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*Rupert Klein**Hans Joachim Schellnhuber**Martin Claßen*

Preface

The Potsdam Institute for Climate Impact Research (PIK) presents its biennial report to friends, patrons, and interested individuals from the fields of science, politics, and economics. The report offers a glimpse into PIK's scientific endeavors over the last two years - 2002 and 2003 - and highlights future directions.

THE MISSION

Under accumulating environmental and developmental pressures on humankind, the 21st century will witness either a conscious transition toward global sustainability or a dangerously widening discrepancy between cultures and generations. To facilitate the first alternative, a profound understanding of the myriad of processes at work is needed, and the respective insights have to be integrated for generating holistic views of the Earth System.

PIK's commitment to make a valuable contribution to this grand scientific challenge has resulted in the design and implementation of a series of complex research projects by natural and social scientists. Although difficulties are inherent whenever a heterogeneous array of disciplines is involved, the configuration of scientists present at PIK, the wealth of specialized knowledge available, and PIK's advanced software platform for model coupling are key

assets that are conducive to problem-oriented and solution-relevant knowledge.

THE INSTITUTE

Founded in 1992, PIK assembles scientists from many disciplines within each of its five departments: Integrated Systems Analysis, Climate System, Global Change and Natural Systems, Global Change and Social Systems, and Data & Computation. Seven research fields—the so-called ToPIKs—ensure that interdisciplinary research is strongly supported since members from all departments work together in these fields. The ToPIKs are: Nonlinear Dynamics of the Ecosphere; Management of Singular Events; Socioeconomic Causes of Global Change; Emergence of a Global Subject; Regional Simulators; Sectoral Climate Sensitivity; and PIKular Culture. PIK is a government institution affiliated with the German Federal Republic and the state of Brandenburg, from which it receives an annual budget of about six million euros. In addition, project-specific funds are secured from national and international sources, amounting to six million euros annually. Major contributions come from the European Commission through its framework programs for research. PIK is a member of the Leibniz Association, an organization comprised of institutes with supraregional scientific remit. At present, there are 137 members on PIK's staff, of which 111 are scientists.

THE EUROPEAN PERSPECTIVE

Earth System Science and Global Change Research require the advancement of international cooperation, which has always been a top priority at PIK. The European perspective has attained a new dimension at the Potsdam Institute with Hans Joachim Schellnhuber's appointment as Research Director of the Tyndall Centre for Climate Change Research in the U.K. This development has helped to establish a special relationship between both institutes. A milestone in the PIK-Tyndall convergence process was the "PIK-Tyndall Summit," convened in Norwich in August, 2003, which served to identify common ground for future scientific interactions.

A milestone on the European road was the "E-VIA-Summit" (European Virtual Institute for Integrated Assessment) held in Milan in December, 2003. It brought together members from leading European institutions concerned with climate change and sustainability issues, representing the critical mass necessary for integrated assessment that blends scientific excellence with political relevance.

PIK has thus played an important role in the construction of a growing network for a science dedicated to the transition to sustainability.

THE FUTURE

The most relevant and ambitious goal within this European collaboration perspective is the development of a "Community Integrated Assessment System" (CIAS): This will be a distributed-modular structure jointly operated by leading European institutions active in global change and sustainability assessment. The partners will pool their most advanced models, data bases, and software tools in order to create a common software platform (CIAMⁿ, Community Integrated Assessment Modules for n Institutions), in order to reproduce CIAS' flexibility technically. CIAS will be able to provide robust and timely answers to pertinent questions of decision makers and civil society. Modelling activities of PIK in "Integrated Assessment" are based on the modular paradigm. PIK makes an important contribution in the development of software and with its High Performance Computer. We are convinced that this is where the future of a co-productive integrated assessment lies.

Hans Joachim Schellnhuber, Director

Martin Claussen, Deputy Director

Rupert Klein, Managing Representative of the Executive Board



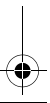


Research Program

The integrated analysis of the Earth and selected subsystems thereof is PIK's main task. To this end current projects address questions of the overall stability of the Earth System, the vulnerability of ecological and social systems to global changes, and the interactions between the natural and social spheres.

PIK's interdisciplinary approach is reflected in its scientific structure with five departments and the seven research fields, called ToPIKs. PIK's ToPIKs include the following fields: Nonlinear Dynamics of the Ecosphere; Management of Singular Events; Socio-Economic Causes of Global Change; Emergence of a Global Subject; Regional Simulators; Sectoral Climate Sensitivity; PIKular Culture. Within these ToPIKs the "human capital" of the different departments work together in various PIK Projects.

The ToPIK mentor of each ToPIK stimulates the discussion between the PIK Projects of this ToPIK, bundles ideas, and summarizes results within his research field, the ToPIK. It is the responsibility of the mentor to acquire new resources and to recommend the establishment of a new PIK Project. Each PIK Project, equipped with a Project Speaker, works across disciplines on problems of global change.



ToPIK 1 — Nonlinear Dynamics of the Ecosphere

ToPIK Mentor: Martin Claussen

The ecosphere, also referred to as the natural Earth system, is a dynamical system. It encompasses the geosphere—mainly atmosphere, oceans, ice masses, and the Earth interior—and the terrestrial and marine biosphere. This ToPIK explores the dynamics of the ecosphere as well as its resilience to large-scale natural and anthropogenic perturbations. Examples are the continuing emission of greenhouse gases, large-scale changes in land cover, and variations in solar luminosity. Investigations include exploration of so-called switches and choke points in the ecosphere, i.e., regions in which slight external forcings or disturbances can trigger large changes of climate.

ToPIK 1 is structured according to spatial and temporal scales. The project TRIPEDES addresses the long-term coevolution of geosphere and biosphere during the past eons since the beginning of our Earth and the eons to come. QUEST focuses on the current geological epoch, the Quaternary (i.e., the last two million years), which is characterized by a waxing and waning of large ice sheets in the Northern Hemisphere. BIS aims to enhance our understanding of the terrestrial biosphere on seasonal to centennial time scales. As a subproject of BIS, EVITA's main topic is the application of special thermodynamic concepts to find integrated parameters which describe the state of global vegetation. Finally, CLIMBER-3 was set up to construct and implement a new Earth system Model of Intermediate Complexity (EMIC) which is designed to bridge the scales between QUEST and BIS.

Geosphere and biosphere have strongly affected each other during most of the Earth's history. Presumably, the gradual cooling of the natural Earth system triggered an abrupt acceleration in evolution at the beginning of the Cambrian some 542 million years ago. The global near-surface temperature dropped and reached a threshold at which complex multicellular creatures could develop which, in turn, affected their environment (see PIK Project TRIPEDES). In the recent past as well as in present-day climate such amplifying feedback processes between vegetation and atmosphere play an important role at high northern latitudes, at the border between taiga and tundra, as well as in Northern Africa, between Sahara and Sahel. In particular in Northern Africa, abrupt vegetation changes may be expected in the future (see PIK Project QUEST). The boreal vegetation at high northern latitudes seems to be not only an amplifier, but also a sensitive indicator of climate change. For the first time, an advance of spring budburst in the last two decades and an increase in vegetation abundance in the northern boreal zone were realistically simulated by using a process-based vegetation model (see PIK Project BIS).

Climate change does not always occur gradually, but sometimes happens abruptly, according to palaeoclimatic evidence. A new theory is able to explain the dynamics of such abrupt climate changes, in particular the peculiar regularity in the occurrence of these events. This suggests that it is possible to make robust statements on potential abrupt events in future climate (see PIK Project QUEST).



Martin Claussen

PIK Projects

BIS

CLIMBER 3

EVITA

QUEST

TRIPEDES

Biosphere Interactions in the Earth System (BIS)

Project Speaker: Stephen Sitch

Project Members: Franz Badeck, Werner von Bloh, Alberte Bondeau, Victor Brovkin, Wolfgang Cramer, Dieter Gerten, Wolfgang Lucht, Tanja Rixecker, Sibyll Schaphoff, Birgit Schröder, Yuri Svirezhev, Kirsten Thonicke, Irina Venevskaia, Sergey Venevsky, Sönke Zachle

Funding: Klima, Vegetation und Kohlenstoff: Jahreszeitliche und langfristige gekoppelte Dynamik - BMBF, Advanced Terrestrial Ecosystem Analysis and Modelling - EU

The aim of BIS is to study the role of the land biosphere as a provider of the human environment and services and as part of the coupled physical and biogeochemical Earth system, on the timescale of historic and future human intervention, i.e., years to centuries. The Dynamic Global Vegetation Model Lund-Potsdam-Jena (LPJ) is used as a research tool.

CHANGES IN LAND COVER

LPJ was coupled to the climate model CLIMBER-2. The model was used to infer the decreasing role of land-cover changes for atmospheric CO₂ during the last 150 years.

GREENING OF THE NORTHERN LATITUDES

Remote sensing and results from the process-based vegetation model LPJ agree on an advance of spring budburst in the last two decades and an increase in vegetation abundance in the northern boreal zone (Figure 1). Results from LPJ point to temperature as the primary driver.

CO₂ EXCHANGE

Modeled interannual exchange of CO₂ from LPJ compared well with results from atmospheric inversion studies. Comparison between terrestrial models showed the largest uncertainty in their representation of heterotrophic respiration, which has major implications for the sign and magnitude of future carbon-climate feedbacks. A study into the effect of parameter uncertainties found LPJ to be robust in its ability to simulate water and carbon exchange and the vegetation structure.

CARBON STORAGE

The uncertainty in future terrestrial carbon storage due to differences in projections of future climate is large in magnitude, and it is uncertain what the sign of the response, representing source or sink, will be. The largest regional uncertainty remains in the response of tropical rainforests of South America and Central Africa due to

large differences in projected future precipitation among climate scenarios.

FIRE DISTURBANCE

LPJ is one of the few large-scale biosphere models able to simulate fire disturbance. A regional fire model was developed which successfully reproduces both number of fires and area burnt in the human-ignition dominated Iberian Peninsula and forests in Brandenburg. In paleo-climate applications the role of fire on atmospheric trace gas concentrations was quantified.

HYDROLOGY

A recent study has shown LPJ to be at least as good as existing global hydrological models in calculating large-basin runoff and evapotranspiration at local flux measurement sites. Hence LPJ is a suitable tool for large-scale water resource studies.

LAND USE

A prototype representation of croplands has been implemented. This was needed for improved carbon cycle estimations and for future food security issues.

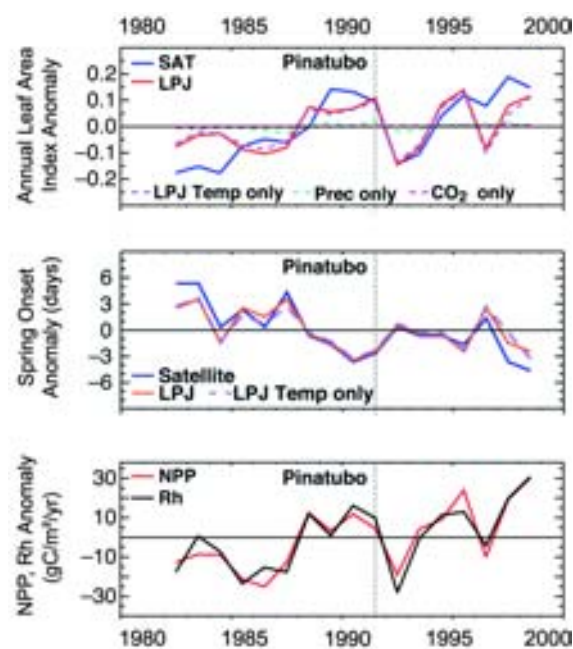


Fig. 1: Northern boreal zone anomalies in annual Leaf Area Index, the onset of spring, Net Primary Production (NPP) and Heterotrophic respiration (Rh). Results from LPJ driven by changing fields of temperature only are shown in yellow (Lucht *et al.* 2002).

CLIMBER-3, Earth System Model of Intermediate Complexity

Project Speaker: Andrey Ganopolski

Project Members: Stefan Rahmstorf, Eva Bauer, Victor Brovkin, Reinhard Calov, Martin Claussen, Alexa Griesel, Matthias Hofmann, Anders Levermann, Claudia Kubatzki, Marisa Montoya, Miguel Maqueda, Susanne Nawrath, Vladimir Petoukhov

Funding: Study of the Atlantic thermohaline circulation in a highly efficient global ocean-atmosphere model - BMBF, Comer Science and Education Foundation, James S. McDonnell Foundation

The practical necessity to improve our understanding of the nonlinear dynamics of the ecosphere requires the development of comprehensive Earth System Models (ESMs) which incorporate all major components of the Earth system: atmosphere, hydrosphere, cryosphere, and biosphere, and describe the large set of relevant physical, chemical, and biological processes. The enormous complexity of the Earth system and the broad range of time scales considered require the use of Earth System Models of Intermediate Complexity (EMICs). One of the first models of this class, the CLIMBER-2 model, has been developed at PIK in recent years. The goal of the CLIMBER-3 project is to develop an EMIC with higher spatial resolution and better representation of individual processes, but still sufficiently computationally efficient to allow a broad range of research.

MODEL DEVELOPMENT AND APPLICATION

As a first step in development of the CLIMBER-3 model a pilot version, CLIMBER-3 α , was designed and tested. CLIMBER-3 α is a coarse resolution coupled climate model based on the statistical-dynamical atmosphere model POTSDAM-2, the same model as used in CLIMBER-2 but with a higher spatial resolution. CLIMBER-3 α consists of a 3-dimensional ocean general circulation model (POTSMOM, a considerably modified version of the GFDL Modular Ocean Model 3), a dynamic-thermodynamic snow-sea ice model (ISIS) and an Ocean Carbon Cycle Model (OCCM). The Ocean Carbon Cycle Model is directly implemented into the POTSMOM. It has a high level of modularity; that is, depending on the degree of complexity considered, biogeochemical components and processes can be switched on or off. The OCCM operates in different modes from a simple inorganic model to a state-of-the-art plankton

model which includes effects of iron limitation on phytoplankton growth coupled to the ocean carbon cycle.

The coupling between the atmosphere and ocean components is provided by the Coupler. The coupling procedure does not include any flux corrections, and up to now wind-stress fields have been prescribed from observations. The CLIMBER-3 α model has moderate computational costs, and has been successfully validated against modern climatology. Currently CLIMBER-3 α is already being used for a variety of research (Figure 1).

The newest version of the statistical-dynamical atmosphere model POTSDAM-3 and integrated land-surface scheme are currently under development and are expected to be implemented in the next version of CLIMBER-3. The new atmosphere model POTSDAM-3 as compared to the current version is based on the improved description of atmospheric dynamics and synoptic processes. The integrated land-surface model describes the exchanges of water, CO₂, and energy between the atmosphere and the underlying land surfaces as well as vegetation processes. It consists of the surface-vegetation-atmosphere transfer scheme (BATS) and of the Dynamic Global Vegetation Model Lund-Potsdam-Jena (LPJ)l.

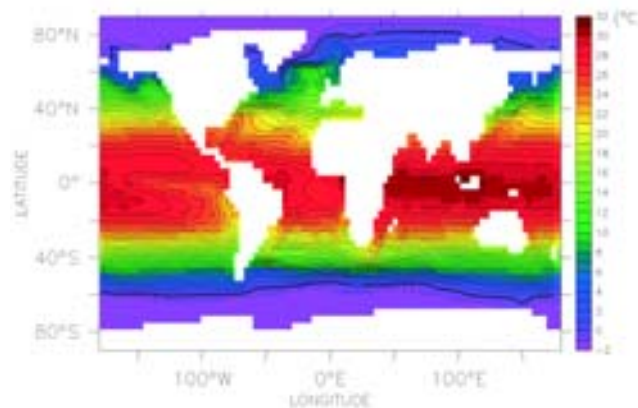


Fig. 1: Sea surface temperature (SST) simulated by the CLIMBER-3 α model (annual mean). Climber-3 α can compare a realistic thermodynamic equilibrium state of the climate, reached after several thousand years of simulation.

Exergy, Vegetation and Information: Thermodynamics Approach (EVITA)

Project Speaker: Yuri Svirezhev

Project Members: Wolf Steinborn, Valeri Pomaz

Funding: PIK

Despite the fact that up to now no direct homeomorphism between models in thermodynamics and ecology exists, it could be useful to formulate thermodynamic concepts in application to an ecosystem. From the thermodynamics point of view, any ecosystem is an open system. An ecosystem in the climax state corresponds to the state of dynamic equilibrium, when the entropy production within the system is balanced by the export of entropy from the system to the environment. The energy and matter exchange between the system and its environment is almost completely determined by the first autotrophic-level, the vegetation. Vegetation and soil can be considered as the ecosystem. The atmosphere and the surrounding region, which also includes neighboring ecosystems, can be considered the environment of the system.

EVITA'S FOCUS

The EVITA project aims to apply a special thermodynamic concept to the problem of integrated indices. These describe the state of vegetation and use the spectrum of radiation balance for their calculation.

