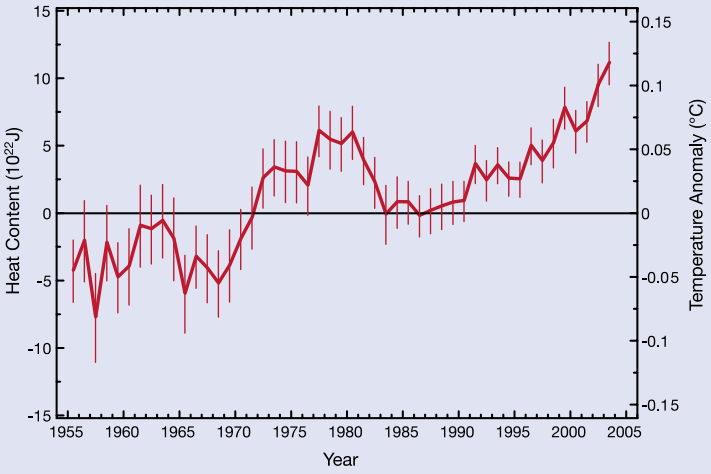

Figure 2. Time series of yearly ocean heat content for the 0–700 m layer. From Levitus et al. (2005). Science 287(5,461), 2,225–2,229.

Theme 3: Feedbacks to the Earth System

This theme will consider the present and future capacity of the ocean to affect the climate system via ocean effects on atmospheric composition and ocean heat storage. Key issues: (i) the varying capacity of the ocean to store anthropogenic CO_2, (ii) ecosystem feedbacks on ocean physics and climate, and (iii) how changes in low-oxygen zones affect the nitrogen cycle, especially transformations involving N_2O. For example, N_2O emissions are not uniformly distributed over the sea surface: the tropical upwelling zones containing O_2-deficient mesopelagic waters make a disproportionately large contribution (Fig. 3). Modelling the potential feedbacks from marine biogeochemical cycles and ecosystems to the Earth System will require detailed understanding of local and regional manifestations of global change in the ocean, and their interactions with other parts of the Earth System.

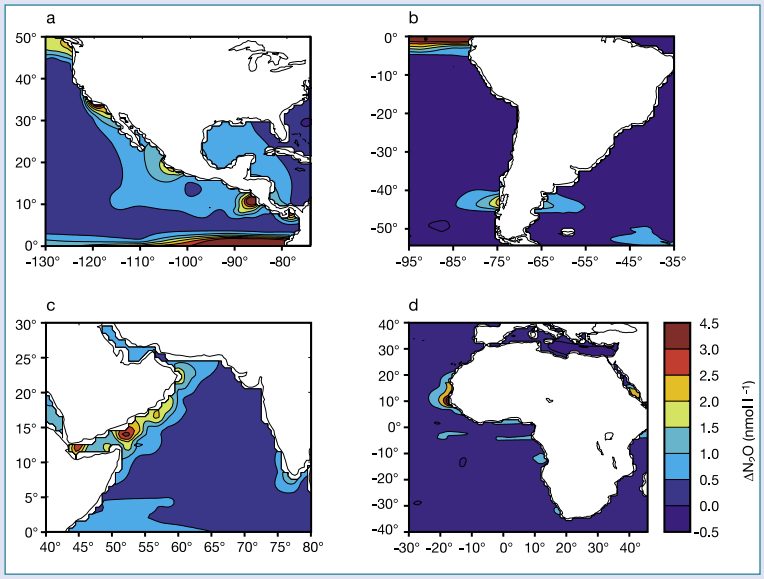

Figure 3. Annual composite maps of ΔN_2O at the sea surface (nmol l^{-1}). (a) Pacific Northwest and Central American coast, (b) western coast of South America, (c) perimeter of the Arabian Sea, and (d) west coast of Africa. From Nevison et al. (2004). Global Biogeochemical Cycles 18, GB1018.

Theme 4: Responses of Society

This theme will focus on interactions between human and ocean systems. Its motivation stems from recognition that humans not only influence ocean systems, but that humans also depend on ocean systems for goods and services. The theme goal is to promote an understanding of the multiple feedbacks between human and ocean systems, and to clarify what human institutions can do, either to mitigate anthropogenic perturbations of the ocean system, or to adapt to such changes. A major challenge of this theme will be to bring together scientists from a wide range of disciplines, to identify areas of joint concern and interest, and to create an ongoing natural-social science marine research community.

Implementation

IMBER will take advantage of new and innovative approaches to marine research ranging from new molecular techniques to sustained *in situ* and remotely sensed observations. The development of new sustained observation sites will be an important part of the implementation strategy complemented by targeted field-based process studies, *in situ* mesocosm studies, and field and laboratory experiments. A suite of hierarchical models will be developed to test hypotheses, analyse data and extrapolate in space and time, and identify crucial knowledge gaps that require new observations. Extrapolation to the global scale will require integration and assimilation of data from basin-wide surveys. To support modelling and synthesis, interconnected biological, geochemical and physical databases will be built, extended, and updated in near real-time.

Answering the broad interdisciplinary questions will require an effort much larger than any single nation can mobilise. Multiple investigators spanning disciplines, and intercomparisons of data across a range of systems will be needed. Interfacing the natural and social science communities to study the key impacts and feedbacks between marine and human systems will be a major challenge. IMBER will encourage collaborative activities that will draw on the expertise of other international research projects and programmes, including the Global Ocean Observing System, to avoid duplication and to ensure a truly interdisciplinary approach.

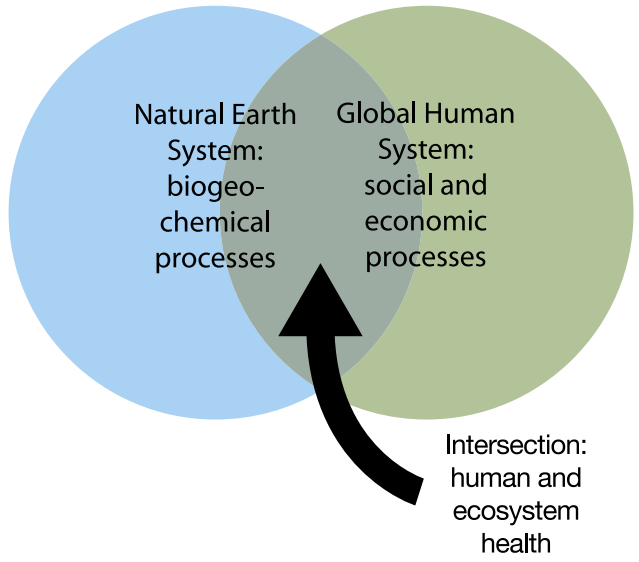

Figure 1. Interactions between Earth System health and human health [2].