RESEARCH STRATEGY

A calculation of the energy, entropy and information characteristics of the energy transformation can be performed using existing data sets by measuring the components of radiation balance. The vegetation tends to minimize the exergy with respect to the radiation balance. Differences between the current exergy and minimum exergy are shown in Figure 1. Minimal values of this difference on the continents correspond to the maximal productivity of global vegetation. These indices may be used as an integrated description of the climatic homeostasis of vegetation since the change of radiation balance is a main driving force for climate change.

CASE STUDY: AGRICULTURE IN NORTH GERMANY

From 1988 until 1997 land management and the energy input—organic and inorganic fertilizers—and output in the watershed of Lake Belau in North Germany were studied. There was a tendency toward a decrease of

entropy overproduction of maize, oats, wheat, and perennial grass and no changes for rape, rye, barley, and annual grass. The entropy overproduction means a measure of the degradation of agroecosystems and the agricultural impact on the environment decreased by 11 percent. This means the study region has reached a higher level of sustainability, although the agroecosystems produce more entropy than they can export to the environment. Possibilities to compensate for the imbalance in the entropy budget are the following:

- the anthropogenic energy input could be reduced,
- the crop production could be reduced,
- the export of biomass could be increased.

The reduction of anthropogenic energy input seems to be the most useful strategy. On the one hand, the excessive amount of fertilizer during the observation was reduced, whereas on the other hand the yield was increased, which could partly be a result of weather conditions. The resulting overproduction of entropy significantly depends on the selected reference system. According to the hypothesis, the reference system must be a natural one, similar to the examined agroecosystem.

ASSESSMENT OF THE METHOD

The proposed methodology can be utilized as a focal feature of future ecological monitoring activities via remote sensing. Thus, assigned parameters can be used as measures of the ecological sustainability of anthropogenically influenced systems.

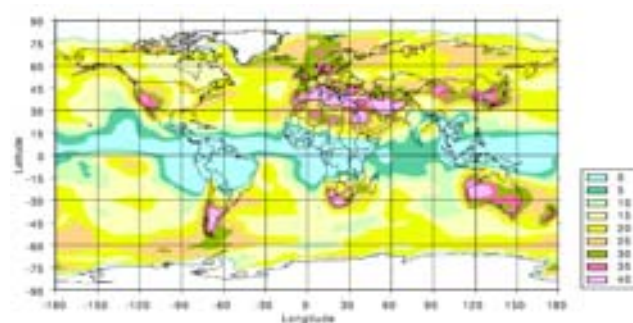


Fig. 1: Map of the difference between the current exergy and minimum exergy [in W m^{-2}]: minimal values of this difference on the continents correspond to a maximal productivity of global vegetation. NASA data were used for this analysis.

Quaternary Earth System Stability (QUEST)

Project Speaker: Martin Claussen

Project Members: Eva Bauer, Victor Brovkin, Reinhard Calov, Siegfried Franck, Andrey Ganopolski, Alexa Griesel, Matthias Hofmann, Anja Hünerbein, Claudia Kubatzki, Anders Levermann, Till Kuhlbrodt, Miguel Maqueda, Marisa Montoya, Susanne Nawrath, Vladimir Petoukhov, Stefan Rahmstorf, Yuri Szerezhev

Funding: Variabilität und Dynamik des Klimasystems während der letzten Interglaziale - BMBF, Modelltheoretische Untersuchung des Einflusses von Änderungen der Leuchtkraft der Sonne auf das Klima der letzten 12.000 Jahre - BMBF, Simulation der langfristigen Variabilität im Klimasystem des Holozäns mittels eines gekoppelten Atmosphäre-Ozean-Biosphäre-Modells mittlerer Komplexität - BMBF, Study of the Atlantic thermohaline circulation in a highly efficient global ocean-atmosphere model - BMBF, Vom Eem ins Holozän: Modellierung des letzten Warm-Kaltzeitzyklus mithilfe eines Klimasystemmodells mittlerer Komplexität - DFG, Modelltheoretische Untersuchung zur Rolle mineralischen Staubes im Klimasystem des späten Quartärs - DFG, Comer Science & Education Foundation - McDonnell Centennial Fellowship

Humans have altered the chemical composition of the atmosphere and the land surface at a pace that is drastic even in geological terms. According to our best current understanding, the global warming of the near-surface atmosphere during at least the last decades is, to a large part, caused by humans, and it is expected that this trend will continue or even increase during the next decades. To improve our understanding of the dynamics of the natural Earth system in its present geological epoch, the late Quaternary—in particular, the stability of this system to natural and anthropogenic perturbation—the QUEST project was designed. Three results from this project are presented in the following as examples of QUEST achievements.

ABRUPT CLIMATE CHANGE

Heinrich events, i.e., large-scale surges of the North American (Laurentian) ice sheet, represent one of the most dramatic types of climate change occurring during the last glacial. These surges were successfully simulated as internal oscillations of the ice sheet. Such surges are, albeit at a smaller scale, possible in present-day ice sheets. Dansgaard/Oeschger (D/O) events, i.e., drastic temperature changes in the Greenland-North Atlantic region during the last glacial, have been explained in terms of stochastic resonance. This is a process in which the events are triggered by a combination of random climate variability plus a weak underlying cycle in the hydrological cycle, for example. The new theory is able to explain the peculiar regularity in the occurrence of the D/O events.

NATURAL INCREASE IN GREENHOUSE GASES

The increase of atmospheric CO₂ concentration during the last 8,000 years was simulated by using, for the first time, a fully coupled atmosphere-ocean-vegetation model including models of terrestrial and marine biogeochemistry. The study indicates that the increase in atmospheric CO₂ concentration of some 20 ppm (parts per million) is partly due to a climatically induced degradation of boreal and subtropical vegetation and partly due to changes in oceanic biogeochemistry.

HUMANS AND CLIMATE DURING THE LAST 1,000 YEARS

Climate variations during the last 1,000 years were simulated by imposing natural and anthropogenic forcings. It was found that natural forcing, such as changes in insolation and volcanic activity, dominated climate variations until the end of the 18th century. During the 19th century changes in albedo due to deforestation probably extended the so-called Little Ice Age which, naturally, would have ended in the first half of the 19th century. In the second half of the 20th century emission of greenhouse gases appears to be the most important climate forcing.

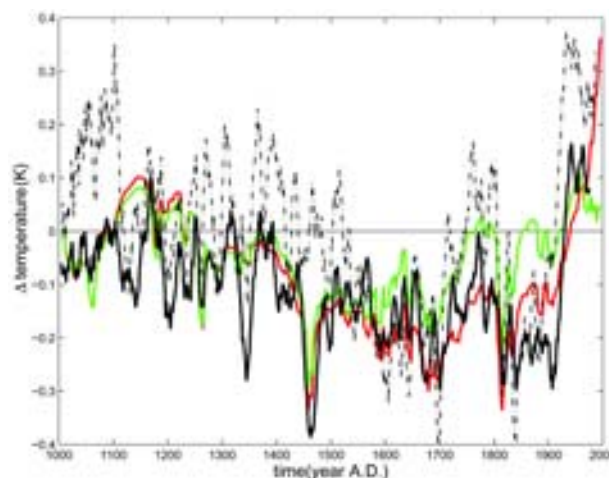


Fig. 1: Changes in Northern Hemisphere mean temperature during the last 1,000 years taken from reconstructions until the middle of the last century (black lines). The red and green curves show the results obtained with the climate system model CLIMBER-2. In one of the simulations (indicated by the green line) only estimated natural climate forcing is prescribed, in the other case (red line) anthropogenic forcing is also considered (Bauer *et al.* 2003).

Theoretical Research in Planetary Ecological Dynamical Earth Systems (TRIPEDES)

Project Speaker: Siegfried Franck

Project Members: Werner von Bloh, Christine Bounama, Yuri Svirezhev, Antony Z. Owinoh, Pavel Egorov

Funding: Stabilität der Selbstregulation im System Erde - HSP-N Bund/Land, Koevolution von Bio- und Geosphäre auf langen Zeitskalen - DFG

EVOLUTION MODELS OF THE EARTH SYSTEM

A coupled biosphere-geosphere model (CBGM) for the long-term evolution of the Earth system was developed in the framework of the project TRIPEDES. This model describes the global carbon cycle between the reservoirs formed by the Earth's mantle, ocean floor, continental crust, biosphere, kerogen (dispersed, insoluble, organic carbon in rocks) and the coupled ocean and atmosphere reservoir. This basic model was refined by introducing three different types of life forms: procaryotes, eucaryotes, and complex life forms. This was done under the assumption that every different type of life form exists in a specific temperature tolerance window and that only the complex life forms enhance biogenic weathering appreciably. These investigations led to a new hypothesis for the Cambrian explosion 542 million years ago: a

gradual global cooling triggered a sudden increase of biodiversity.

DYNAMICAL HABITABILITY OF EXTRASOLAR PLANETARY SYSTEMS

It is not feasible with present-day technology to detect Earth-like habitable planets around sun-like stars. Nevertheless, one can examine known planetary systems with the help of computer models to determine whether habitable Earth-like planets on stable orbits around their host stars might exist. Such a configuration is named dynamically habitable. To investigate dynamical habitability a simplified version of the CBGM was applied. The calculations show that habitable Earth-like planets on stable orbits are in principle possible in the systems 47 Ursae Majoris (UMa) and 55 Cancri (Cnc). This likelihood is further increased if these planets are so-called "water worlds," i.e. a large portion of their surface is covered with oceans. Since our Earth can be classified as such a "water world," it could exist as dynamically habitable in both planetary systems.

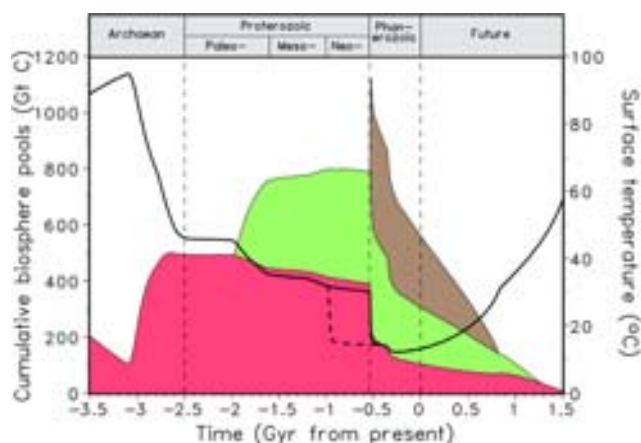


Fig. 1: Evolution of the mean global surface temperature (bold black line) and the cumulative biosphere pool of procaryotes (red), eucaryotes (green), and complex life forms (brown) in Gt carbon. Before the Cambrian explosion the system exhibits bistability; there is a second evolutionary path for the surface temperature (dashed black line; von Bloh et al. 2003)

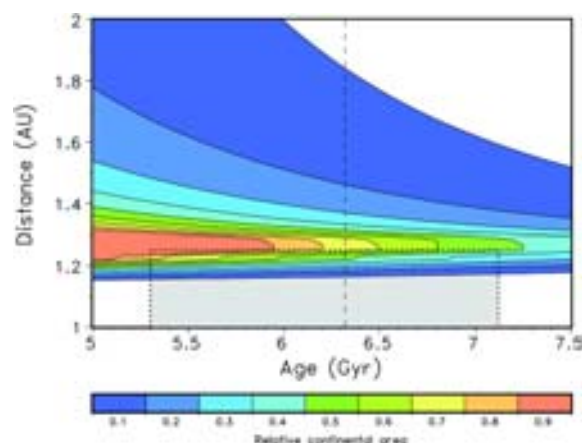


Fig. 2: The habitable zone (HZ) around 47 UMa. The age of the central star is 6.32 (+1.2, -1.0) billion years. The different colors show the HZ for different portions of relative continental area. The gray shaded area shows the limits of stable orbits up to a distance of 1.25 Astronomical Units (AU) from the central star. (Franck *et al.* 2003)

ToPIK 2 — Management of Singular Events

ToPIK Mentor: Stefan Rahmstorf

This ToPIK is concerned with extreme events such as severe storms, floods, and droughts, or with abrupt changes in the Earth system, so-called singular events. Examples of these are the break-up of a large ice sheet, a meteorite impact, or a major volcanic eruption. Singular events are characterized by a major impact or change occurring over a relatively short time, in contrast to a gradual trend. Singular events can have a particularly damaging effect on natural and socioeconomic systems. This ToPIK aims at characterizing singular events with respect to their potential consequences, at defining and assessing associated risks, and at developing mitigation and adaptation strategies.

Singular events present a particular challenge to science and society—they present risks that are difficult to predict and their impacts can be severe. Hence, much more uncertainty surrounds singular events compared with most other aspects of climate, but the risks nevertheless cannot be ignored. This problem was approached from very different directions by the projects in ToPIK 2.

The aspect of uncertainty and the possibility of early warning was the focus of the GRAIN project, which by analyzing a simple conceptual model found that near the critical point of an abrupt change in ocean circulation, certain precursor oscillations may arise. While this is an interesting theoretical result, there is still a long way to go before such ideas can be used to find possible early warning signs in the real ocean.

A different way of dealing with uncertain global change events is not to predict them, but instead to assess the vulnerability of the coupled human-environment system to a wide range of possible events. This helps to identify vulnerable regions and sectors of the economy and provides information for reducing their vulnerability. For example, the EVA project produced maps depicting the most vulnerable regions and sectors in Europe. Another initiative within EVA focused on people's adaptive capacity to extreme river events in the lower Rhine valley in Germany, as part of the German Research Network Natural Disasters (DFNK).

Yet another way to assess risks associated with singular events is to play out certain scenarios in a "what if" style: in this way an integrated assessment of the consequences of a major change in Atlantic ocean circulation is performed in the INTEGRATION project. Jointly with German and Norwegian partners, the impacts on marine ecosystems, fisheries, agriculture, and forestry are explored with a range of impact models, including a model that tracks the fate of individual cod larvae in the Norwegian Sea.

How can we avoid singular events? Two projects have used a "tolerable window" approach to provide guardrails for future emissions with the goal of preventing singular events. GRAIN has devised a method for including the risk of global river flooding events when designing a "safe" climate policy, and INTEGRATION has computed a whole range of "safe" emission corridors that would minimize the risk of ocean circulation changes.



Stefan Rahmstorf

PIK Projects

EVA

GRAIN

INTEGRATION

Environmental Vulnerability Assessment (EVA)

Project Speakers: Richard Klein, Wolfgang Cramer

Project Members: Lilibeth Acosta-Michlik, Markus Erhard (until December 2003), Uta Fritsch, Hans-Martin Füssel, Andrey Ganopolski, Torsten Grothmann, Jochen Hinkel, Sabine Lütkemeier, Anthony Patt, Dagmar Schröter, Frank Thomalla, Anne de la Vega-Leinert, Sönke Zachle, Mark Zebisch

Funding: Schutz klimasensitiver Systeme in Deutschland: Empfehlungen zum Schutz und zur Anpassung durch den Klimawandel gefährdeter Systeme in Deutschland - UBA, Advanced Terrestrial Ecosystem Analysis and Modelling - EU, Climate Change and Adaption Strategies for Human Health in Europe - EU, Dynamic and Interactive Assessment of National, Regional and Global Vulnerability of Coastal Zones - EU, Integrated Assessment of Vulnerable Ecosystems under Global Change - EU, Indikatoren des anthropogenen Klimawandels in Europa - WAKE II- Bewertung von gegenwärtigen und zukünftigen Klimamaßnahmen in Europa im Kyoto Prozess- EU, Security Diagrams - Ein innovativer Ansatz zur Abschätzung der Gefährdung durch extreme Klimaereignisse - Gesamthochschule Kassel, Einrichtung eines "Deutschen Forschungsnetzes Naturkatastrophen (DFNK)" - Bundesministerium für Bildung und Forschung

EVA is an ongoing interdisciplinary project that involves scientists from all five departments of PIK. Since 2001, its objective has been to develop and apply tools for conducting environmental vulnerability assessment. This involves the analysis, evaluation, and presentation of data and information on:

- the mechanisms and magnitude by which global change affects natural and human systems,
- responses and interactions of these systems that reduce their exposure and enhance their adaptive capacity to global change.

EVA has pursued this objective in collaborative, externally funded projects which addressed the following questions:

- What will be the combined effects of global change on terrestrial and coastal ecosystems and the functions and services they provide to society?
- How will these changes affect social and economic processes, and how will they interact with other ongoing developments in society?
- What capacity does society have to adapt to global change, and what are the opportunities and constraints on increasing this capacity?

Research in EVA has been a combination of quantitative modeling and qualitative analysis. Using large data sets and scenarios of relevant socioeconomic and environmental variables, the purpose of quantitative modeling in EVA has been to map potential impacts of global change

and the capacity of society to adapt to these impacts, thus providing insights on spatial and temporal patterns of vulnerability. Qualitative analysis in EVA has aimed at better understanding social factors that can cause or reduce vulnerability to global change, such as the perceptions of individuals and private companies of their ability to prepare for and cope with extreme weather events.

Underpinning these two types of research is a conceptual framework of vulnerability that distinguishes between exposure, sensitivity, and adaptive capacity as the three main determinants of vulnerability to global change. Exposure and sensitivity give information about the potential impacts of global change, while adaptive capacity is a measure of the extent to which one can respond to those impacts (Figure 1).

EVA will continue until December, 2004. Interim results, based on the conceptual framework shown in Figure 1, have highlighted the close connection between vulnerability to global change and the socioeconomic development status of exposed individuals, communities or countries. This connection will be explored in greater detail over the next few years within the newToPIK 6—Vulnerability and Development project (see page 46).

Members of EVA have contributed actively to a large number of national and international initiatives and meetings related to vulnerability and adaptation to climate change. Organizations that have benefited from input from EVA include the United Nations Development and Environment Programmes, the World Bank, the International Strategy for Disaster Reduction, Germanwatch, the Intergovernmental Panel on Climate Change, the Organization for Economic Co-operation and Development, and the World Health Organization.



Fig. 1: Simplified version of the conceptual framework of vulnerability underpinning the research carried out in EVA.

Guardrails and Indicators for Climate Protection (GRAIN)

Project Speaker: Elmar Kriegler

Project Members: Nicolas Bauer, Ottmar Edenhofer, Hermann Held, Thomas Kleinen, Gerhard Petschel-Held

Funding: Sequentielle indikatorbasierte Regelungsstrategien im Rahmen des Leitplankeansatzes in der integrierten Klimaschutzanalyse - VolkswagenStiftung, Wissenschaftliches Sekretariat zur Unterstützung des neuen Vorsitzenden von IGBP-GAIM - BMBF

The GRAIN project explored innovative approaches to assess robust climate protection strategies under uncertainty and nonlinearity. The research focused on four key questions.

HOW CAN WE ACCOUNT FOR THE LARGE UNCERTAINTY ABOUT THE COMPLEX HUMAN-ENVIRONMENT SYSTEM?

The uncertainty about climate change cannot be quantified by precise probabilities in many cases. We have investigated the suitability of weaker uncertainty measures which offer the possibility to capture ambiguity and imprecision, respectively. Random set and possibility theory were applied to transfer the large uncertainty about typical parameters in integrated assessment climate models—such as climate sensitivity—to estimates of global mean temperature change in the 21st century. Warming estimates on this basis can generate very imprecise uncertainty models. The imprecision of information allows the decisionmaker to opt for different equally "rational" choice sets. Results show that even in cases where the ambiguity about future climate impacts is large, a small choice set of optimal policies might be identified.

HOW CAN WE CONSTRUCT INDICATORS OF NONLINEAR THRESHOLDS?

During recent years, the danger of abrupt changes in the climate system has received increasing attention. In some cases, these abrupt changes can be understood within the framework of dynamical systems theory. For example, a collapse of the North Atlantic thermohaline circulation can be understood as a saddle-node bifurcation. We have investigated these transitions and have developed an indicator that allows the determination of the distance to the bifurcation point from information contained in the variability of the system.

HOW CAN WE INCORPORATE EXTREME EVENTS?

Climate change brings about changes in the mean climate, as well as changes in the variability and the

extremes of climate. An increase in extreme events, like floods and droughts, constitutes one of the major concerns associated with climate change. We have investigated how changes in extremes can be incorporated within the tolerable windows approach, which aims at the calculation of the remaining "maneuvering space" for climate policy, when certain impacts of climate change are to be excluded. As a first exemplary application, we considered the case of floods on a global scale. For the world's largest river basins, we derived a change in probabilities for flood events due to changes in the hydrological cycle associated with climate change. We were able to condense this information in a climate impact response function that enables policymakers to specify flood guardrails.

WHAT IS THE IMPACT OF TECHNOLOGICAL CHANGE ON CLIMATE PROTECTION AND WELFARE?

We have developed the model MIND—an endogenous growth model resolving the energy sector—for assessing the role of technological change in achieving climate protection goals. It is shown that technological change in different sectors can reduce the costs of climate protection substantially. In particular, learning-by-doing in the renewable energy sector has a considerable impact on reducing emissions and associated welfare losses. Improving energy efficiency is important as a preparatory step for the introduction of renewables. Carbon Capturing and Sequestration (CCS) allows for postponing the transformation of the energy sector from a fossil fuel-based to a renewable energy system.

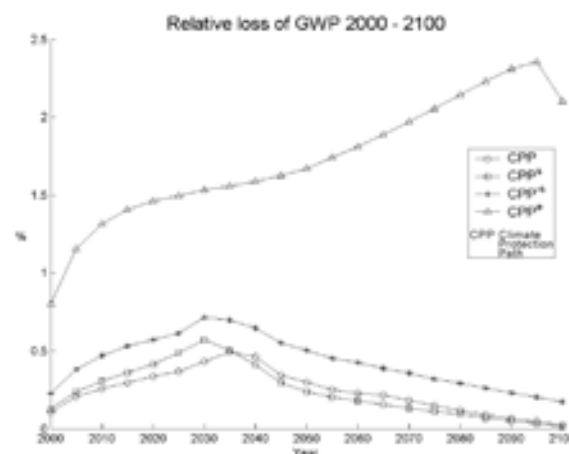


Fig. 1: Gross World Product losses relative to the case without climate protection for different portfolios of mitigation options. (CPP: all options; CPP^S: no CCS; CPP^L: no CCS, no learning by doing in renewable energy sector; CPP^E: only energy efficiency).

Integrated Assessment of Changes in the Thermohaline Circulation (INTEGRATION)

Project Speaker: Till Kuhlbrodt

Project Members: Stefan Rahmstorf, Wolfgang Cramer, Carlo Jaeger, Stefan Pohl, Kirsten Zickfeld, Gerd Bürger, Matthias Hofmann, Franz Badeck, Frank Wechsung, and external working groups

Funding: Integrated Assessment of Changes in the Thermohaline Circulation – DEKLIM Programme of the BMBF

Ecosystems and human societies in the North Atlantic region greatly profit from the warmth that the North Atlantic Current carries to them. Climate models and data from the past show that the thermohaline circulation (THC) in the oceans, of which the North Atlantic Current is one branch, may abruptly weaken or even shut down altogether. INTEGRATION explores the possibilities and consequences of future changes of the THC, addressing the following guiding questions:

- How likely is a weakening or a breakdown of the THC?
- What are the potential impacts of THC changes on ecosystems, economy, and society?
- What are possible strategies to reduce the risk of changes of the THC?

To answer the guiding questions an Integrated Assessment approach comprising the following components is used:

- climate scenarios from several climate models,
- exploration of the marine and terrestrial impact chains using various impact models,
- an expert elicitation collecting the current knowledge about the THC and the risks of its changes,
- a dialogue with stakeholders to assess the dangerousness of a THC breakdown,
- an uncertainty analysis addressing several types of uncertainty,
- an integrated assessment model (IAM) to outline mitigation options reducing the risk of a THC breakdown.

RESULTS

Two scenarios have been investigated so far: a moderate weakening and a complete breakdown of the THC. Preliminary simulations with the Climber-2 model (*Climate Biosphere model-2*) suggest that the latter could lead to a cooling by several degrees localized over the northern Atlantic region. These climate scenarios are downscaled to drive the impact models. First results of the phytoplankton model show that the main effect of THC changes is expected to be through changes in nutrient

supply. Cod stocks in the Barents Sea will most likely be negatively affected, due both to the local cooling and the decreased advection of copepods, an important prey. Simulations with a bio-economic fishery model show almost entirely negative consequences, with greatest economic losses for trawl fishery. In agriculture, the cultivation zone for wheat shifts northward with global warming; this movement will be reversed by a THC breakdown. In the global vegetation model Lund-Potsdam-Jena (LPJ), the tendency of soils to be a net carbon sink during global warming is reversed, so that in the breakdown scenario they temporarily become a net carbon source. An Integrated Assessment of climate protection strategies suggests a reduction in future greenhouse gas emissions to minimize the risk of a THC breakdown (see Figure 1). The quantification of parameter uncertainty is carried out through modeling and by eliciting experts' opinions. The dialogue with stakeholders revealed the importance of risk communication, especially with respect to the long timescale of oceanic circulation changes. The possibility of an additional sea level rise of up to 50 centimeters poses yet another threat to coastal areas. INTEGRATION continues its task in 2004 and 2005.

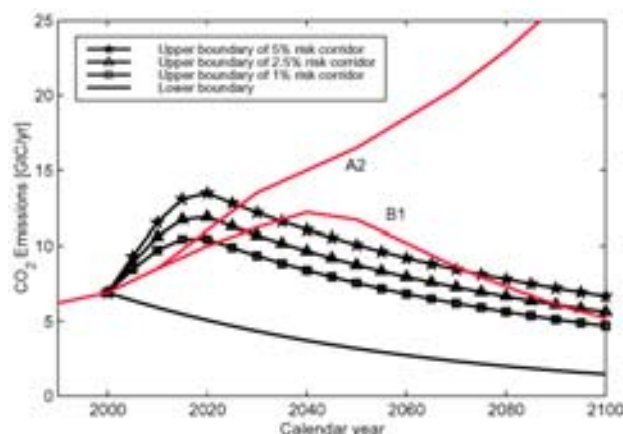


Fig. 1: Emission corridors—the areas between upper and lower boundaries—which prevent a breakdown of the THC with x% probability. Any emission path leaving the x% risk corridor leads to a THC breakdown with probability greater than x%. To limit the probability to 5%, for instance, emissions would have to be reduced within the coming decades relative to the business-as-usual scenarios A2 and B1. The corridors were computed with the IAM (Zickfeld & Bruckner 2003).

ToPIK 3 — Socioeconomic Causes of Global Change

ToPIK Mentor: Carlo Jaeger

Humankind is about to carry out an unplanned large-scale geophysical experiment with the climate of the planet. Society is prepared to pay for climate impact research because it wants to know what it must expect—in order to prepare appropriately and to adapt to the inevitable. It is, however, also the responsibility of this field of research to think about the causes of climate change, and about possible remedial action, its feasibility, and the associated costs and benefits. Causes need to be investigated before they can be tackled. This is an interdisciplinary task with a clear social sciences core. In this ToPIK, this core is formed by a broad spectrum of the social sciences including economics, sociology, political sciences, psychology, and geography—embedded in the interdisciplinary landscape of PIK and supported by mathematics and computer modeling.

A distinction is often made in research on social driving forces between direct drivers and underlying causes. ToPIK 3 looks at both dimensions. The timescale we employ here is unusually long for many types of socio-scientific analysis—the next 20, 50, or even 200 years. We have to think in terms of these time horizons because the inertia of the climate system and long-term structural changes in national and especially in global social systems have to be taken into account. One research focus of this ToPIK deals with the possible contribution of technological developments toward the reduction of anthropogenic greenhouse gas emissions. Particular emphasis is put here on the energy system as a whole, its development paths, and the respective cost structure. The learning curves of renewable energy sources are just as important as the technical possibilities for storing carbon dioxide—in order to "buy time" for example. At the same time we look at the chances offered by information and communication technologies. Technological change can only tap the full potential for climate protection if it is embedded in a wider social change and in appropriate overlying political structures. We therefore look intensively at consumption and lifestyle changes and at political instruments and institutions. A relatively new field of research in this ToPIK deals with the role of global financial markets. The central question here is how their functional mechanisms can be used or modified so as to achieve a more sustainable development of economy and society and to promote climate protection.

To tackle the causes of climate change intelligently, we have to consider both the long-term perspectives and what is feasible here and today. PIK has decided to deliberate intensively on the possible contribution of the European Union to the "here and now" of climate protection (see PIK Project EUROPA). And we show that those who want to talk about climate protection are not necessarily obliged to draw an altruistically motivated map of renouncement and painful restructuring. It is quite possible—and this is demonstrated by our empirical results, the models, and by discussions with decisionmakers—to sketch a story of profit, innovation, wise structural change, and modernization.



Carlo Jaeger

PIK Projects

EUROPA

EUROPA

Climate Change and Financial Markets

Projekt Speaker: Carlo Jaeger

Project Members: Anne Biewald, Hannah Förster, Yvonne Gruchmann, Armin Haas, Cezar Ionescu, Rupert Klein, Frank Meissner

Funding: Bundesministerium für Bildung und Forschung, in the framework of the project "Europa," and PIK

THE CHALLENGE

In the past decades, losses for weather related disasters—corrected for inflation—have jumped from about five billion euros to more than 50 billion euros. Only one quarter of these damages is currently insured.

Financial markets are affected by climate change via its implications for insurance, but also via those for energy supply. Investments in producing commercial energy until 2030 are expected to amount to more than 15 trillion euros. An example of decisions currently taken in this domain is the agreement by UK-based financiers to back ambitious climate policy targets with a 400 million pound deal to finance off-shore wind farms.

Research on climate change has paid little attention to financial matters so far. This might change given the increased vulnerabilities and the political debate on future energy investment securities. The present project helps in meeting the resulting challenge for research and policy.

INNOVATION IN MODELING AND THEORY

Recent research on insurance markets shows how profit-maximizing firms deal with constraints on the ruin probabilities they are willing to accept. With the model LAGOM—a Swedish word for harmony and balance—we represent insurance markets along these lines. The model is based on a multi-agent architecture and takes advantage of the tools provided by the PIAM and SimEnv projects.

Expectations for climate risks are modeled by an expectation manager equipped with Bayesian up-dating processes. It may be used to represent the role of scientific communities and mass-media in shaping the expectations of various economic agents.

A software agent operating as model driver allows for flexible enlargements of the present structure. One of the next steps will be the introduction of a banking module that can be used to represent the role of credit and stock markets.

POLICY DESIGN

After the Elbe-flood, the EU implemented a solidarity fund for financing relief measures in the face of this kind of disaster. PIK research on climate change and financial markets has led to concrete proposals for how to use this instrument as a stepping-stone toward new combinations of adaptation and mitigation measures in climate policy.

In the spirit of a "Kyoto-plus" strategy, the implementation of the European emissions trading scheme can be gradually complemented by public-private partnerships in establishing markets for insuring climate risks. These markets can generate two kinds of desirable incentives. They can induce economic agents to avoid locations exposed to new risks from climate change. And they can foster investment in products and technologies that will avoid those risks altogether.

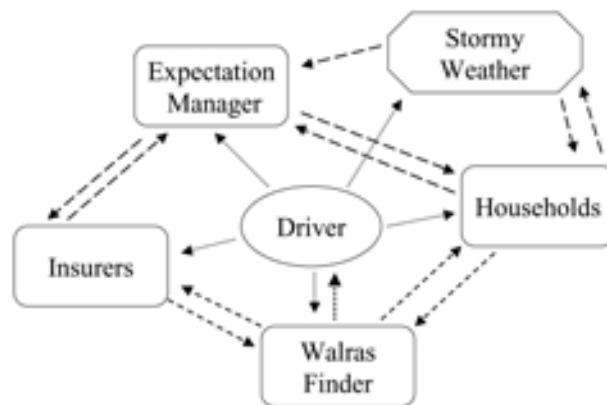


Fig. 1: Structure of the LAGOM model.

EUROPA

How to Model Induced Technological Change

Project Speaker: Ottmar Edenhofer

Project Members: Katrin Gerlinger, Armin Haas, Carlo Jaeger, Marian Leimbach, Ina Meyer, Jürgen Scheffran, Detlef Sprinz

Funding: Framework of the project EUROPA - Bundesministerium für Bildung und Forschung, Ozean-Sequestrierung von CO₂ und die Transformation des Energiesystems - VolkswagenStiftung, PIK

THE DYNAMICS OF THE TECHNOLOGICAL CHANGE

Many discussions of climate policy take it for granted that reducing emissions gets more and more costly as one wants less and less emissions. This implies a simple linear dynamics with far-reaching policy implications. Under these assumptions, e.g., the European emissions trading scheme puts European industry at a disadvantage compared with their competitors.

Currently, research on technological change is one of the most buoyant fields in economics, and many findings suggest that two important effects lead to a different dynamics. First, there is learning by doing: building a single windmill is very hard, but once experience can be accumulated by on-going investment in windmill production, costs will fall. Second, there is investment in research and development: producing electricity from hydrogen was all but impossible a few decades ago, meanwhile targeted research and development has led to interesting prospects in fuel-cell technology. The current project investigates the relevance of these two effects for European climate policy.

IMPLICATIONS FOR CLIMATE POLICY

If models take the two mentioned effects explicitly into account they yield a nonlinear dynamics with multiple equilibria: small efforts to reduce emissions lead to additional costs for the economy and leave heavy users of fossil fuels with a comparative advantage, large efforts toward emissions reduction turn the situation around. In the latter case, climate policy becomes an investment with sizeable economic returns, implying comparative advantages for carbon reducers.

The basic modeling structure—embodied in the MIND model—has been developed in close cooperation with the PIK Projects GRAIN and PIAM. MIND suggests that large emissions reductions might be feasible at perfectly reasonable costs (Figure 1).

This result is already obtained for a globally aggregated analysis. A regionalized model—REMIND—is currently under development in order to study the dynamics of international competition and the interactions between climate policies, foreign investments, and trade.