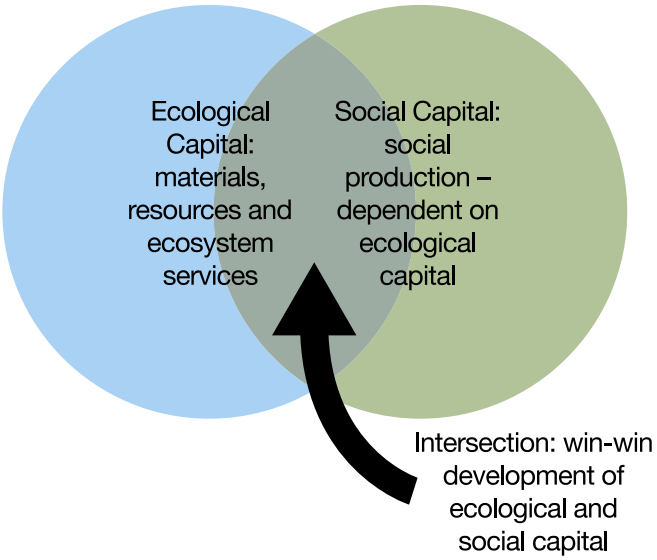

Figure 2. Interactions between nature and society.

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hand increases in social capital should not exceed the ecological capital carrying capacity (Figure 2). From this perspective it is only when the relationship between humans and nature is harmonious and development is dynamically balanced that development can be considered sustainable.

Using this philosophy the relationship between ecological capital and social capital provides an indicator of human-environment interactions. Here, an ecological capital assessment of China is presented using two new indexes: the first index – "harmony" (*Ps*) – is used to assess the static equilibrium of ecological capital and social capital, and the second index – "syncretism" (*Rp*) – is used to assess the dynamic equilibrium of ecological capital and social capital [3].where *EC* is ecological capital, *GDP* is gross domestic product, *ECP* is *EC* per unit area, *GDPP* is *GDP* per unit area and *t* is time. *Ps* is therefore the ratio of *EC* to *GDP* in a given area, and the ratio of the rate of ecological capital development to social capital development assesses whether development is balanced. Values of *Ps* and *Rp* for each county in China have been calculated (Figures 3 and 4).

$$Ps = \frac{ECP}{GDPP}$$

and

$$\frac{1}{Rp} = \Delta Ee = \frac{EC_{t2} - EC_{t1}}{EC_{t1}} \Big/ \frac{GDP_{t2} - GDP_{t1}}{GDP_{t1}}$$

The results of this assessment are worrying and indicate that ecological conservation should be paid higher attention, especially in the western provinces. In order to protect the vulnerable and critical ecological environment of western China, the government is implementing a development strategy that gives high priority to ecological conservation. The concept of "constructing ecology industrially and developing industry ecologically" has become widely accepted [4].

One of the more promising approaches to achieving "harmony" is land-use adjustment. Effective land utilisation and sustainable development would be aided by "ecology-oriented" land-use planning: separating different land uses into productive land, living land and ecological land, and optimising the land-use pattern at different scales. 'Productive land' provides society with material products, and includes land for industry, agriculture and transport. 'Living land' is where people dwell, including residential areas and public service land. 'Ecological land' provides society with ecosystem services, maintains ecosystem function and environment quality, and ensures the health of both people and the Earth System. On the local scale harmony requires land-use adjustment and landscape redesigning; on

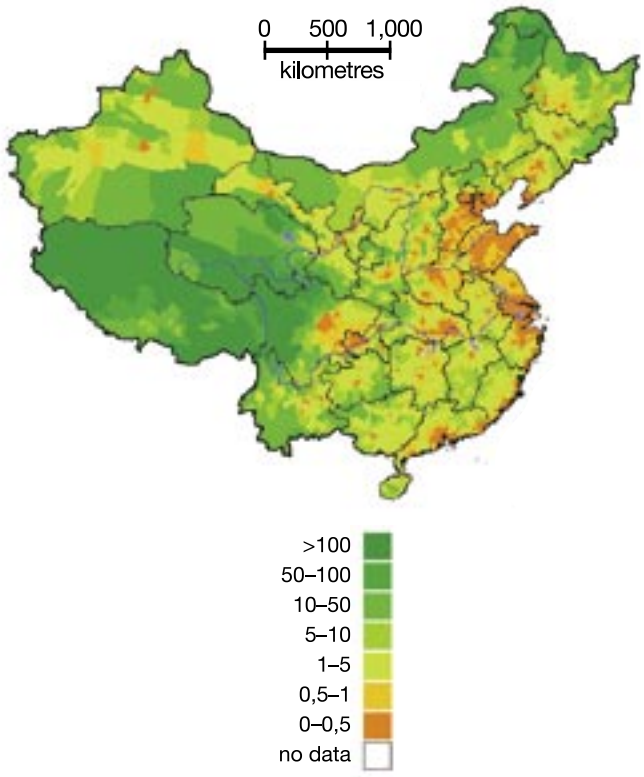

Figure 3. *Ps* values for the year 2000.