THE ROLE OF INTERNATIONAL COMPETITION

When the dynamics of technological change is duly taken into account, a large economic region like Europe plays two interlinked roles: it develops know-how in some technological fields rather than in others, and it may or may not transfer such know-how into other economic regions.

The first role is relevant when developing options like use of renewable energy or sequestration of carbon from burning fossil fuels. The second role is relevant when considering foreign direct investment abroad. Both roles are analyzed with the REMIND model in the current project.

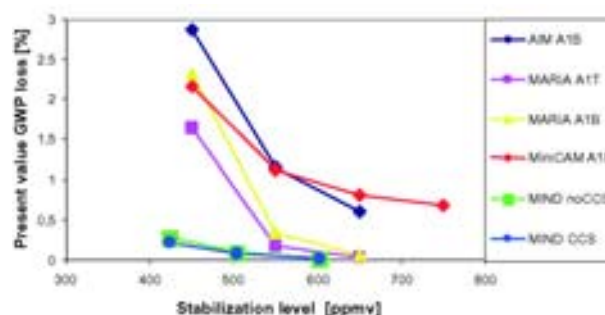


Fig. 1: Costs of climate stabilization at different levels according to different models. The PIK model MIND shows significantly lower costs.

EUROPA

Lifestyles and Sustainable Consumption

Project Speaker: Fritz Reusswig

Project Members: Maren Ewald (until 2002) Torsten Grothmann, Hermann Lotze-Campen, Ina Meyer, Diana Runge, Julia Schwarzkopf (until 2002), Susanne Stoll-Kleemann (until 2002), Martin Welp

Funding: Framework of the project EUROPA - Bundesministerium für Bildung und Forschung, Entwicklung eines Sustainability Portfolio - Deutsche Telekom, PIK

CONSUMPTION AS A DRIVER OF GLOBAL CHANGE

A key driver of global climate change is the use of fossil fuel-based—commercial—energy for heating, mobility, and other consumption purposes. Such energy use in turn depends on an infrastructure of durable goods like houses, cars, roads, etc. and is "fuelled" by income development, value structures, and other factors that affect people's individual preferences and perspectives for a "good life." Are there realistic prospects for a transition toward more sustainable consumption? Do they hold for eight billion people?

It is hardly feasible to bring about such a transition simply by making critical goods more expensive: the price changes required would be so large that governments would have great difficulties in managing the resulting conflicts over redistribution of income. Fortunately, lifestyles change for other reasons, too. Figure 1 shows a world map of energy use. Income is important but not the only influence. Cultural and geographical factors interact with income and prices to bring about such large-scale consumption patterns. Global lifestyle dynamics has been investigated in different case studies.

VIRTUAL MOBILITY

The first case study refers to mobility. The results show that income per capita is the most important factor for greenhouse gas emissions from traffic on the household level, with infrastructure and policy frameworks as important factors influencing private mobility. An interesting factor in the future may become the substitution of physical mobility by virtual mobility. Basic technological innovations bringing about the "information society" have been investigated with regard to their substitution potential for CO₂ emissions (e.g., telephone and video conferences).

MEAT CONSUMPTION

The second case study concerns meat consumption. Sociological research has shown that reduced meat consumption is a strong symbolic marker for environmental concern. Moreover, it has immediate environmental relevance in terms of changing use of agricultural land and water. Again, income per capita is a key factor for meat consumption. However, data from the U.S. and Europe suggest a slight de-coupling of income and meat consumption growth, probably rooted in a change toward healthier and more pro-environmental lifestyles. An interesting question for future research is whether or not this might influence the dietary habits in important developing countries.

RISK PERCEPTION

The third case study deals with the perception of flood risks which are publicly perceived as highly visible impacts of climate change. Among other things, this is important for insurance purchases and for decisions about building sites. Here, cultural factors at the individual level are particularly prominent. Recent research investigates the efficiency of "fast and frugal" heuristics for decisions about risks where actuarial evidence is not available. With regard to lifestyle changes, a key issue is given by health risks. Their importance suggests that isolated concern about climate change is less likely to bring about lifestyle changes than more broadly framed environmental concern. Our results suggest that climate risk communication should not only focus on the risk of climate change but at least as much on how to model induced technological change.



Fig. 1: Patterns of energy use. The six global energy use clusters are based upon time series on carbon intensity, energy intensity, energy efficiency, CO₂ emissions, and per capita income during the 1990s.

ToPIK 4 — Emergence of a Global Subject

ToPIK Mentor: Gerhard Petschel-Held

Global change is changing the fundamental modes of operation of the Earth system. Research within this ToPIK is motivated by the thesis that a necessary change in the direction of global change needs not only new strategies for environment-related human actions, but that new structures of global decisionmaking are needed—structures which we might call a global subject. These new structures encompass new forms of observing and perceiving global changes as well as a new coalition between existing or emerging actors within global change.

The following research questions were addressed:

- How to better organize and structure interdisciplinary research, in order to develop an efficient, transparent, and flexible modeling toolbox for decisionmaking (see PIK Project PIAM)?
- Which structures of international environmental organizations exist today, and what determines the efficiency of the overall structures and of individual organizations? To what extent can these organizations be improved for better global environmental management (see PIK Project GloGov)?
- How to extend and modify present-day observation instruments of global change, in order to improve the data availability in particular on socioeconomic developments and to create new images of sustainable development (see PIK Project GPP)?

The research approaches pursued in the ToPIK are new and thus have required extensive conceptional work. Each of the three projects has developed an innovative framework, which now and in the near future serve as baselines for more concrete realizations and research. Strategically, the so-called modular approach to integrated model-based assessment appears to be of utmost importance. Not only has the PIAM project laid new conceptual and theoretical foundations, but it has succeeded in establishing the modular approach as a community-wide strategy for a new generation of integrated assessment. The basic idea is to develop independent modules of particular sections of the coupled human-climate system with well-defined interfaces for communication between the modules. This ensures that the best knowledge available enters into individual models and that individual modules can be exchanged, added to, or removed from the overall assessment model. The PIAM project also provided the numerical and technological framework for module coupling.

Within the GPP project the concept of a Geoscope was developed. By integrating regional and sectoral foci, a Geoscope provides an instrument for a representative observation of the most important socioeconomic and, to a lesser extent, also natural trends and developments, related to sustainable development.

Finally, a cross-project discussion was initiated to improve and sharpen the overall strategic questions of the ToPIK. As a major result, a new, more illustrative and concise title for the ToPIK was formulated which starting in 2004 will serve as a headline for the second phase of research within the ToPIK: Global Actors in the Sustainability Transition.



Gerhard Petschel-Held

PIK Projects

GloGov

GPP

PIAM

Global Governance (GloGov)

Project Speaker: Frank Biermann (until July 2003); Klaus Dingwerth
Project Members: Lilibeth Acosta-Michlik, Torsten Grothmann, Robert Marschinski, Gerhard Petschel-Held, Bernd Siebenhüner
Funding: Wirksamkeit und Lernfähigkeit internationaler Organisationen in der Umweltpolitik - VolkswagenStiftung

The Global Governance Project is a collaborative research project of the Potsdam Institute for Climate Impact Research, the Freie Universität Berlin, the Vrije Universiteit Amsterdam, and Oldenburg University. Project work is divided into three research groups: "Managers of Global Change" (MANUS), "Multiple Options, Solutions, and Approaches in Climate Governance" (MOAIC), and "New Mechanisms of Global Governance" (MECGLO).

MANAGERS OF GLOBAL CHANGE

The research project "Managers of Global Change: Effectiveness and Learning of International Environmental Organisations" addresses these questions:

- How effective are international environmental organizations?
- How do different organizational designs influence effectiveness?
- How can international environmental organizations learn to improve their effectiveness?
- How can new approaches such as qualitative modeling help to understand these processes?

The project is conducting comparative in-depth studies of nine international environmental organizations, including the United Nations Environment Programme (UNEP), the World Bank, the International Maritime Organisation (IMO), and several convention secretariats. The group has specified criteria of effectiveness and learning and developed a set of hypotheses about the relationship between the various variables. Six of the nine field-trips to the international organizations and secretariats were completed in 2003; the remaining interviews will take place in spring 2004. The team is currently evaluating the data gathered from its field-trips. Final results are expected at the end of 2004.

MULTIPLE OPTIONS, SOLUTIONS, AND APPROACHES IN CLIMATE GOVERNANCE

This group explores the consequences of parallel approaches and regimes in climate policy and analyzes

what sets of compatible and diverging rules emerge in parallel regimes, how they may predetermine the political opportunities for coordination, and what response strategies policymakers could avail of.

NEW MECHANISMS OF GLOBAL GOVERNANCE

The MECGLO research group analyzes the emergence of new mechanisms of global environmental governance over the last few years. Among these mechanisms are so-called global public policy networks, multi-stakeholder processes, and green alliances between business actors and civil society groups. The group explores why these collaborative arrangements come into being and what impacts they have on the effectiveness and legitimacy of global environmental governance.

The Global Governance Project organized and co-organized the 2002 and 2003 Berlin Conferences on the Human Dimensions of Global Environmental Change which took place at the Freie Universität Berlin in December, 2002 and 2003. In addition, the project has established the Global Governance Speakers Series; guest speakers included among others Klaus Töpfer (Executive Director, United Nations Environment Programme), Sheila Jasanoff (Harvard University), and Reinhard Loske, Member of the Bundestag for the Green party.



Fig. 1: Headquarters of the United Nations in New York. The MANUS project analyzes the effectiveness of international organizations in addressing global environmental problems.

Geoscope Preparatory Project (GPP)

Project Speaker: Wolfgang Lucht

Project Members: Hermann Lotze-Campen, Carlo Jaeger

Funding: PIK

SEEING THE FUTURE

The consequences of human action in the Earth system are not only a passive function of developments within human societies. Actions are also influenced by an analysis of priorities against the background of cultural and physical predispositions, and are evaluated in view of real or perceived outcomes. As the scope of human activities has reached a global scale and is affecting the Earth system as a whole, it seems essential to ensure that opportunities for reflective feedback are available which are compatible with this scale. What societies are able to perceive of the consequences of their actions, and how this perception is embedded in ongoing societal discourse about priorities and directions of action, is strongly dependent upon the extent and focus of available observations, associated frameworks of interpretation, and options for analytical transformation. Do we already have the right instruments to provide human societies with a suitable feedback on the consequences of human action with respect to global change, sustainability, and the Earth system seen as a whole?

CREATING IMAGES OF THE WORLD

It is part of the mission of PIK to contribute to the discourse on global change novel images of the world, that have the potential to influence the course of human actions. Such images can be based directly on observation, derived from webs of theoretical thought, or created numerically by computer models. The Geoscope Preparatory Project is a small exploratory project aimed at fostering discussion of this topic. As the available stream of information about the state of the planet increases, questions addressed are whether the available observation systems are already adequate, what the principles of constructing macroscale knowledge from localized observations may be, and how the extent and content of global observation are related to issues of theory and formalization.

AN INTERNATIONAL DEBATE

Work was brought forward through a series of national and international workshops and a dedicated web page. Under the title of "Sustainability Geoscope" discussions

were held on how to provide humanity with an improved early warning system for developments in the Earth system, on increasing the observational basis in the area of societal and cultural drivers of global change, and on integrating knowledge across disciplinary boundaries. Ideas emerging from these discussions were published in a number of contexts, many connected to the international debate on a science addressing the challenge of sustainability. A Geoscope prize is awarded annually (Figure 1).

A CHALLENGE

One finding of the project is that the current strong focus of global observation on the primarily physical aspects of the Earth system, on the one hand, and on the mainly financial aspects of economic accounting on the other, strongly limits our view of the Earth system. Overcoming this limitation will be critical for designing the numerical information tools required by societies in the next decades, and for shaping more reflective mental models of the world. As a consequence, the next phase of work is designed to create computer-derived images of the world that combine mental, economic and natural scientific aspects by linking together numerical process models in the area of human structuring of the global land surface on the basis of scenarios derived from observed patterns (see PIK Project BIOS-X). The Geoscope discussion will also continue as a PIK activity.



Fig. 1: Hermann Lotze-Campen presents Brent Yarnal of Penn State University with the first "Architect of the Geoscope" prize, consisting of bottles of olive oil from three different countries.

Potsdam Integrated Assessment Modules (PIAM)

Project Speaker: Carlo Jaeger

Project Members: Ottmar Edenhofer, Jochen Hinkel, Cezar Ionescu, Rupert Klein, Marian Leimbach

Funding: PIK

The focus of this project was construction of a modular Integrated Assessment (IA) model. IA modeling integrates models of various scientific disciplines. Formerly, all modules of an IA model were generally programmed in the same programming language and developed within a single institution. Specialist knowledge of other research groups could be integrated into existing IA models to a limited extent only. This deficit motivated the PIAM team to establish a modular modeling platform. Such an approach sets out to foster a culture of scientific cooperation, in which expert knowledge, encapsulated in modules, can be exchanged freely and reused frequently to answer important global change research and stakeholder questions.

PIAM first introduced a simple terminology for modular IA modeling. On the most basic level three different types of modules are distinguished:

- Domain knowledge modules (data and functional modules),
- Numerical coupling modules,
- Job control modules.

To integrate the modules into one functional tool (an integrated model), the following tasks have to be performed:

- The inputs and outputs have to be connected according to the mathematical description of the coupled system.
- Numerical algorithms have to be developed to capture the feedbacks between the domain knowledge modules.
- The execution of the modules has to be controlled, i.e., a control algorithm must be written which tells the modules when to execute, where to read the data from, and where to send it.

Within a prototypical application, the modular concept was operationalized and basic elements of the PIAM platform and technology were developed and tested. This application made use of the TDT data transfer library, developed by the department Data & Computation (Scientific Computing), to couple modules written

in different languages and running on heterogeneous platforms.

The configuration of the first application contains an economic module, a climate module, a numerical coupling module, and a job control module, depicted as Module A, Module B, Coupling Module, and the orange box in Figure 1a. The economic and the climate module are linked by a climate guardrail that requires the economic system to reduce emissions (vector y in Figure 1a) to a level that prevents the change of global mean temperature (vector x in Figure 1a) from exceeding 2°C or 3°C. An iterative meta-optimizing algorithm was developed to handle the resulting feedback loop. Within each iteration, this algorithm adjusts an emission barrier (vector y^* in Figure 1a) aiming at keeping within the guardrail (first phase) and additionally aiming at increasing welfare (second phase). While in early iterations emission reduction paths result that reduce economic welfare significantly, in final iterations the guardrail can be kept without a significant loss of welfare (see Figure 1b).

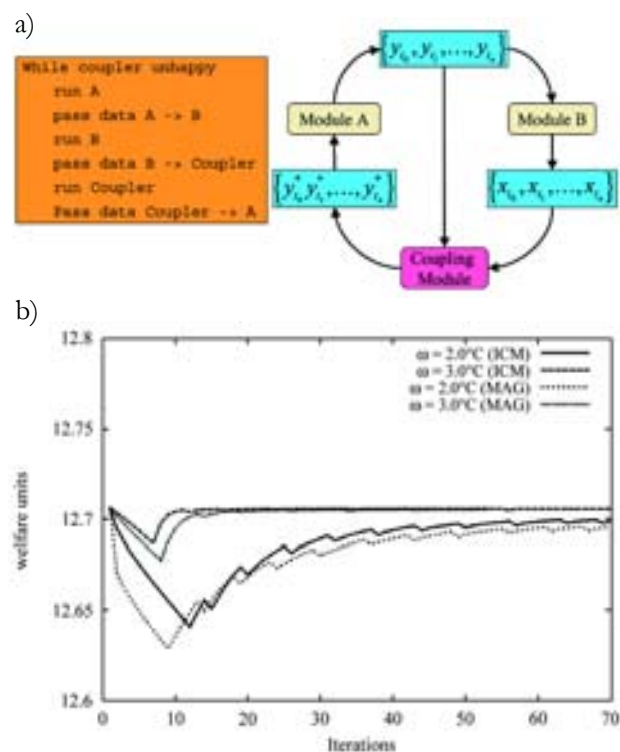


Fig. 1: a) Schematic configuration, b) Convergence of welfare (four cases distinguished by climate guardrail: 2°C and 3°C, and applied climate module: ICM - ICLIPS, MAG - MAGICC)

ToPIK 5 — Regional Simulators

ToPIK Mentor: Manfred Stock

The projects in ToPIK 5 deal with application-oriented components for regional simulators. In collaboration with ToPIK 6, specific regional vulnerability and adaptation strategies are determined, scenarios and targets worked out, and computer simulations performed, which can serve on a regional level as a foundation for strategic decision-making on long time horizons.

WHAT ARE REGIONAL SIMULATORS?

Regional simulators are integrated tools for decisionmaking. They consist of various components (such as methods, data, and models) tailored to the respective problem. A goal of regional simulators is to make it possible to take complex dependencies, uncertainty, and nonlinear temporal developments better into account during the planning process. Factors such as temporal and spatial changes in climate, land use, demography, and the economic and political framework play a role here. A user-friendly interface and the intelligible representation of simulation results should make it possible for decisionmakers to investigate interactively "what if?"-type questions and to fine-tune the simulation to the specific regional features and challenges.