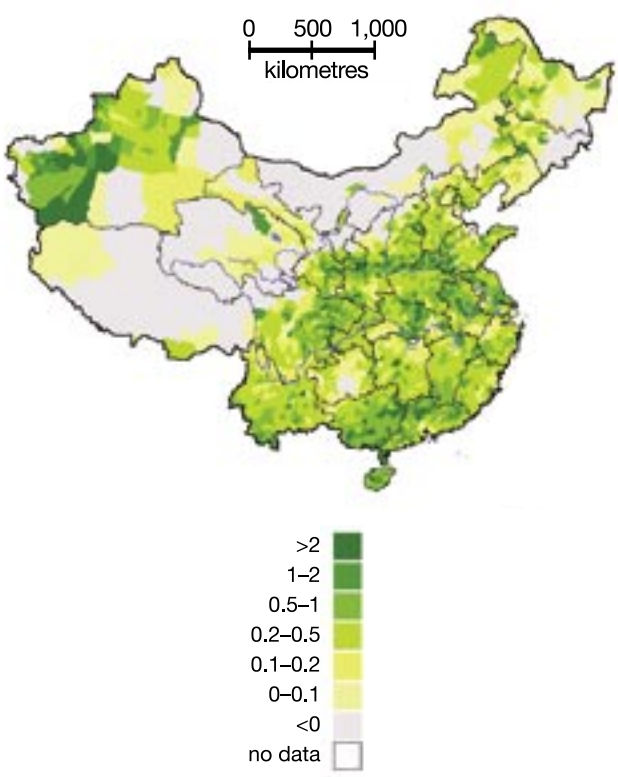

Figure 4. *Rp* values for the period 1995–2000.

the regional scale harmony requires optimisation of land-use patterns.

To build on this very preliminary study of environmental "harmony", future studies will focus on the impacts and feedbacks of land-use change, the optimisation of ecological and social capital and ecologically-oriented land-use planning.

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Carbon Budgeting for the Terrestrial and Marginal Sea Ecosystems of China

Y. Huang, G. Yu and P. Chen

Greenhouse gases – especially CO_2 and CH_4 – are intimately connected to climate change, and their rapid increase is challenging the scientific community and policy makers. To predict future climate change accurately and find ways to manage atmospheric CO_2 concentrations, the processes and feedbacks that drive the carbon cycle must first be understood.

The Study on Carbon Budget in Terrestrial and Marginal Sea Ecosystems of China (CBTSEC) is a US$8.5 million flagship project of the Knowledge Innovation Program, launched by the Chinese Academy of Sciences (CAS). Around 150 scientists and more than 250 graduate and postdoctoral students from 18 CAS institutes with different academic disciplines are involved in the project. From 2001–2005 the project will

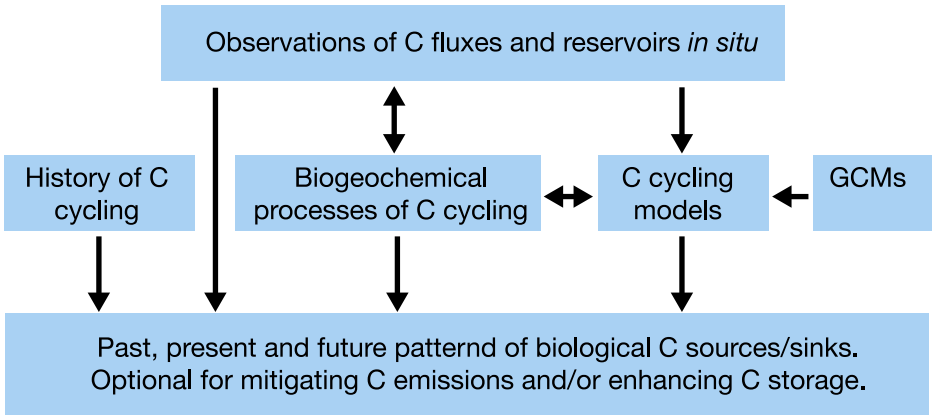


Figure 1. CBTSEC framework.

investigate: (i) the geographical and temporal patterns of carbon sources and sinks, (ii) the driving processes and control mechanisms of carbon cycling in terrestrial and marginal sea ecosystems – both natural and anthropogenic, (iii) the likely future dynamics of the carbon cycle, and (iv) options that can enhance carbon storage and/or reduce the carbon emissions from these ecosystems (Figure 1).

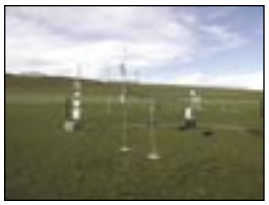
Observations of carbon dynamics are a fundamental component of attempts to understand the carbon budget. The ChinaFLUX network (www.chinaflux.org) was established in 2002 to make systematic field observations of carbon flux and storage. The network covers sixteen ecological stations including forests, grasslands, croplands,


Flux observation site of Haibei highland frigid meadow

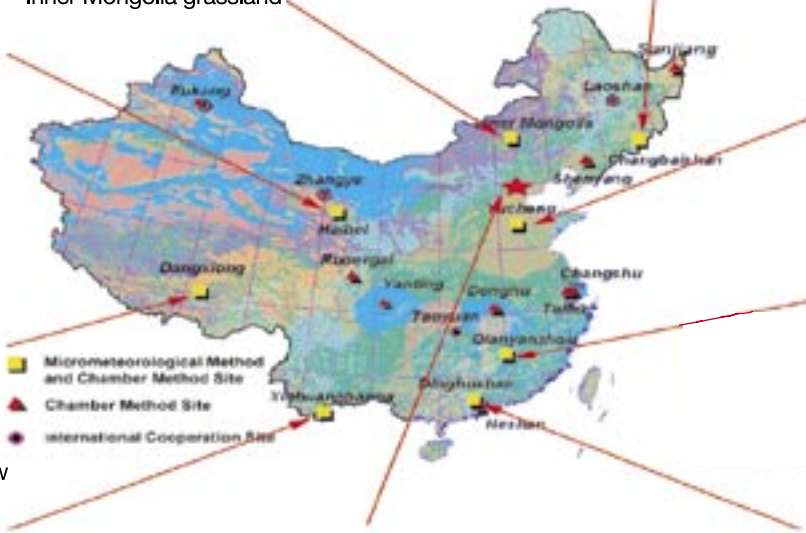

Flux observation site of Inner Mongolia grassland


Flux observation site of Changbaishan temperate deciduos broad-leaved and coniferous mixed forest


Flux observation site of Yucheng warmer temperate dry farming cropland


Flux observation site of Dangxiong alpine meadow


Flux observation site of Qianyanzhou planted forest on red soil hill region



CERN ChinaFLUX Office


Flux observation site of Xishuangbanna tropic seasonal rainforest


Flux observation site of Dinghushan sub-tropic typical tropical evergreen broad-leaved forest

Figure 2. The ChinaFLUX network established by CBTSEC.