THE ROLE OF INDIVIDUAL PROJECTS IN TOPIK 5

The SYNAPSE project uses specially developed methods, such as the syndrome approach, to identify regional focal points of problematic developments accompanying global change and point to promising initial strategies for coping with them. This makes it possible to select components in a targeted way for use in further, deeper analysis. The QUIS project analyzes examples of the sustainability of regional developments, making use of qualitative differential equations (QDEs) to describe the interaction between the anthroposphere and economy, on the one hand, and the ecosphere on the other. This method enables the identification of the conditions under which catastrophic—i.e., nonsustainable development paths can be avoided.

In ReCSim methods and models for calculating regional climate changes are developed. These models are an advancement over previous techniques in terms of improving both the spatial and temporal resolution and the reliability of results, in order to meet the high requirements of climate impact research. Thus, for example, it was possible to show that with the STAR model, the development trend of regional climate parameters such as precipitation can be estimated with an error of less than ten percent. Work is also being done on regional dynamic climate models with the aim of obtaining this level of reliability not only for trends but also for extreme events.

The goal of the BEST project is to provide a regional simulator for the Berlin-Brandenburg region, integrating natural-landscape and socioeconomic components. The project has investigated the possible impacts of a regional climate-change scenario until the middle of this century on the hydrology, agriculture, and forestry of the region. In the future, a further significant decrease in precipitation, increased evaporation, and thus a worrying decline in groundwater recharge can be expected. The results met with great resonance from the public and decisionmakers and have led to intensive and lasting discussions about suitable adaptation measures, such as forest restructuring or the renaturation of wetlands.



Manfred Stock

PIK Projects

BEST

ReCSim

SYNAPSE

Brandenburg Simulator of Environmental and Socioeconomic Transformations in the Context of Global Change (BEST)

Project Speaker: Frank Wechsung

Project Members: Friedrich-Wilhelm Gerstengarbe, Peggy Gräfe, Fred Hattermann, Anja Habeck, Ylva Hauf, Werner Lahmer, Petra Lasch, Valentina Krysanova, Joachim Post, Felicitas Suckow, Martin Wattenbach, Peter C. Werner, Frank Voß, Reinhard Weng

Funding: Integrierte Analyse der Auswirkungen des globalen Wandels auf die Umwelt und die Gesellschaft im Elbegebiet - GLOWA, Grobrasteranalyse zu den Möglichkeiten für umweltentlastende Landnutzungsänderungen in Folge des globalen Wandels - VolkswagenStiftung

OBJECTIVES

The frequency, intensity, and duration of water shortage is more pronounced in the Elbe river basin than in any other major German river basin. Water shortage leads to limitations for conventional water supply but also affects ecological functions of water bodies, moors, and wetlands. As a consequence conflicts arise among water users with contrary goals. The project BEST explored future problems of water availability and water usage possibly occurring in the Elbe basin as consequence of global change. The investigations were carried out within the framework of the GLOWA-Elbe project together with 20 German research institutions and were additionally supported by the Volkswagen Foundation. The Brandenburg area played a central role in these investigations.

WHAT KIND OF CLIMATE CHANGE SCENARIO IS PLAUSIBLE AND PARTICULARLY PROBLEMATIC?

A plausible scenario is a temperature increase of 1.4 °C in the next 50 years associated with a decrease in total annual precipitation. In some regions, the decrease would be up to 200 mm—exceptions are the Harz and the Thüringer Wald regions. The decrease in precipitation would be established by a continuing trend of decreasing summer precipitation and no further increase in winter precipitation.

WHAT IS THE IMPACT OF THE DECREASING ANNUAL PRECIPITATION?

The evapotranspiration would remain relatively stable. Consequently, surface and subsurface run-off, as well as groundwater recharge would be decreased (up to 50 percent of the current level).

WHAT ARE THE HIGHER ORDER CONSEQUENCES OF THE SCENARIO?

Agriculture: The mean regional yield for winter cereals would decrease between 10 and 15 percent. The maize yields would remain stable. Yield gains could be realized in the northern part of the region. The likelihood of the abandonment of agricultural land would increase in Brandenburg if production-related subsidies are decreased.

Berlin: The surface water inflow from the Spree River to Berlin would decrease. Stimulated growth of algae would cause water quality problems during the summer when the nutrient load were not reduced by at least 30 percent.

Spreewald: Consequences of a sinking of the groundwater table would be losses of valuable areas for nature conservation, peat loss by increased mineralization, nutrient losses to the receiving water course, and changes in native vegetation.

Upper Spree: The available water volumes for flooding of residual pits from open cast brown coal mining would be reduced. Altered priorities for regional water distribution would be necessary in order to address water conflicts.



Fig. 1: Elbe river basin.

Regional Climate Simulation (ReCSim)

Project Speaker: Rupert Klein

Project Members: Uwe Böhm, Nicola Botta, Friedrich-Wilhelm Gerstengarbe, Detlef Hauffe, Martin Kücken, Hermann Österle, Antony Z. Owinoh, Peter C. Werner, Ursula Werner, Martin Wodinski

Funding: Federal Ministry for Education and Research - BMBF; Ministry for Agriculture, Environmental Protection and Regional Planning of the State of Brandenburg - MLUR-Brandenburg; Ministry for Agriculture and Environment of the State of Saxony-Anhalt - MRLU-Sachsen-Anhalt; Regional Office for Environmental Protection Baden-Württemberg - Landesanstalt für Umweltschutz Baden-Württemberg

THE DYNAMIC-STATISTICAL CLIMATE MODEL STAR

The development of the model STAR is based on the idea that only generalized information from global climate model results should be used as initial parameters to calculate scenarios on the regional scale. These parameters and/or their changes are coupled with observation data by especially developed similarity relations. Using Monte Carlo simulations, any number of realizations of future climate scenarios can then be calculated and the most probable development can be derived. Previous validations have shown that the model error is generally below 10 percent.

The model has already been successfully used for calculating future scenarios for the Elbe river basin, for Brandenburg, Bavaria, and Baden-Württemberg, and it has been tentatively used in other areas of the Earth. Figure 1 shows the precipitation change for Brandenburg within the next 50 years.

THE DYNAMIC LOCAL CLIMATE MODEL (CLM)

Based on the nonhydrostatic operational weather forecast model LM of the Deutscher Wetterdienst, the CLM climate model was developed in cooperation with the GKSS Research Centre in the period 2002/2003. At the same time, a preprocessing module was developed that allows analyses of the European Centre for Medium-Range Weather Forecasts (ECMWF) to be used for the initial and boundary value supply of the CLM. In cooperation with the Brandenburg University of Technology

in Cottbus, a validation module was developed that allows us to comprehensively evaluate the model quality for climate simulations from a combination of multivariate and univariate statistical methods. The model was successfully used for seasonal periods with different horizontal resolution between approx. 50 kilometers and 7 kilometers as well as for the reproduction of the climate in 1979/1988 over Europe.

THE DYNAMIC CORE OF CLM

Parallel to the aforementioned activities, the dynamic core of CLM was modified for different standardized test cases. It can now be used for different resolutions, stochastic boundary conditions, different background conditions, and different topographies. The accuracy and stability of the dynamic core for almost hydrostatic flow conditions was investigated. Moreover, a balanced finite-volume method was implemented for these almost hydrostatic flows in conservation form for mass, momentum, and energy. As a result, we were able to show that this access can be used to distinctly reduce errors in the vertical velocity of air masses. The difficult modeling of precipitation should profit from this result.

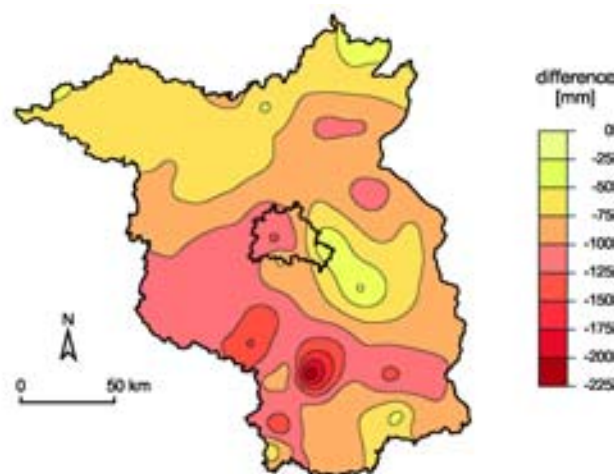


Fig. 1: Projected precipitation difference for Brandenburg between 1951/2000 and 2046/2055.

Syndrome Assessment and Policy Strategy Evaluation (SYNAPSE)

Project Speaker: Gerhard Petschel-Held

Project Members: Klaus Eisenack, Jürgen Kropp, Matthias Lüdeke, Diana Reckien, Diana Sietz, Oliver Walkenhorst

Funding: Urban Sprawl: European Patterns, Environmental Degradation and Sustainable Development - EU; Typische Ursache-Wirkungsmuster der Landnutzungsänderung und deren qualitative Modellierung in ausgewählten Entwicklungs- und Schwellenländern - DFG

Work within the SYNAPSE project is based on the syndrome's approach where the processes directing the dynamics of global change as unsustainable are decomposed into major patterns of human-civilization interactions. These syndromes result from the close interplay between socioeconomic, political, and cultural processes of human use of nature, on the one hand, and natural processes of resilience, recovery, and renewal on the other.

RESEARCH QUESTIONS

To what extent can the concepts and methods of the Syndromes Approach be used on a regional scale in order to obtain an understanding of processes sufficient to develop policy options within a participatory process involving regional stakeholders? This overarching question has been investigated within three case studies which are briefly presented here.

Results

NORTHEASTERN BRAZIL

Smallholder agriculture appeared to be the relevant pattern and to be describable by the generic qualitative variables yield-oriented labor, off-farm wage labor, resource quality, yield, and budget. In Figure 1 the modeled dynamics and the present dynamic states of northeastern Brazil's municipios are displayed. The formal analysis revealed that the critical states of rural exodus can only be avoided by an increase in resource quality, either by natural/farm budget-driven renewal or by external interventions such as land reform and improvement of irrigation facilities—clearly showing the direction of potentially successful development measures.

URBAN SPRAWL IN EUROPE

Here a comparative study of seven urban agglomerations in Europe revealed common patterns of sprawl mechanisms which were incorporated in a qualitative model framework, able to reconstruct and predict urban sprawl. First policy-relevant results from the ongoing project

were obtained under stakeholder participation. For the Leipzig agglomeration, for example, the reurbanization could, according to the model results, be endangered by the increasing sprawl of middle-income households due to gentrification of the inner city. This sets clear guidelines for a policy striving for compact city development.

OVEREXPLOITATION OF MARINE RESOURCES

The qualitative model developed was able to trace the evolution of capital and fish stock in good agreement with observed patterns. It was possible to show that overcapitalization is unavoidable in unregulated fisheries in industrialized countries in North America, the European Union, and Asia. Investigation of co-management strategies revealed that government quota recommendations based purely on the observation of fish stocks expose the fishery to a high economic and the stocks to a high ecological risk.

Future Activities

The successfully applied syndrome approach will be further developed in the following PIK projects: SYNDICATE, reviewing the original list of syndromes and striving for a worldwide indication of their occurrence; the INTERVULNERABILITY project where the simultaneous impact of climate change and globalization on livelihoods in developing countries will be investigated; and COMPROMISE, dealing with optimal management regimes for renewable resources.

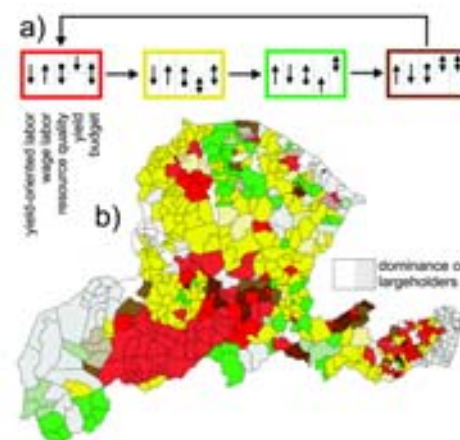


Fig. 1: a) Modeled trend combinations of smallholder agriculture in northeastern Brazil and their development over time. b) Spatial distribution of trend combinations: rural exodus and insecure income prevail.

ToPIK 6 — Sectoral Climate Sensitivity

ToPIK Mentor: Wolfgang Cramer

Projects in this ToPIK deal with the vulnerability of natural systems and economic sectors, which depend on them. Using specifically developed numerical models, we investigate probable reactions of these systems in response to scenarios of global change. Wherever possible, we look for alternative management strategies, in order to reduce the negative consequences of global change and to identify options for long-term sustainable management.

Economic sectors with particular climate sensitivity that have been studied during recent years are components of agriculture and forestry. We have concluded a national study of the sensitivity of the entire forest-related sector in Germany (see PIK Project SAFE). One of the central results is that different climate scenarios induce widely differing conditions for production in German forest companies. It was also shown that, besides wood production, most other services provided by forests (e.g., recreation) are impacted by climate change. Overall, the planning of adaptive measures in the forest sector requires a significant additional research effort.

Agriculture operates with shorter planning horizons than forestry. This determines a quicker response potential to a changing environment, but also causes a higher sensitivity to changes in the global market place. During recent years, we have studied the vinicultural sector, focusing particularly on product quality (see PIK Project CLAWINE). Investigation of long-term observations allowed a statistical analysis of the relationship between weather and quality of Riesling cultures in the German Rheingau province. It was shown that 83 percent of the variability in quality was directly related to weather conditions. Concerning the potential growth area of grapes in Central Europe, a displacement of its northern boundary could be observed, and a scenario study shows that this trend is very likely to continue.

An example for a relatively direct connection between climate and agricultural production is Morocco. There, wheat yield is a crucial economic parameter, and it changes dramatically from year to year (see PIK Project AIM). In 2000, harvests were very low—as had been predicted early that year by a model developed at PIK. Additionally, for the subsequent years, which showed strong fluctuations, we could show that atmospheric pressure distribution can serve as an early warning predictor for harvests occurring later in the year. This could be used for operational harvest forecasts.

Conclusions for the adaptive capacity of these sectors to climate change range from recommendations to more diverse management (e.g., in forestry, where monocultures showed the highest vulnerability) to the exploitation of new markets, as in viniculture, and to the use of operational forecast instruments to the improved planning within a given year, as in Morocco.



Wolfgang Cramer

PIK Projects

AIM

CLAWINE

SAFE

Agriculture Emphasizing Integrated Modeling (AIM)

Project Speaker: Gerd Bruschek

Project Members: Frank Wechsung, Ylva Hauf

Funding: PIK

About 35 percent of Morocco's population is dependent on agriculture, while only about 9.5 million hectares of land are suitable for agricultural production. From 1982 to 2003 agriculture made up 15.9 percent of Gross Domestic Product. Domestic wheat production is thus of key significance for Morocco.

AIM investigates weather extremes and climatic changes and their effects on agricultural production. Effects of changes on the economic sector are also evaluated. Figure 1 shows the relationship between Morocco's cereal production value and Gross Domestic Product for agriculture.

LONG-TERM PREDICTIONS

Two complementary predictors for the anomalies in Morocco's wheat yields could be identified:

- a pre-planting (PRE) and,
- an early post-planting (ePOST) one.

PRE (Figure 2) uses strong correlations of year-to-year changes in pre-planting Atlantic sea surface temperatures (SST) and Moroccan wheat yields.

The ePOST predictor allows mid-season predictions. It relates fluctuations in the North Atlantic Oscillation (NAO) and in cereal yields to each other. The NAO related linear regression model adjusted for 1982-1995 performed similar reliable results like the SST-based model in the prediction mode during 1996-2004.

RESULTS

Morocco's cereal harvest was dramatically low in 2000. The cereal yield at 4.76 dt per ha was the second lowest since independence. This was well predicted by both of our predictors several months in advance of first alerts of the Food and Agriculture Organization (FAO) in April 2000. The average yield in 2002 and the above normal yield in 2003 could be predicted by both, PRE and

ePOST. Morocco's wheat production in 2003 showed a bumper crop due to favorable weather conditions. In November, 2003, our pre-planting (PRE) prediction assessed a potentially large harvest for cereals in the upcoming 2004 season several months in advance of first FAO, PECAD (Production Estimates and Crop Assessment Division of the Foreign Agricultural Service), and USDA (U.S. Department of Agriculture) assessments.

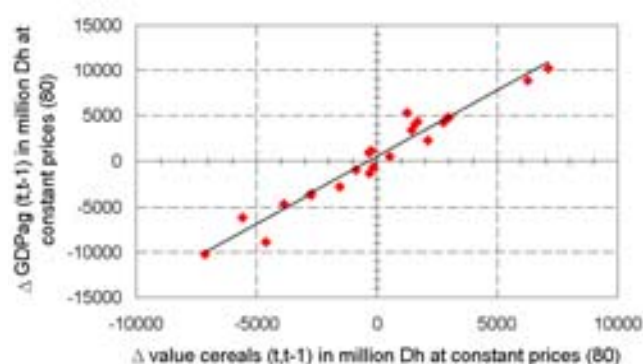


Fig. 1: Linear regression between year-to-year changes (1982-2003) in Moroccan cereal production value [Δ production value ($t, t-1$)] and the Gross Domestic Product Agriculture [Δ GDPag ($t, t-1$)] in local Dirham (Dh) currency at constant 1980 prices.

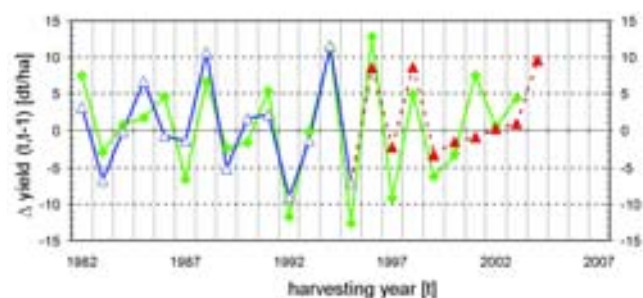


Fig. 2: Comparing year-to-year changes in national Moroccan observed wheat yields for 1982-2003 (filled rhombus) with simulated changes a) in 1982-1995 (open triangle), the period the model was calibrated to; and b) in 1996-2004 (filled triangle), when the model was run in a predictive mode.

Climate Adaptability of European Wine Production (CLAWINE)

Project Speaker: Manfred Stock

Project Members: Franz Badeck, Antonella Battaglini, Friedrich-Wilhelm Gerstengarbe, Thomas Kartschall, Peter C. Werner, Martin Wodinski

Funding: Perspektiven der Klimaänderung bis 2050 für den Weinbau in Deutschland - FDW

The CLAWINE project assesses the vulnerability of wine production under climate change and possible strategies of adaptation. It has established a European network of scientific institutions and wine producers.

RESULTS

In order to complete the basic weather data record covering all German viticultural areas, including the Rheingau, Pfalz and Kaiserstuhl areas, observation data for the period 1951 - 2000 from 109 meteorological stations and 700 precipitation stations in southern Germany were made available.

It was shown that there is a strong correlation between quality ratings in wine and weather conditions. 83 % of the variability in quality ratings can be explained by weather-related factors. The results support the hypothesis that a combination of generally increasing quality in warmer, sunnier years and a reduction of quality in extremely hot years can be expected.

The investigation of potential viticultural areas for different grapevine varieties was extended from individual reference sites to regional studies, including eastern Germany. The results show a northward spread of viticultural areas in the last decades of the 20th century. This trend is likely to continue in the 21st century (Figure 1).

As part of the project, winegrowers in France, Germany and Italy were sent a questionnaire on their experience with climate change. 255 winegrowers responded. More

than 80 percent of them had noticed that climate change is affecting wine quality.

The results support our assumption that northern winegrowers are going to benefit from climate change while those in the south may suffer in terms of quality and quantity.

OUTLOOK

200 different realizations of future climate scenarios for the period 2001 to 2055 covering all German viticultural areas will be calculated using the climate scenario model STAR. The most probable regional scenario will be derived. In addition, scenarios of quality change under climate change will be developed. Investigation of the potential for cultivating different grape varieties will be extended to cover all wine production areas in Germany. This study will also include climatically-induced changes in pests and diseases.

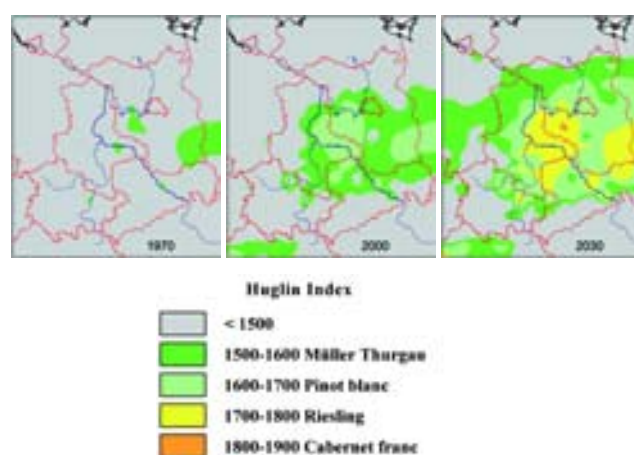


Fig. 1: Long-term development of the Huglin Index in Eastern Germany—here based on the ten-year averaged values—for the decades 1961-1970, 1991-2000 and 2021-2030. The Huglin Index is a warm-sum index based on the sum of maximum and mean daily temperatures above 10°C during the vegetation period from 1st April to 30th September.

Sensitivity and Adaptation of Forests in Europe under Global Change (SAFE)

Project Speaker: Petra Lasch

Project Members: Franz Badeck, Cornelia Fürstenau, Ylva Hauf, Marcus Lindner (up to March 2003), Peter Mohr (2002), Joachim Rock, Felicitas Suckow

Funding: Silvicultural Response Strategies to Climatic Change in Management of European Forests - EU, Multi-Source Inventory Methods for Quantifying Carbon Stocks and Stocks Changes in European Forests - EU, Doktorandennachwuchsgruppe - HSP-N/MWFK.

The overall objective of SAFE is the analysis of likely impacts of global change, including relevant socio-economic trends on managed and unmanaged forests in Europe. Global change may influence the productivity of forest species, competitive relationships among the species, the carbon sequestration, water budgets, and biodiversity at the local and regional scale.

REGIONAL FOREST MANAGEMENT

With a regional study we developed and investigated adaptive strategies for sustainable forest management under global change and the aspect of multifaceted demands on forest ecosystems. Mechanisms of forest goods and services (wood production, carbon sequestration, biodiversity) affected by climate and forest management were addressed. A main focus was on trade-offs between forest functions. The forest growth model 4C (FORESt Ecosystems in a changing Environment) was

used to investigate these questions. The study area was the management unit Kleinsee, a low productive forest area in southeastern Brandenburg mainly stocked with Scots pine and Sessile oak. Different management objectives were compared, such as forest conservation, application of new forest management guidelines, and short-rotation pine plantation maximizing wood production. Mean carbon storage over 100 years is hardly influenced by management. However, management favoring mixed forests leads to higher carbon storage in above and below grown biomass but less in wood products and soil (Figure 1).

CLIMATIC FIRE RISK

2003 was a year with severe forest fires in Brandenburg, which raised the question of possible future trends in fire risk under climate change. Although the fires in Brandenburg are predominantly caused by humans, climatic conditions highly influence the flammability of the fuels. Climate scenarios (see PIK Project ReCSim) were used to calculate three different fire risk trends up to 2050 (Figure 2). The forest fire risk increased for three plausible scenarios of a moderate climate warming. Similar results were obtained with two additional fire risk indices that are in use in hazard prediction and management of precautionary measurements.

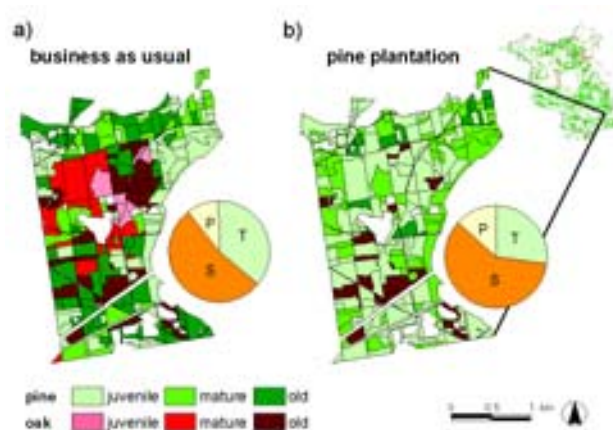


Fig. 1: Impact of two management strategies on forest functions in Kleinsee after 100 years. Species composition and age distribution for preference mixed forest (a) and pine plantation (b). Distribution of carbon in the pools: S, soil organic matter and litter; T, above- and below-ground tree biomass; P, wood products and landfills.

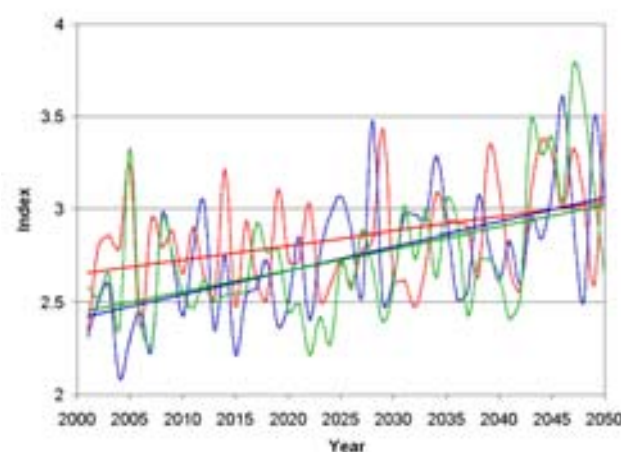


Fig. 2: Climatic fire risk trends according to an index used for fire hazard prognosis (DWD), 2001 - 2050.

ToPIK 7 — PIKular Culture

ToPIK Mentor: Rupert Klein

PIK operates in a scientific field, Global Change and Earth System Analysis, that is as yet largely unexplored. Serious challenges arise from the complexity of the systems considered, from the necessity of truly interdisciplinary research which they imply, from the absence of a comprehensive data base, and from the fact that most of our research activities rely heavily on computational modeling. In response, within "PIKular Culture," there are two kinds of activities covering the "Human Dimension" and the "Methods and Technologies" used in our daily work.

Projects of the "human dimensions" type focus on our capability for interdisciplinary dialogue, on the philosophical and conceptual underpinnings of our research, and on a common baseline of priorities. These activities force participants to step back from everyday occupations, and to take on the "how, what for, how well, and why" of research at PIK as the focus of attention. Projects in this group within the present reporting period were PIRSIQ and PROGRESS (see below for project summaries).

An important and successful example for the kind of activity pursued here is the "Cartesian Seminar" run within the PIRSIQ project. Its idea is to select texts of general interest to PIK's research and study them to an unusual depth within a small, quite stable, regularly convening, and slowly increasing group of participants. The focus is on developing a truly common understanding of the text among the participants. Thus, we have consistently exercised our communication skills on diverse, interdisciplinary themes.

As much as interdisciplinary research requires the proper mindset, it also needs to be supported through appropriate methods, techniques, and technologies to prosper. Projects of the "Methods and Technologies" type aim at developing this support through solid contributions to PIK's own set of research tools. The PIKular Culture ToPIK, in particular, houses projects targeting methods or technologies of crosscutting interest within PIK's research profile. Projects in this group within the present reporting period were PRUNE, QUIS, and SimEnv.

An excellent example is the PRUNE project, which is entering its final harvesting phase in 2004. Its goals were to build a repository of tools and techniques for analyzing uncertainties associated with our models, and to apply some of these techniques to one of the models used frequently in ongoing research projects at PIK. For the latter the project chose the Climate Systems department's intermediate complexity CLIMBER-2 climate model. The PRUNE team was able to show how a systematic use of validation data from paleoclimate records can drastically reduce the uncertainty in choosing the free modeling parameters. The Latin Hypercube Monte Carlo method, implemented in joint work with the SimEnv-Project, was used for this study. The latter aimed at providing a simulation environment allowing researchers to access heterogeneous models in a unified fashion and to launch coordinated simulation runs. QUIS addressed the conceptual underpinnings of one of PIK's most demanding challenges: The merger of qualitative and quantitative research paradigms. Specifically, systematic techniques were developed to allow at least qualitative predictions from models whose description is associated with extreme uncertainties. The main theoretical tools were concepts of qualitative differential equations and differential inclusions.



Rupert Klein

PIK Projects

PIRSIQ

PROGRESS

PRUNE

QUIS

SimEnv

PIRSIQ

Project Speaker: Rupert Klein

Project Members: Cezar Ionescu, Nicola Botta, all PIK Members

Funding: PIK

PIK's interdisciplinary research goals necessitate a conscious activity aiming at the development of common or at least overlapping, priorities and notions of quality. PIRSIQ has supported this development by initiating cross-disciplinary discussions and philosophical reflections on our research work.

Research at PIK involves a number of difficulties inherent in our objects of study, which are complex and inhomogeneous in terms of the disciplines concerned. Thus, they lead to the necessity of each department playing simultaneous roles as supporter and scientific leader of a project. These difficulties, while also being at the core of the PIKular Culture ToPIK, are NOT at the core of the PIRSIQ project. In contrast, we focus on contingent complexity due to, among other things, different languages, metaphysical concepts, sets of priorities, and educational backgrounds. But this troublesome diversity is actually one of our most important assets and the very basis of the PIRSIQ project. In *Zen and the Art of Motorcycle Maintenance*, Robert Pirsig demonstrated how the concept of Quality can be an essential one in the attempt to reconcile the seemingly orthogonal "romantic/artistic" and "scientific/technological" world views. It is reasonable to expect that this concept will also prove useful to our task of fostering interdisciplinary research work at PIK. Within this project we have initiated several activities in order to foster the PIK-internal scientific dialogue.

PIRSIQ SEMINAR

In the framework of this seminar we have invited external speakers as well as members of the institute to provide their views on topics related to PIRSIQ's overall goals. Seminar titles ranged from "Object-oriented software design" (Bertrand Meyer, inventor of the Eiffel

programming language), via "State of the art of climate model validation" (Andrey Ganopolski, developer of CLIMBER, the intermediate complexity climate model), "Remarks about model validation" (Nicola Botta, member of Data & Computation's Scientific Computing group), "Translating language and numbers to describe climate change risks" (Antony Patt, Boston University and PIK) to "Wittgenstein and the idea of an Empire" (Carlo Jaeger, head of Global Change and Social Systems at PIK).

CARTESIAN SEMINAR

Our research requires an in-depth exchange of ideas and information among scientists from various disciplines. Each discipline, however, generally increases the efficiency of internal discourse by developing its own abbreviations, and by relying on a presumed contextual background. As the specifics of these specializations are rarely spelled out explicitly, they often impede an efficient interdisciplinary dialogue. Within the Cartesian Seminar we counteract this difficulty by exercising our communication skills. We discuss short texts of general interest to PIK's research at a very detailed level, the goal being a common, clear understanding of the text among the small group of participants. Among the texts studied were parts of Hilary Putnam's *The Many Faces of Realism*, an introductory chapter from *Self-similarity: Similarity and Intermediate Asymptotics* by Grigary Isaakovich Barenblatt, "Notes on the Theory of Choice" by M. Krebs, and a note on *Domains of Discourse* by Carlo Jaeger.

SCIENTIFIC TRAINING

The project also organized lectures on applied mathematics. Among them were an introductory course on "Dynamical Systems" by Yuri Svirezhev, PIK, and a series on "Multi-valued Logics and Applications" by Paul Flondor "Politehnica" University of Bucharest, who stayed at PIK as a PIRSIQ guest for three weeks in 2003.

Program for Post Graduate Earth System Studies (PROGRESS)

Project Speaker: Manfred Stock
Project Members: all PIK Members
Funding: PIK

PROGRESS was founded in 2001 to promote the interdisciplinary exchange among doctoral students and between students and established scientists. The program was not meant to pursue specific research questions, but rather to facilitate structures for mutual exchange and learning.

THE SITUATION

At the end of 2002 147 persons filled positions at PIK. Of these 121 were scientists, including 26 Ph.D. students. In 2003 the number of staff members decreased to 137. Of these 111 were scientists and the Ph.D. students numbered 38. Their average age was 31.

The percentage of female Ph.D. students ranged between 46 percent in 2002 and 40 percent in 2003.

Each PIK department supported several Ph.D. students. With 45 percent of all students the highest number of students worked within the Department of Integrated Systems Analysis. 24 percent of our Ph.D. students belonged to the Natural Systems Department, 18 percent to Social Systems, 8 percent to Data & Computation, and 5 percent to Climate System.

In 2002 four Ph.D. students finished their thesis at the University of Potsdam in the Faculty of Mathematics and Natural Sciences (see Appendix). Two of them received Postdoc positions at PIK; one took advantage of existing scientific cooperations on our "Telegrafenberg Campus" and joined the GeoForschungsZentrum; the fourth is working as a Postdoc at an institute in Valencia in Spain. In 2003 two Ph.D. students finished their thesis, one at the University of Kiel in the Faculty of Mathematics and Natural Sciences and the other one in the Faculty of Mathematics and Natural Sciences in Potsdam. One of these two scientists works at PIK; the other received a contract at the Max-Planck-Institute for Biogeochemistry in Jena. The latter is currently cooperating as a guest researcher with PIK.

Between 2002 and 2003 three of our Ph.D. students received prizes (see Awards) for their Ph.D. thesis.

ACTIVITIES WITHIN THE PROJECT

One major activity of the doctoral students was the self-organization of a series of workshops where some general methodological and theoretical fundamentals of PIK's integrated vision were studied and discussed. More specifically, two workshop series on "Dynamic Optimization" and on "Nonlinear Dynamics" were held. Due to the interdisciplinary character of the groups a high degree of mutual learning was achieved.