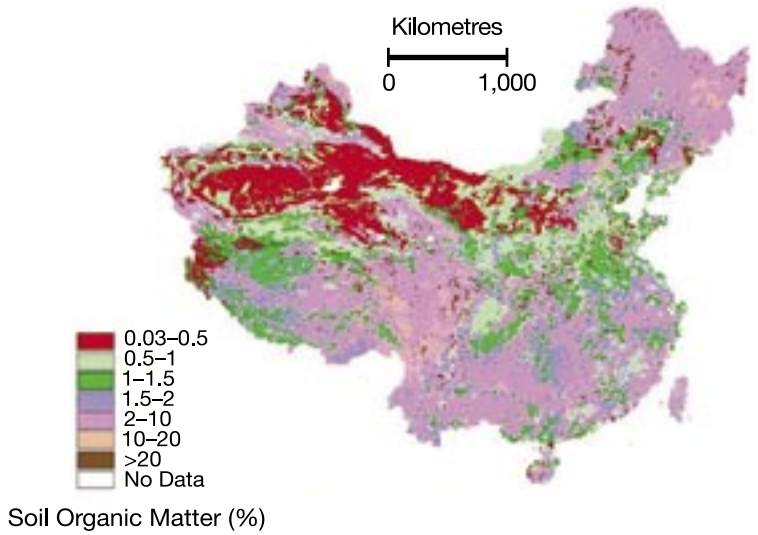


Figure 3: Example map from the digital soil map of China, showing percentage soil organic matter in the top 10 cm.

wetlands and fresh water bodies (Figure 2). Eddy covariance is used for measuring net ecosystem CO_2 exchange and static chamber and gas chromatography are used for measuring emissions of CO_2 and CH_4 from soils and/or the soil-plant system. Remote sensing is applied to identify land use and land cover, and to estimate net primary production and carbon storage. Using these observations, direct measurements of carbon assimilation and emissions are obtained, as well as information on the temporal and spatial patterns of carbon sources and sinks.

Case studies and process studies provide the fundamental building blocks of mechanistic knowledge essential for system-level understanding. Case studies on the biogeochemical processes will determine the interactions of soil, climate, vegetation and human activities. Research priorities for this theme are to understand the mechanisms that control exchanges of carbon between the soil and vegetation, between land and the atmosphere, and between marginal seas and the atmosphere. Because human activities are becoming more and more important in carbon dynamics, the effects of land use practices and ecosystem management on the carbon budget are also emphasised in this theme.

A central challenge in this carbon cycle research is to synthesise the massive array of different measurements and case study and process study results into a single, internally consistent framework. The CBTSEC project is applying a comprehensive synthesis approach to achieve this objective, which combines measurements and models within a GIS. In essence, observations (remotely sensed and *in situ*), process and case studies, and models (ecosystem models and the GCMs) are integrated within the GIS to infer complete space-time distributions of carbon budgets, and to make reliable projections of the response of China's ecosystems to global change. Carbon models concerning weather variables, soil parameters, plant species and human activities are being developed for different ecosystems. Possible options including land use practices and sustainable management of ecosystems for carbon sequestration are also being investigated.

A base database has been established to provide temporal and spatial information on climate, soil, land use and land cover, based on site-specific and up-scaled datasets. An example of the use of this database is the recent production of a 1:1,000,000 digital soil map of China (Figure 3) by the Institute of Soil Science, and its continuing efforts to compile an associated soil database (www.issas.ac.cn/english/soil_database.htm).

Each of the above themes provides essential pieces of the puzzle needed to understand the carbon budget of the ecosystems of China. The CBTSEC provides a framework within which to assemble these pieces, and with new work to fill gaps, to build a coherent national picture. Meanwhile, the project will encourage the exploration of new issues and future pathways of the carbon cycle that have not yet been envisaged.

Because of the potentially dire consequences of climate change, the Chinese government is examining ways to control greenhouse gases emissions in the face of economic and population growth pressures. The CBTSEC project will provide the necessary scientific information to guide government policy makers.

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New Roles and Faces

IMBER Executive Officer

Sylvie Roy has been appointed as the Executive Office for IMBER (see Centrefold). Sylvie has a BSc in biochemistry and an MSc in microbiology from the University of Montreal. Her PhD in oceanography from the University of Quebec was based on mathematical modelling of CO_2 production rates of marine bacteria using enzyme kinetics equations. Subsequently Sylvie has researched the production of DMS (dimethylsulphide) and DMSP (dimethylsulphoniopropionate) in the North Atlantic, and the effects of heavy metals on the productivity of the phytoplankton population in the Halifax Harbour Basin. Her research interests include marine production of DMSP and DMS, aspects of the global carbon cycle – especially metabolic production of CO_2, as well as enzymatic control of the rates of CO_2 production, O_2 consumption and nitrate reduction. In 2003, Sylvie joined the Canadian SOLAS Secretariat as cruise coordinator and data manager and was Acting Executive Director for six months. Sylvie will be based in Brest at the Institut Universitaire Européen de la Mer located on the Technopôle-Iroise campus of University of Brittany.

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SOLAS Executive Officer

Jeff Hare has been appointed as the new Executive Officer for SOLAS. For the past nine years Jeff was a research marine meteorologist at the University of Colorado and the NOAA Environmental Technology Laboratory in Boulder, Colorado. Originally from south-eastern Ohio, Jeff has a bachelor's degree in electrical engineering from the University of Cincinnati and a master's degree and PhD in meteorology from Penn State University. His research interests are in air-sea interactions, including small-scale turbulent heat exchange between the atmosphere and ocean, climate variability over the ocean, and exchange of greenhouse gases between the air and sea. This research has taken him to many places all over the world, and the measurement campaigns were conducted primarily from research ships. Jeff is now at the SOLAS IPO in the School of Environmental Sciences, University of East Anglia, Norwich.

E-mail: jeff.hare@uea.ac.uk

AIMES Co-Chairs

The IGBP Officers have approved Colin Prentice and Dave Schimel as the inaugural Co-chairs for the new Analysis, Integration and Modelling of the Earth System (AIMES) project of IGBP.

Colin leads the Quantifying and Understanding the Earth System (QUEST) programme for the UK Natural Environment Research Council and is Professor of Earth System Science at the University of Bristol. His research experience includes Quaternary palaeoecology, multivariate data analysis and vegetation dynamics modelling, and he has been among the pioneers in global-scale modelling of biosphere processes and their interactions with climate. He has been Head of the Department of Plant Ecology in Lund University, Sweden, and was a founding director of the Max Planck Institute for Biogeochemistry in Jena, Germany. He led the chapter on "The Carbon Cycle and Atmospheric Carbon Dioxide" in the IPCC Third Assessment Report in 2001, and was awarded the Milankovitch medal by the European Geophysical Society in 2002. His involvement with IGBP began as a member of the planning team for the GCTE project, and later as a member of the GAIM Task Force, which he co-chaired from 2003. His current research focuses on the use of simple models to elucidate key processes in plant physiology and ecology that have global-scale implications for climate and the carbon cycle, and the application of large-scale biosphere models to analyse the risks of anthropogenic climate change.

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Dave Schimel is a Senior Scientist in the Terrestrial Sciences Section of the Climate and Global Dynamics Division at the National Center for Atmospheric Research, Boulder, Colorado, USA, and professor and Director of the Max-Planck Institute for Biogeochemistry, Jena, Germany. Dave has a BA from Hampshire College, Massachusetts, and a PhD from Colorado State University. His research interests are in the carbon dynamics of terrestrial ecosystems, and modelling ecosystem responses to global change. Dave was a member of the IGBP GAIM Task Force, was a convening lead author on the 1994 and 1995 IPCC reports, and chairs the Biogeochemistry Panel of NASA's Earth Observing System Project. He was an ISI Highly Cited Researcher in 2003, and was elected as an External Member of the Max-Planck Society in 2002.

E-mail: schimel@ucar.edu

New SC-IGBP Vice-chair

Mary Scholes – an ICSU-appointed member of the Scientific Committee of IGBP – has been appointed as a new Vice-chair of the Committee. Mary is a professor in the School of Animal, Plant and Environmental Sciences at the University of Witswatersrand, Johannesburg, South Africa, where she specialises in the biogeochemistry of savannah ecosystems and soil biological processes. Mary was Co-chair of IGAC in 2001–2002, was appointed by ICSU to the SC-IGBP in 2002, was elected as a member of CACGP in 2002, and is a member of the Scientific Advisory Committee of the International Nitrogen Initiative (a joint Fast-Track Initiative of SCOPE and IGBP).

E-mail: mary@gecko.biol.wits.ac.za

Staff Changes at the IGBP Secretariat

After more than 15 years with the IGBP Secretariat, Elise Wännman – the Director for Finances – has retired. Elise is the longest serving staff member of the Secretariat, having carefully managed IGBP finances and guided many other administrative aspects of IGBP. She may well be the best-known of all the Secretariat staff – especially after her many years of helping with fundraising, and making sure all of us toe the line in terms of properly spending and accounting for our funds. Elise, in her capacity as Director of Finances, has helped navigate IGBP through waters both stormy and calm, and helped us make it through lean economic times. She has provided invaluable support to all the Executive Directors of IGBP: Thomas Rosswall, John Marks, Chris Rapley, Will Steffen and Kevin Noone. Their jobs would have been much more difficult without Elise's constant support. We offer Elise our most sincere thanks for her hard work, dedication, and loyalty to IGBP over her many years here, and wish her an extremely happy retirement.

Britta Boström-Huáman was been appointed to assume responsibility for managing the IGBP finances. Britta comes to the IGBP Secretariat from a Swedish company that manages cooperative development projects funded by the Swedish International Development Agency (SIDA), and bring with her extensive experience in financial administration and accountancy. Britta grew up in Luleå in northern Sweden, and began studying geosciences at Umeå University. After two years of study she decided to take a "short break" which has lasted more than twenty years. During her "short break" Britta travelled extensively through South America, worked in tourism and financial administration, and started a family. We welcome Britta to the Secretariat team.

E-mail: britta@igbp.kva.se

Susannah Eliott – Deputy Director, Communications – has accepted an appointment as the inaugural Chief Executive Officer for the new Australian Science Media Centre based in Adelaide, which is sponsored in equal parts by the private sector and media outlets. When Susannah leaves IGBP at the end of August, she will have completed five years with IGBP, during which time she has tirelessly led the development of the IGBP communications and outreach efforts. Susannah's efforts have established IGBP as an important voice on global change science in the international media, and have helped made IGBP science more accessible to the education sector and to policy-makers. We wish Susannah an enjoyable and rewarding future back in Australia, and look forward to maintaining contact with her in her new role.

Hilarie Cutler has been appointed as a tempory Graphics Designer at the IGBP Secretariat. Hilarie has run her own design company in Stockholm for over five years, undertaking work for a wide range of clients. She brings a wealth of experience and enthusiasm to IGBP. Hilarie originally hails from New York, but has lived in Stockholm for 18 years.

Hilarie replaces John Bellamy who is taking a six month leave of absence from early August to work with another international organisation based in Stockholm.

E-mail: hilarie@igbp.kva.se

IGBP Opportunities

Fast-Track Activity
Co-ordinator

The Global Water System Project (GWSP) seeks a co-ordinator to facilitate a series of fast-track activities initiated by the GWSP Scientific Steering Committee. This is a temporary, fixed-term position at the small International Project Office at the University of Bonn. More information can be obtained from www.gwsp.org or eric.craswell@uni-bonn.de. The closing date for applications is 31 August 2005.

GWSP
Global Water System Project

GLOBAL CHANGE IGBP

Upcoming Vacancy –
Science Communication

In August 2005 IGBP will advertise for a full time senior science communicator to be based at the Secretariat in Stockholm. An advertisement for this position will be distributed widely, will appear on the IGBP website as well as in various publications. Candidates with senior-level experience in science communication will be sought, but selection criteria will be broad, in order to encourage applications from diverse science communications backgrounds to apply.

Project Director – Earth System Atlas

A broadly trained scientist is sought to lead the effort to develop an Earth System Atlas – a project initiated within IGBP. The Atlas will provide data regarding the Earth System and Global Change, along with web-based tools for data manipulation and visualisation (see prototype earthsystematlas.org). The ideal candidate will ha ve a background in Earth System analysis, experience with global data sets and data centres, excellent communication and managerial skills, and a demonstrated ability to maintain extramural funding.

This is a one-year term position (with continuation contingent on obtaining additional funding), based at Lehigh University (in Bethlehem, Pennsylvania, 80 km north of Philadelphia). Candidate from underrepresented groups are encouraged to apply.