During the winter term 2002/2003 a formal doctoral seminar on "Earth System and Sustainability Science" was held at the University of Potsdam organized by Gerhard Petschel-Held. A total of 15 students from four PIK departments took part in the seminar; eleven of them presented results of their own research. The scope of talks ranged from economic modeling, via ocean dynamics, to urban structures and carbon emissions. The seminar thus not only provided opportunities for training in giving presentations, but served as an effective platform for interdisciplinary exchange of information.

In 2003 the ToPIK Process 2004+ (see "The ToPIK Process 2004+ — or: A Never-ending Story?") was organized. Within this brainstorming procedure (e.g., adjustments of the ToPIKs, submission of sketches, attendance at the ToPIK-workshop, and the preparation of proposals) young scientists as well as senior scientists were equally involved. The result was a renewal of PIK's research structure based on an interdisciplinary exchange of scientists with different educational backgrounds and ages. The Ph.D. students benefited from their participation through training in interdisciplinary discussions and their involvement on an equal level with senior scientists. This helped to strengthen their self-confidence within the overall structure of the institute.

At the end of 2003 this project was finished, but the improvement of our Ph.D. students' situation as well as the support of our women students will be one of our most important goals in the following years.

Propagation of Uncertainties in Earth System Models (PRUNE)

Project Speaker: Hermann Held

Project Members: Brigitte Knopf, Thomas Schneider von Deimling, John Schellnhuber

Funding: Wissenschaftliches Sekretariat zur Unterstützung des neuen Vorsitzenden von IGBP-GAIM - BMBF; Modellvalidierung und Ignoranzdynamik - BMBF; Ozean-Sequestrierung von CO₂ und die Transformation des Energiesystems - VolkswagenStiftung

The Earth system modeling community increasingly recognizes uncertainty analysis as crucial, for the sake of community-internal quality standards as well as for decision-making support within Integrated Assessment. PRUNE strives at an uncertainty analysis which is characterized by an interplay of increased dynamical understanding and statistical analysis, and began by setting up two corresponding branches.

- In a conceptual branch, PRUNE notes that the modeling community's master strategy consists of coupling an increasing number of nonlinear modules while still having to prescribe part of the dynamics as "forcing." PRUNE has addressed in particular the sense in which a forced set-up can substitute for the more demanding coupled set-up.
- In a second branch, PRUNE derives an objective measure for the effects of parameter uncertainty in a complex climate model on important diagnostic variables like climate sensitivity.

UNCERTAINTY ANALYSIS OF MODULE COUPLING

Prescribing a single sub-module by data (forcing) can have a decisive influence on the predictability of the system. In most cases the forced version is able to mimic its fully coupled counterpart, but there can be regions in parameter- and state-space where the two approaches differ significantly. We analyzed a conceptual coupled ocean-atmosphere model. Compared to the fully coupled version, the bifurcation diagram of the forced system reveals artificial bistability. Furthermore, in the time series artificial predictive skill can be observed (see Fig. 1) which we explain by the generic existence of unstable periodic orbits. We conclude that with respect to both effects, a forced model set-up must be tested with alternative coupling designs before being taken for granted.

CLIMBER-2 PARAMETER UNCERTAINTY ANALYSIS

Ensemble runs of PIK's climate system model (CLIMBER-2) have been realized to investigate the effect of parameter uncertainty on model output of high

relevance for climate prediction. The focus of the analysis was on the uncertain range of climate sensitivity, the equilibrium temperature response to a doubling of atmospheric CO₂. Statistical analysis of 5,000 CLIMBER-2 runs yielded a bimodal behavior of climate sensitivity—triggered by the extent of southern hemisphere sea ice.

Comparison of model output data with climatologies of the pre-industrial and Last Glacial Maximum period (21 kyr BP) leads—by means of Bayesian learning—to a reduction of the uncertainty range of climate sensitivity.

PRUNE's two branches will increasingly cross-fertilize. A qualitative switch in the CLIMBER-2 sea ice dynamics was found under a purely statistical approach. On the other hand, switches of the type usually revealed by bifurcation analysis allow certain parameter combinations to be definitely excluded, and here imply the most objective type of Bayesian learning. It is planned to enter into dialogue with the GCM community as to how ensemble methods to obtain initial values and parameter uncertainty can be combined with the methods to detect artificial predictability described above in the analysis of decadal predictability.

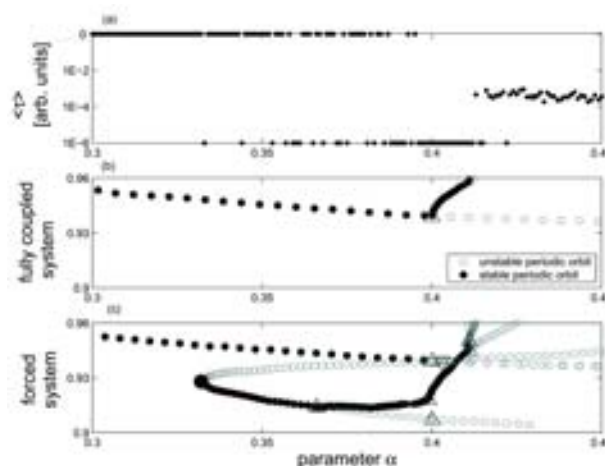


Fig. 1: (a) Mean time $\langle \tau \rangle$ based on a whole run, where the two trajectories of forced and coupled system are closer than a certain threshold; (b) bifurcation diagram of periodic orbits of a certain variable for the fully coupled system; (c) bifurcation diagram of the same variable for the forced system. Specific bifurcations are denoted as triangles. Note that predictability (a) correlates with properties of periodic orbits (b) and (c).

Qualitative Intelligence Service (QUIS)

Project Speaker: Matthias K. B. Lüdeke

Project Members: Klaus Eisenack, Gerhard Petschel-Held, Oliver Walkenhorst, Thorsten Arnold

Funding: Evolution Equations for Deterministic and Stochastic Systems - EU

QUIS aims at bridging the gap between the quantitative modeling and recent progress in hybrid and qualitative modeling techniques. The project concentrates on methods using qualitative differential equations (QDEs) and differential inclusions. These are increasingly used in other projects on smallholder agriculture, urban sprawl, and fisheries management (See PIK Project SYNAPSE and GloGo). Their advantages are an adequate representation of uncertain knowledge, of intrinsically qualitative relations in dynamic models (in particular occurring in descriptions of the human-environment interaction), and the sound generalization of heterogeneous knowledge derived from large numbers of case studies.

During the last two years, progress in the investigation of large qualitative models was made, particularly in analysis of model behavior in relation to sustainability issues (Figure 1a). In parallel, the qualitative simulation software has been substantially enhanced.

Large solution graphs are typical for a QDE. Due to their generality they can consist of up to thousands of qualitative states (rectangles in Figure 1b), each representing a possible combination of trends (small black triangles in Figure 1b) of the relevant variables (rows in the rectangles in Figure 1b). These states are linked by transitions indicating possible changes in time (arrows in Figure 1b), which are, in general, not unique. Robust features in this complex structure which are meaningful with respect to sustainability questions were revealed (e.g., according to Figure 1a, showing a "cartoon" of the Pessimization Paradigm). Three types of clusters of qualitative states have proved to be valuable: lock-ins, no-return sets, and GCBs (generalized chatter boxes). No-return sets are operational modes of a system which cannot be re-entered once they have been left, and are therefore related to irreversible processes. In contrast, GCBs

are modes which can persist for a long time although much fluctuation is observed at a first glance. Lock-ins have been shown to be directly related to sustainability theory (basins of attraction). They denote a situation where the system cannot get out of a region once it has entered (orange and red rectangle in Figure 1b). Algorithms for the detection of these clusters have been developed and integrated into the modeling software.

Combining QDEs with viability theory allows management to be identified which can guarantee that the system is kept between guardrails. Viability theory shows that it is sufficient to investigate the systems dynamics near these guardrails. By restricting the solution of a QDE to this region of the phase space, the resulting graph is much simpler and qualitative management strategies can be derived.

The work on methods of qualitative dynamic modeling for integrated assessment will be continued in the Q³ project. The qualitative representation, the formalization of qualitative theories, and the coupling of QDEs and ODEs will be improved.

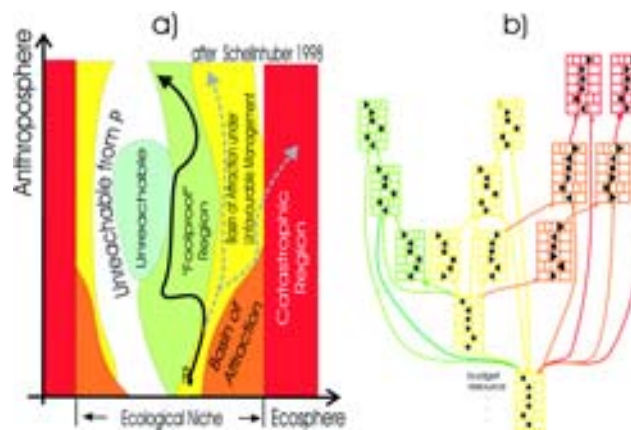


Fig. 1: a) Pessimization Paradigm: avoid states from which trajectories may lead into catastrophic regions; b) solution graph of a qualitative smallholder model reflecting the different state space regions from a), denoted by respective colors.

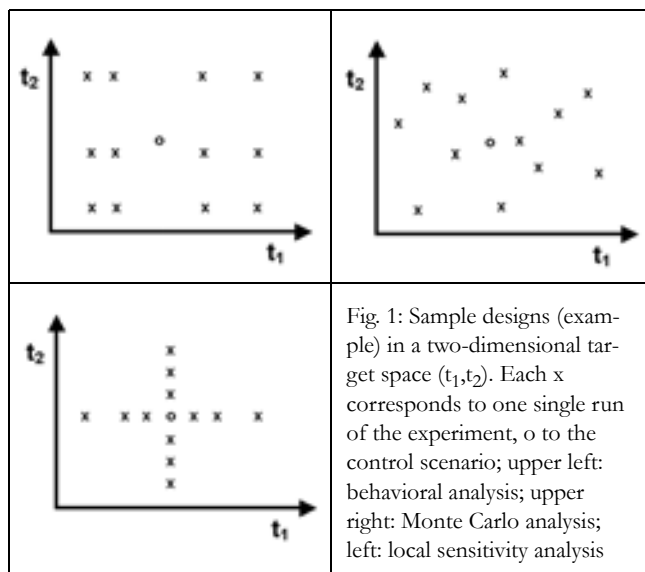
Multi-run Simulation Environment for Quality Assurance and Scenario Analyses (SimEnv)

Project Speaker: Michael Flechsig

Project Members: Claus Rachimow,
Uwe Böhm (Universität Potsdam),
Thomas Nocke (Universität Rostock)

Funding: PIK

The starting point for the SimEnv project was the lack of experimenting frameworks for complex models with barely manageable amounts of model output, as often developed and applied at PIK for Earth System Analysis. Accordingly, the main aim for the project was to research methods and develop tools which, during the entire life cycle of a model, support the user in controlling, managing, and evaluating complex combinations of multiple model runs. At the same time, this simulation environment was required to be a stand-alone tool, applicable autonomously by the model developer and user.



The outcome is the multi-run simulation environment SimEnv that supports key working techniques for model validation, evaluation, sensitivity, and uncertainty analyses and scenario studies in a structured and methodologically sound manner. The interface to the simulation environment supports models implemented in C, Fortran, Python, and GAMS by minimal source code modifications. Additionally, there is an interface at the shell script level. Pre-defined experiment types are the backbone of SimEnv, enabling scanning of the model's dynamics in target spaces spanned up from model parameter, initial or boundary values, and/or driving forces and applying deterministic and probabilistic sampling techniques. Behavioral analysis, Monte Carlo analysis,

and local sensitivity analysis have been implemented so far (Figure 1). The computational load of the resulting multi-run experiment can be distributed across computer networks or on PIK's high performance computer. Interactive experiment post-processing makes use of built-in operator definitions, optionally supplemented by user-defined operators, and applies operator chains to multi-dimensional (gridded) model output and reference data. The goal is to elegantly navigate within the experiment target space and to derive experiment-type-specific secondary output functions. Result output functions can then be evaluated using advanced visualization. Among other formats, the system generates NetCDF model and post-processor output on demand.

SimEnv has been developed in close cooperation with the PIK Projects, which apply it:

Project	Model	SimEnv usage
BIS	LPJ	global model applications
MIND	Mind	scanning parameter spaces
PRUNE	Climber2.3	uncertainty analyses
ReCSim	CLM	sensitivity studies
SAFE	4C	regional model applications

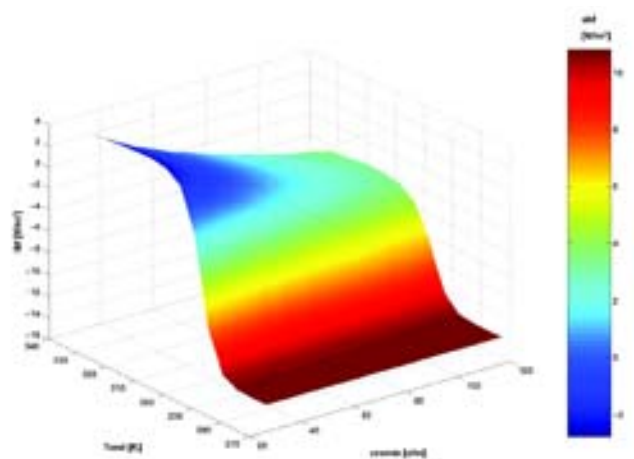


Fig. 2: Exemplary result of a behavioral analysis with the CLM model regarding heat flux anomalies from soil at the surface, averaged over the model area and time in a two-dimensional target space. The above synoptic view was compiled in SimEnv post-processing from the results of 247 single runs of the corresponding experiment.

Development of the Research Structure

The ToPIK Process 2004+ — or: A Never-ending Story?

BY RUPERT KLEIN & HEIKE ZIMMERMANN-TIMM

Quidquid agis, prudenter agas et respice finem.

THE BASIS OF THE TOPIK PROCESS

PIK is organized according to a matrix structure of five departments and seven interdisciplinary research fields, the "ToPIKs." These ToPIKs are maintained for a period of several years, at least seven. PIK Projects are research projects that refer to scientific questions while Tool Projects focus on scientific tools (e.g., fully developed models and data bases). They are established with the aim of professionally preparing, documenting, and providing open source projects in order to increase the distribution of these products within the institute and to the outside. The projects provide the institutional framework for implementing PIK's long-term research agenda. Within each field, "PIK and Tool Projects" of shorter duration reflect current priorities. These projects generally have a life-time of three years; they can be extended without a new research agenda for a fourth year to complete the project work and to publish its results. This last year is referred to as the "harvest phase."

Roughly every three years, the limited life-time of PIK and Tool Projects provides opportunities to critically review current research activities, to react to new challenges, and to initiate new project ideas. The entire ToPIK-based program structure was implemented in 2000/2001, so that the year 2003 was the first time that this major internal review and quest for new ideas was organized. We launched the reviewing and brainstorming phase in May, 2003, with the following stated goals:

- to explore new ideas for future ToPIKs
- to establish Tool Projects

ADJUSTMENTS TO THE TOPIKS

Researchers were invited to review the ToPIKs, with emphasis on

- examination of the ToPIKs' central research questions, and
- adjustments of the ToPIKs' definitions.

The aim of this review was to improve the ToPIKs' coherence and to adjust their strategic aims if needed. This process resulted in minor adjustments to ToPIKs 1,

2, 5, and 7, whereas for ToPIKs 3, 4, and 6 more substantial strategic shifts were implemented (Table 1). These reflect the fact that the concepts of vulnerability and adaptation have become central notions in sustainable science. It was considered necessary to provide a main anchor for related research in the Institute's research agenda in the form of an amended ToPIK 6. As a consequence, ToPIK 3 was adjusted to provide a platform for mitigation-related research, which after the adjustment of ToPIK 6 needed a new focal point. ToPIK 4 was modified to reflect more visibly the multifaceted nature of global political and socioeconomic interactions.

MANAGING THE BRAINSTORMING SEASON

In preparation of the ToPIK-Process 2004+, everyone at PIK was encouraged to submit a project sketch, outlining the research questions, aims, targets, and strategy of a project idea. Ninety-four project ideas were submitted by the end of July, 2003. The sketches were compiled and circulated in advance of the ToPIK-Workshop, which convened in September, 2003, to provide a forum for the evaluation of these ideas. The group of workshop participants consisted of 25 persons, a third of whom were young scientists on the graduate student or post-doc level, a third were members of the institute's leadership, including the ToPIK mentors. Except for the latter group, workshop participation was voluntary and determined from discussions within the ToPIKs. On the first day of the workshop, the sketches were discussed, evaluated, and provisionally assigned to the ToPIKs within five interdisciplinary groups of participants. A subsequent plenary discussion resulted in a first prioritization of the sketches. On the second day, input from invited guests from German universities, primarily Berlin and Potsdam, as well from other Leibniz institutes was solicited and possibilities for future cooperation were explored.

The two-day workshop resulted in a short report, which contained an assessment of each sketch in terms of its relevance, originality, strategy, and clarity. This feedback was the basis for the scientists' decision to move on toward a full project proposal or to delay or discard the project idea.