For more information contact:
Dork.Sahagian@lehigh.edu
or Colin.Prentice@bristol.ac.uk

In the Profile of a Scientist section we aim to feature "early-career" scientists who are making important contributions to Earth System science and to IGBP. We will 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: Peter Rayner

Peter Rayner is an atmospheric researcher currently working at CEA, France.

Thinking back of his school days, Peter describes the 1970s as an exciting time to be a blind child in Australia: "With changing methods of schooling, blind children could expect to spend most of their school lives in the rough and tumble of a normal schoolyard." Expectations of what was possible were also changing. "When I announced, at age ten, that I wanted to be a scientist when I grew up, my indulgent parents treated it as a normal childhood fantasy and not, in principle, impossible", Peter recalls.

A quest for less crowded ground than theoretical physics led him later on to a PhD in paleoclimate modelling at the University of Melbourne and hence to post-doctoral work in climate modelling and dynamics. In 1991 Peter followed his wife to Princeton for her studies and joined the ocean carbon cycle group led by Professor Jorge Sarmiento. "This was a surprising hire since I was neither an oceanographer nor chemist", he remarks.

In the early 1990s various groups had begun to use atmospheric measurements to locate the carbon sink required to balance known growth rates and emissions. The surprising location of this sink in the northern hemisphere and perhaps over the northern hemisphere continents led to a flurry of crosschecking of the result.

"As the only atmospheric modeller in the group, and with friends already working in atmospheric inversion, I was asked to check the result using the local GFDL atmospheric model", Peter explains. "In some sense I am still checking it, fifteen years and two continents later. "

Atmospheric inverse studies seek to deduce the pattern of surface fluxes compatible with atmospheric concentration and isotopic composition data. To do this it is necessary to unwind the impact of atmospheric transport. "In reality we move between interpreting the available (and insufficient) observations, quantifying the various uncertainties in the process (such as imperfect models of atmospheric transport) and investigating the utility of future measurement approaches", Peter describes the challenges of his work.

He was the initial coordinator of the long-running IGBP/GAIM project TransCom (now part of the Global Carbon Project), which focused on the uncertainties of this inversion process caused by unknown model transport.

A recent development was the realisation that satellite measurements of CO_2 concentration, despite lower precision than surface measurements, could enhance the ability to determine sources and sinks because of their greater coverage and density. "It is exciting to watch the development of missions targeting this measurement", he says.

As another exciting direction Peter considers the coupling of atmospheric transport models to models of surface fluxes (such as ocean and terrestrial biogeochemistry models) in order to infer the behaviour of these models directly from atmospheric observations. This both enhances the power of the inversion since it demands dynamical consistency among the various surface fluxes (much as data assimilation does in numerical weather prediction) and allows current observations to constrain model predictions. "As well as taking me full circle back to climate modelling, I also find myself occasionally and surprisingly classified as a terrestrial modeller", he notes. "Maybe one day I will even learn some of that ocean chemistry."

The circumstance of having had an inspiring tutor at university who combined roles as one of Australia´s leading physicists with a gift for communication, Peter considers as a rare privilege and states: "We owe it to our mentors to pass on their gift and this is a role for which I would like to find more time."

IGBP and Related Global Change Meetings

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

ACCENT Symposium: The Changing Chemical Climate of the Atmosphere

12–16 September, Urbino, Italy

Contact: www.accent-network.org/symposium

2nd International AVEC Summer School

18–30 September, Peyresq, Alpes de Haute-Provence, France

Contact: www.pik-potsdam.de/avec/peyresq2005.html

Polar Regions and Quaternary Climate

24–29 September, Acquafredda di Maratea, Italy

Contact: asgablin@esf.org or www.esf.org

7th International CO_2 Conference

26–30 September, Broomfield, CO, USA

Contact: www.cmdl.noaa.gov/info/icdc7

14th PICES Annual Meeting: Mechanisms of Climate and Human Impact on Ecosystems in Marginal Seas and Shelf Regions

29 September–10 October, Vladivostok, Russia

Contact: secretariat@pices.int or www.pices.int

Open Science Conference: Global Change in Mountain Regions

02–06 October, Perth, Scotland, UK

Contact: www.mountain.conf.uhi.ac.uk

6th Open Meeting of the Human Dimensions of Global Environmental Change Research Community

09–13 October, Bonn, Germany

Contact: openmeeting.homelinux.org

CLIVAR/GOOS/OOPC/Argo South Pacific Workshop

10–13 October, Concepción, Chile

Contact: www.clivar.org

GSA Session - Glacial Geology and Lake Sedimentology: In Memory of Geoffrey O. Seltzer

16–19 October, Utah, USA

Contact: pages@pages.unibe.ch

1st Joint HITE-POLLANDCAL Conference

24–25 October, Umeå, Sweden

Contact: www.geog.ucl.ac.uk/ecrc/pollandcal

4th GKSS School of Environmental Research: "Environmental Crises: Science and Policy"

02–11 November, Delmenhorst, Germany

Contact: coast.gkss.de/events/4thschool

1st DIVERSITAS International Conference on Biodiversity.

09–12 November, Oaxaca, Mexico

Contact: secretariat@diversitas-international.org or www.diversitas-osc1.org

Greenhouse 2005: Action on Climate Control

13–17 November, Melbourne, Australia

Contact: www.greenhouse2005.com

Climate Science in Support of Decision Making

14–16 November, Arlington, VA, USA

Contact: www.climatescience.gov/workshop2005/contribpres.htm

International Organizations and Global Environmental Change 2005 Berlin Conference on the Human Dimensions of Global Environmental Change

02–03 December, Berlin, Germany

Contact: www.fu-berlin.de/ffu/akumwelt/bc2005

2006

EcoMod Modelling School

16–21 January, Bangkok, Thailand

Contact: theresa.leary@ecomod.net, www.ecomod.net

1st iLEAPS Science Conference

21-26 January, Boulder, CO, USA

Contact: www.atm.helsinki.fi/ILEAPS/boulder or ileapsipo@helsinki.fi

4th World Water Forum: Local Actions for a Global Challenge

16–22 March, Mexico City, Mexico

Contact: www.worldwaterforum4.org.mx./home/home.asp

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

19–21 April, Honolulu, USA

Contact: secretariat@PICES.int or www.pices.int

17th Global Warming International Conference & Expo

20–21 April, Miami, USA

Contact: gw17@globalwarming.net

Climate Changes and their impact on Boreal and Temperate Forests

05–07 June, Ekaterinburg, Russia

Contact: ecoinf.uran.ru/conference

Holivar 2006 Open Science Meeting: "Natural Climate Variability and Global Warming"

12–15 June, London, UK

Contact: www.holivar2006.org

2007

SOLAS Open Science Conference

06–09 March, Xiamen, China

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

1st iLEAPS Science Conference

The Integrated Land Ecosystem–Atmosphere Processes Study of IGBP is a multi-disciplinary project aimed at improved understanding of processes, linkages and feedbacks in the land-atmosphere interface of the Earth System. iLEAPS will hold its 1st Science Conference from 21–26 January 2006, in Boulder, Colorado, USA.

Conference themes:

1. Land-atmosphere exchange of reactive and long-lived compounds: key interactions and feedbacks in the Earth System.
2. Feedbacks between land biota, aerosols and atmospheric composition in the climate system.
3. Feedbacks and teleconnections in the land surface, vegetation, water and atmosphere system.
4. Measurement of material and energy transfer in the soil, canopy and boundary-layer system.
5. Modelling land-atmosphere interactions.

iLEAPS will financially support registration, travel and accommodation costs for limited number of students and early career scientists, who would otherwise be unable to attend the conference. Sponsored attendees will be primarily, but not exclusively, from developing countries.

Paper submission deadline: 30 September 2005

Early-bird registration deadline: 31 October 2005

Detailed conference information are at:
www.atm.helsinki.fi/iLEAPS/boulder

NCAR Atmospheric Chemistry Division

CHINA ASSOCIATION FOR SCIENCE AND TECHNOLOGY

DEKATI

UCAR University Corporation for Atmospheric Research

DIVERSITAS:OSC1

Integrating biodiversity science for human well-being

9-12 November 2005

Hotel Mision de Los Angeles
Oaxaca, Mexico

For more information visit:
www.diversitas-osc1.org

Contact: info@diversitas-osc1.org

DIVERSITAS
an international programme of biodiversity science

Linking biological, ecological and social disciplines, the

First DIVERSITAS Open Science Conference

will address current issues in biodiversity science:

How is biodiversity changing? And why? • What are the consequences of change for ecosystems and for the delivery of ecosystem services? • What can we do to promote more sustainable use of biodiversity and improve human well-being?

Confirmed Plenary Speakers

Michel Loreau, Chair DIVERSITAS Scientific Committee
David M. Hillis, University of Texas, USA
Bob Scholes, South Africa
David Tilman, University of Minnesota, USA
Jeremy Jackson, Smithsonian Tropical Research Institute, USA
Partha Dasgupta, University of Cambridge, UK
Laurence Tubiana, IDDRI, France
José Sarukhân, CONABIO,Mexico

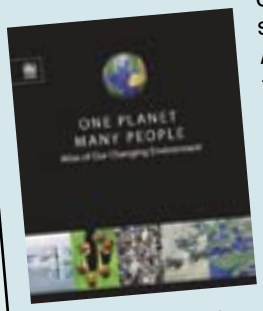
Parallel Sessions will focus on strengthening biodiversity science, supporting the science-policy interface, and on integrated approaches to thematic issues such as biodiversity in specific ecosystems (mountain, agricultural, marine, freshwater, urban), invasive species, and biodiversity and human health.

Online registration now available.

Pin Board

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.

One Planet, Many People



Using a collection of spectacular "Before and After" satellite images for 80 sites around the world, the United Nations Environment Programme's new large-format hard-cover book One Planet, Many People: Atlas of Our Changing Environment documents the dramatic and, in some cases, damaging changes sweeping the Earth. The huge growth of greenhouses in southern Spain, the rapid rise of shrimp farming in Asia and Latin America, and the emergence of a giant peninsula at the mouth of the Yellow River are among the curious and surprising changes seen from space. They accompany images of rainforest deforestation in Paraguay and Brazil, rapid oil and gas development in Wyoming, forest fires across sub-Saharan Africa, and the retreat of glaciers and ice in polar and mountain areas. The atlas, produced in collaboration with organisations including the United States Geological Survey and NASA, also shows the explosive growth of the world's major cities, such as Beijing, Dhaka, Dehli, Las Vegas, Miami, and Santiago. See www.na.unep.net/OnePlanetManyPeople/

LETTER TO THE EDITOR

Dear Editor;

I see nothing gainful or even honest about the notion of sustainability (see Guest Editorial Global Change NewsLetter No.60) in Latin America. Health and economic support along with environmental protection are the most obvious issues, especially in overpopulated Mexico, Central America and some Caribbean islands. Sustainability can be an affluent concept simply out of reach, while the problem is overpopulation and unemployment of the rural poor. Does the relentless ruination of Latin forests speak for biodiversity and sustainability?

Central America needs to create an electricity web for its modernisation and industrial competence. In the global race for employment, the cost of all energy sources has to be kept down if urbanisation with consequent birth control is to succeed. The dams for electricity cause vast lands to be flooded. Even though most of these lands are eroded and worthless not providing a living, more protests and more repression will soon repeat the past via the same relentless population pressure.

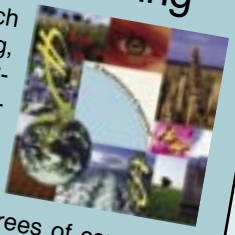
Paul R. Earl
Univ. Autónoma de Nuevo León
San Nicolás de los Garza, NL
Mexico

Millennium Ecosystem Assessment

In late May 2005 the Millennium Ecosystem Assessment released its second report. The report – "Biodiversity and Human Well–being: A Synthesis Report for the Convention on Biological Diversity" – synthesises and integrates findings related to biological diversity from the four Millennium Ecosystem Assessment Working Groups: Conditions and Trends, Scenarios, Responses and Sub-global Assessments, in response to requests for information received through the Convention on Biological Diversity. The report documents the management tools, policies and technologies that exist to dramatically slow the current high rates of biodiversity loss.

International Max Planck Research School on Earth System Modelling

The International Max Planck Research School on Earth System Modelling (Hamburg, Germany) is offering PhD fellowships (2006-2009) to outstanding students for interdisciplinary studies in Earth System rese arch. The School contributes to the development of integrated Earth System models at different spatial and temporal scales and varying degrees of complexity. Apply on-line at: www.earthsystemschool.de by 15 October 2005.



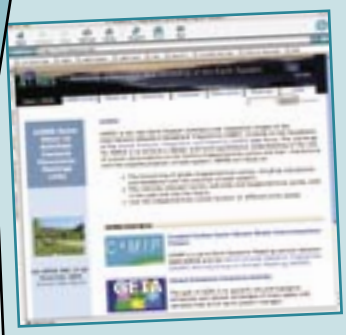
IPCC Working Group II Fourth Assessment

The IPCC is currently undertaking its Fourth Assessment, due to be completed in 2007. Working Group II (WGII) deals with the impacts of climate change, adaptation and vulnerability. If you are aware of material which has appeared since the 2001 assessment and which should be assessed, please note the deadline for submission is 14 April 2006. Notification (to ipcc-wg2@metoffice.gov.uk) should precede submissions to be made after 1 April 2006.

Australian Research Award

The Northern Territory Research and Innovation Board in Australia has conferred its in augural Research Award on Mark Stafford Smith – CEO of the Australian Desert Knowledge Cooperative Research Centre and member of the SC-IGBP. The award recognises Mark as the driving force behind establishment of the Desert Knowledge Centre and his development of the Centre's underpinning concept of the "science of desert living". The concept links indigenous and western science concepts to distinguish the factors that allow people to live well in the desert from those that don't. Within IGBP Mark has been using these same skills to help guide the new Global Land Project, especially to help strengthen the interactions between the biophysical and human dimensions research communities.

AIMES Website



The AIMES project (Analysis, Integration and Modelling of the Earth System) of IGBP has recently established a wesbite (www.aimes.ucar.edu). To find out more about AIMES download the draft Executive Summary of the project Science Plan, or contact the Executive Officer, Kathy Hibbard (kathy@ucar.edu).

Eminent Scientists Symposium

IGBP and five other organisations including the Korea Environment Institute and the UN Economic and Social Commission for Asia and the Pacific co-sponsored the recent Eminent Scientists Symposium, part of the Ministerial Conference on Environment and Development, Korea, March 2005. The symposium focussed on the role of science in global change, environment and development, and was attended by over 70 scientists from 30 countries. The 35 presentations covered a wide range of topics from the Earth System and its climate to sustainable development, atmospheric brown clouds and early warning systems for extreme events. See: www.unescap.org/mced for the overall meeting report.

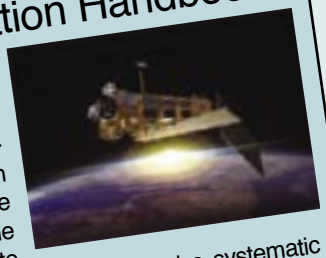
Top Ranking for LUCC Paper

According to Essential Science Indicators, a LUCC synthesis article (Lambin et al. (2001) The causes of land-use and land-cover change – moving beyond the myths. Global Environmental Change: Human and Policy Dimensions 11(4), 261-269) is in the top 1% within its field. Rating are based on the number of citations papers receive within a given period. The paper can requested from the LUCC IPO (lucc.ipo@geog.ucl.ac.be).

Royal Colloquium

Several IGBP scientists participated in a royal colloquium "Arctic Under Stress: A Thawing Tundra" at the end of May 2005 on board the Swedish icebreaker M.V. Oden as it sailed from Luleå in northern Sweden to Stockholm. The meeting was hosted by His Majesty King Carl XVI Gustaf of Sweden, who was joined by his daughter Her Royal Highness Crown Princess Victoria, His Royal Highness the Crown Prince Frederik of Denmark and a group of 15 international scientists and policy makers. The workshop examined the implications for policy and resource management of the rapid changes occurring in the Arctic, and their connections to environmental change at the global scale.

Earth Observation Handbook



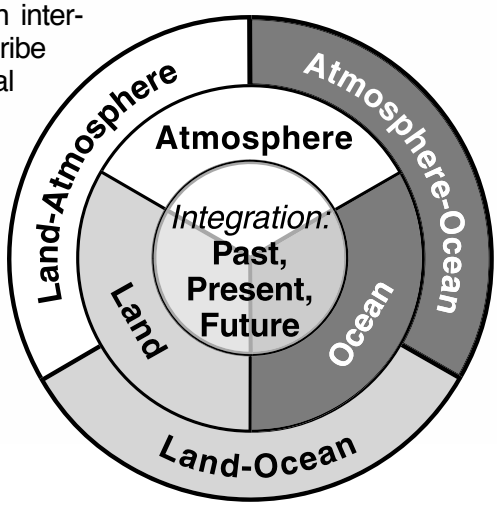
The European Space Agency has published the 2005 Earth Observation Handbook of the Committee on Earth Observation Satellites (CEOS). The Handbook presents the main capabilities of satellite Earth observations, their applications and a systematic overview of the present and planned Earth observation satellite missions and their instruments. Hard copies of the Handbook can be requested via www.ceos.org and an online version of the Handbook can be found at www.eohandbook.com.

QUEST of Discovery

A new programme on Earth System science has been launched in the UK. The programme – QUEST (Quantifying and Understanding the Earth System) – is funded by the Natural Environment Research Council and is led by Professor Colin Prentice of Bristol University, also Co-Chair of IGBP's AIMES project. QUEST is placing a strong emphasis on an interdisciplinary, integrative approach in two major directions: (i) an integration of natural sciences, social sciences and humanities to study the coupled human-environment system, and (ii) an integration of palaeo-research, contemporary observations and process studies, and Earth System modelling. QUEST will play a lead role in implementing the Earth System Atlas activity of AIMES. See quest.bris.ac.uk.

The International Geosphere-Biosphere Programme

IGBP is an international scientific research programme built on interdisciplinarity, networking and integration. IGBP aims to describe and understand the interactive physical, chemical and biological processes that regulate the total Earth System, the unique environment that it provides for life, the changes that are occurring in this system, and the manner in which they are influenced by human actions. It delivers scientific knowledge to help human societies develop in harmony with Earth's environment. 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 System Science

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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