RESULTING PROPOSALS

Based on the results of the ToPIK Workshop, everyone at PIK was invited to submit a proposal based on the submitted sketches. The evaluation criteria used at the ToPIK Workshop as well as guidelines set by the leadership were provided. Administrative guidelines included one responsible project leader, two to four full-time participants, who spend 80% or more of their time on the project. The total number of participants was not to exceed seven persons.

A special request was made to consider PIK's mission in the formulation of the proposals; this included meeting the persistent challenge of highly complex integrated research problems as well as the necessity for in-depth regional studies. An additional important dimension was the incorporation of the European perspective into the proposals. Impetus for this came about from the connections that have been established between PIK and the Tyndall Centre since Hans Joachim Schellnhuber's tenure in the U.K.

By the end of October 2003, forty-four proposals had been submitted for consideration.

FINAL DECISIONS

After consultations with the ToPIK mentors, the research coordinator, and—importantly—the Scientific Advisory Board decisions were prepared by the PIK council. All submitted proposals were found to be of high quality, so that this content was not an issue for final selection. A primary criterion, however, involved resource requirements. Some projects with similar goals and scope were combined, so that the total number of projects was reduced to the targeted number of 35 PIK and TooL Projects (Table 2). Three of these projects were assigned a PILOT-Project status, i.e., their implementation depends on the availability of external funding, and on the project's advance within the coming year (ASSERT, COMPROMISE, and Intervulnerability). In addition, two successful projects advanced to the "har-

vest phase" in order to complete their research activities. Within PIK's research structure, an additional category of undertaking has been established: ACTIVITIES. These are projects that are of broad interest to our institute, but which will require minimal resources, such as seminar series, discussion platforms, and the like.

THE END OF THE TOPIK PROCESS 2004+ AND FUTURE PERSPECTIVES

We, Rupert Klein and Heike Zimmermann-Timm, would like to extend our gratitude to our colleagues for their active participation in the brainstorming activities and in the important phase of proposal development, both of which were essential for the renewal of our research program. Without your enthusiasm, discipline—and patience with us—this complex process would not have been possible.

The institute's Scientific Advisory Board, reviewing the ToPIK process in November, 2003, sounded some warnings regarding the complexity of the process and the dangers of an over-emphasized bottom-up organization. At the same time they applauded the general development of the research program. Ignacio Campino, one member of our Board of Trustees, who participated in the ToPIK Workshop, was so impressed with this self-review process that he would like to adopt the concept of blending bottom-up/top-down management within his group at a major company.

We now look forward to further fruitful discussions as our ToPIKs and various PIK projects unfold. The progress that we expect in the future will serve as the basis for our next review phase, ToPIK process 2007+, at which time we will convene again to reanalyze, brainstorm, and fine-tune our work.

In closing, through this and subsequent review processes, we hope to maintain PIK's ability to carry out its mandate and to adjust to new demands and challenges.

Research Program 2004 - 2006

ToPIK 1—Nonlinear Dynamics of the Ecosphere

ToPIK Mentor: Martin Claussen

The ecosphere is a dynamic system which encompasses the abiotic geosphere—mainly the atmosphere, oceans, ice masses, and the Earth's interior—and the living world as composed of the terrestrial and marine biosphere; humankind is considered as the external driver of the system. This ToPIK explores the dynamics of the ecosphere and its resilience to large-scale natural and anthropogenic perturbations. Examples are the continuing release of fossil-fuel combustion products into the atmosphere, large-scale changes in land cover, and variations in solar luminosity. Investigations include exploration of so-called switches and choke points in the ecosphere, i.e., regions in which slight external forcings/disturbances can trigger large changes of climate and other vital Earth System elements.

ToPIK 2—Critical Thresholds and Extreme Events

ToPIK Mentor: Stefan Rahmstorf

This ToPIK is concerned with extreme events such as storms, floods, or droughts, and with abrupt changes in the Earth System, such as the break-up of a large ice sheet. Extreme events and abrupt changes are often the result of transgressing critical thresholds. In the vicinity of critical thresholds, a gradual change in environmental conditions can be translated into abrupt changes to natural and socioeconomic systems. Such changes could be as diverse as the collapse of the thermohaline circulation, the bankruptcy of the insurance industry, and large-scale migration flows triggered by environmental degradation.

Abrupt changes and extreme events are characterized by a major impact or a qualitative change occurring over a relatively short time, in contrast to a gradual change. They can have a particularly damaging effect on natural and socioeconomic systems. Scientific study of critical thresholds and extreme events is important to define what would constitute a "dangerous anthropogenic interference with the climate system," which most countries agreed they would avoid under Article 2 of the United Nations Framework Convention on Climate Change (UNFCCC).

Research under this ToPIK might take different perspectives. They encompass:

- sketching and analyzing scenarios for critical thresholds, abrupt changes, and extreme events,
- test cases about critical thresholds, abrupt changes, and extreme events and their consequences,
- developing and applying methods for risk assessment and to deal with the large uncertainties and limited information,
- devising and analyzing policy instruments and institutional arrangements that are particularly suited to avoiding critical thresholds, and at "preparing" for potential extremes and abrupt changes.

ToPIK 3—Mitigation Management

ToPIK Mentor: Carlo Jaeger

The reductions in greenhouse gas emissions required to mitigate climate change pose a major management challenge. There is no doubt that significant and lasting reductions can be achieved by a combination of changing patterns of energy use with changing technologies of energy production as well as new options for carbon sequestration. The question is how these possibilities can be turned into new business opportunities under realistic boundary conditions, and what actors and instruments may be helpful for this purpose.

In view of successful mitigation management, a wide array of organizations needs to find viable strategies in a situation characterized by complex interactions between technological innovation, lifestyle changes, financial markets, and political negotiations.

A key task of the ToPIK is to develop software modules representing different aspects of the organizational search for promising mitigation strategies. These modules shall be combined with modules embodying knowledge rooted in the natural sciences, to be developed in other ToPIKs as well as outside of PIK. Mitigation management requires an unusual capability to integrate knowledge from very different sources in view of a practical problem.

Science by itself, however, will not be able to cover the whole range and the subtleties of management knowledge already in use—even if fraught with contradictions—that can be useful for mitigation management. Therefore, ToPIK 3 needs to embed the development of computer models in a long-term stakeholder dialogue, a dialogue to be shared with other ToPIKs.

ToPIK 4—Global Actors in the Sustainability Transition

ToPIK Mentor: Gerhard Petschel-Held

Research within this ToPIK analyzes structures for managing a heterogeneous Earth system and the human-induced changes within this system taking place on all scales, from local to global. Particular emphasis will be put on the potential of these structures to support sustainable development. To this end projects in this ToPIK address three basic issues:

- Analysis of fundamentals of today's perceptions of global change and the potential to improve on those. Issues like attitudes and lifestyles could be considered as well as monitoring systems that could stimulate changes of perceptions and opinions.
- Investigation of the emergence, structure, interactions, and respective strengths of today's institutions and organizations acting globally. Questions like "How can these institutions be improved toward sustainability management?" are addressed. Furthermore, the processes and conditions promoting new ways of governance and the emergence of new global actors could be assessed.
- Searching new and innovative means of conceptualization and formalization of describing and managing a heterogeneous, in large parts self-regulating, Earth system. Models, data, and expert opinions need to be brought together in a consistent, reproducible, and efficient way.

ToPIK 5—Regional Simulators

ToPIK Mentor: Manfred Stock

This ToPIK aims at understanding mechanisms and modes of regional vulnerability to impacts of global change. Regions face different impacts and respond differently even to similar forcings. The vulnerability of a region and its society depends on the understanding of the expected impacts and the region's ability to adapt. To support understanding of regional vulnerability as well as to enhance adaptive capacity, regional simulators have to be developed which include the following elements:

- detection of regions with particular vulnerability to climate change impacts,
- identification and assessment of the relevant climatological, ecological, social, and economic conditions and processes for selected regions with respect to vulnerability,
- development and adaptation of appropriate simulation models for the dynamic description of these processes,

- combination of submodels to a Regional Integrated Assessment Model and its evaluation with respect to scientific quality, range of applicability, and uncertainty,
- development of a user interface to operate the feedback between simulation and real regional planning and decision-making processes.

The resulting Regional Simulators will be problem-oriented representations of the regional specific state of scientific knowledge.

ToPIK 6—Vulnerability and Development

ToPIK Mentor: Wolfgang Cramer

The projects within this ToPIK address aspects of vulnerability and adaptation related to climate-sensitive ecological systems, economic sectors, social groups, or regions. The investigations focus on fundamental aspects of quantitative assessment, including appropriate methodology for the study of vulnerability and adaptation at different scales. Projects work on issues and regions that have particular need of additional studies. Examples are the consequences of global change for ecosystems and the services they provide, including carbon sequestration, wine production, forest yield, and biodiversity, or the vulnerability of developing regions in the global context. Most projects work in direct contact with stakeholders, thereby aiming at results that can be used as a foundation for long-term management decisions.

ToPIK 7—PIKular Culture

ToPIK Mentor: Rupert Klein

PIK operates in a scientific field—Global Change and Earth System Analysis—that is as yet largely unexplored. Serious challenges arise from the complexity of the systems considered, from the necessity for truly interdisciplinary research which they imply, from the absence of a comprehensive data base, and from the fact that most of the pursued research activities rely heavily on computational modeling.

In response, within "PIKular Culture," PIK intends to

- establish a functioning interdisciplinary dialogue,
- reflect the philosophical background of its research,
- develop common priorities and standards of quality, and to
- synchronize and—if necessary—extend existing disciplinary scientific procedures.

To this end, the ToPIK hosts and invites (internal) applications for two types of projects:

1. HUMAN DIMENSION

Projects of this type focus on our capability for interdisciplinary dialogue, on the philosophical underpinnings of our research, and on a common baseline of priorities. The activities will force participants to step back from everyday occupations, and to take on the "how, what for, how well, and why" of research at PIK as the focus of attention. Unusual, oblique, and mind-boggling project ideas are explicitly invited.

2. METHODS AND TECHNOLOGIES

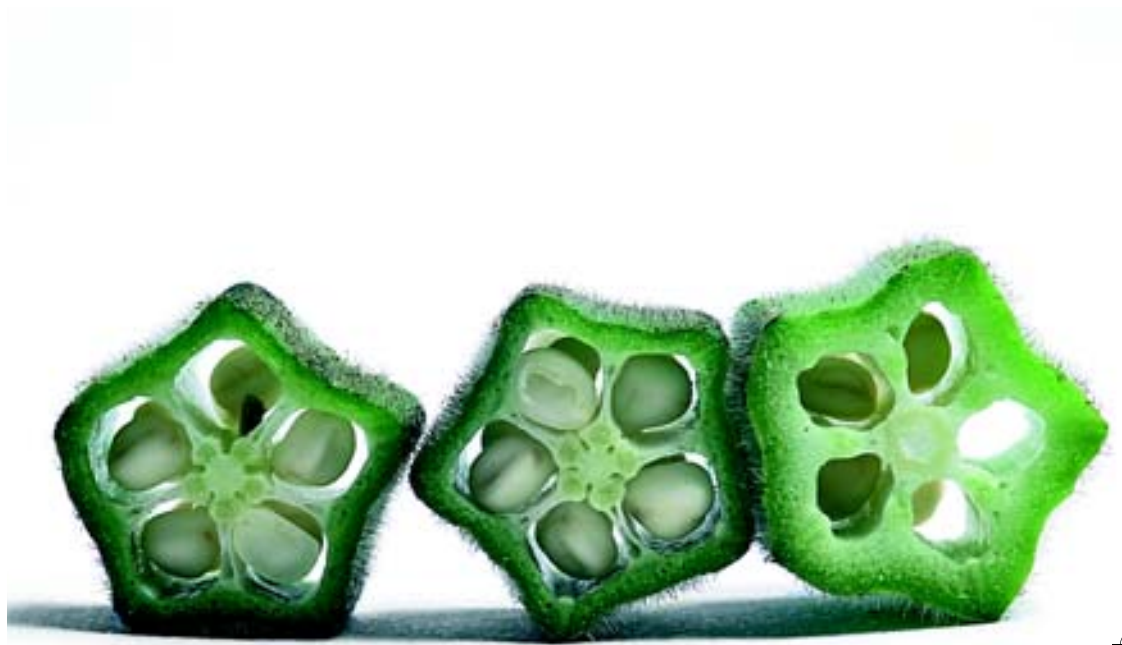
As much as interdisciplinary research requires the proper mindset, it also needs to be supported through appropriate methods, techniques, and technologies in order to prosper. Activities of the second type aim at developing this support within Research and Development projects which will generally aim at becoming Tool Projects in the long run. Precursors to Tool Projects aiming at methods or technologies of crosscutting interest within PIK's research profile are solicited.

PIK Projects 2004 - 2006

ToPIK	Acronym	Title	Project Speaker
1	AO-QUEST	Atmosphere-Ocean Dynamics under the QUEST Umbrella	Anders Levermann
1	ASSERT (Pilot Project)	Assessment of Uncertainty in Climate Change Projections	Hermann Held
1	CLIMBER-3	CLIMBER-3, Earth System Model of Intermediate Complexity	Stefan Rahmstorf
1	C-QUEST	Carbon Cycle in Quaternary Earth System Stability	Victor Brovkin
1	ICE-QUEST	Ice Sheets and Quaternary Earth System Stability	Andrey Ganopolski
1	PLACES	Planetary Ecospheres	Siegfried Franck
1	PCM	Potsdam Climate Module	Martin Claussen
1	RedSynA	Reduced Models for the Dynamics and Statistics of Synoptic Scales in the Atmosphere	Rupert Klein and Vladimir Petukhov
2	INTEGRATION	Integrated Assessment of Changes in the Thermohaline Circulation	Till Kuhlbrodt
2	PREVENT	Assessing and Preventing Dangerous Climate Change	Martin Welp
2	UP-RACE	Uncertainty, Prediction, and Risk Assessment of Critical Events	Jürgen Kropp
2	WatREx	Water-related Extremes	Zbigniew Kundzewicz
3	BIOS-X	Scenarios of Expanded Human Use of the Biosphere	Wolfgang Lucht
3	Lifestyle Dynamics	Lifestyle Dynamics and Sustainable Consumption Patterns	Fritz Reusswig
3	PBM	Potsdam Biosphere Module	Wolfgang Cramer
3	SPARK	Strategic Portfolio Analysis of Climate Change Mitigation Options under Risk and Opportunity	Ottmar Edenhofer
4	AsPIK	Asymptotic PIK: Climatic Risks and Financial Markets	Carlo Jaeger
4	EYES	Science-Society Dialogues	Martin Welp
4	GEOSCOPE (Activity)	Geoscope Design Project	Hermann Lotze-Campen
4	GloGov (Harvest Phase)	Global Governance	Klaus Dingwerth

PIK Projects 2004 - 2006 (Continued)

ToPIK	Acronym	Title	Project Speaker
4	PolMod	Political Modeling: Simulating Political Decisions and Assessing their Effectiveness	Detlef Sprinz
5	BEST-Assessment	Brandenburg's Environmental and Related Socioeconomic Transformations in the Context of Global Change assessment	Frank Wechsung
5	BEST-IF	Brandenburg's Environmental and Socioeconomic Transformations: Integrated Framework	Valentina Krysanova
5	HYDREX	A Set of Statistical Models for the Assessment of Extreme Hydro-Climatical Events in Endangered Regions	Friedrich-Wilhelm Gerstengarbe
5	SYNDICATE	Syndromes and Paradigms 2005: Building a Network for Dialectical Conceptualization	Gerhard Petschel-Held
6	COAST	Coastal Vulnerability	Richard Klein
6	COMPROMISE (Pilot Project)	Conflict Resolution, Management and Problem Solving for a Sustainable Resource Utilization	Jürgen Kropp
6	ForEVAS	Forest Ecosystems: Vulnerability Assessment of Goods and Services	Petra Lasch
6	Intervulnerability (Pilot Project)	Intervulnerability Assessment: A Framework to Assess Vulnerability to Interacting Impacts of Climate Change and Globalization and Its Empirical Application using an Agent-based Model	Lilibeth Acosta-Michlik
6	SERVICE	Strategies to Enhance the Resilience of Viniculture toward Impacts of Climate and Environmental Change	Manfred Stock
6	VME	Vulnerability Maps of Europe	Franz Badeck
7	EURECA (Activity)	Exploring Uncertainty for Environmental Change-related Decision Making	Brigitte Knopf
7	FORECAST (Activity)	Future Options of Research in Climate Change—Application Strategies	Manfred Stock
7	ModSimEnv	Techniques and Tools for Model Coupling, Evaluation and Assessment	Michael Flechsig
7	PixDat	PIK eXtensible Database & Access Tools	Markus Wrobel
7	PRUNE (Harvest Phase)	Propagation of Uncertainties in Earth System Models	Brigitte Knopf
7	Q3	Bridging Qualitative, Semi-quantitative and Quantitative Knowledge for Modeling	Matthias Lüdeke
7	S	Software Components for Distributed Adaptive Finite Volume Methods	Nicola Botta
7	PIRSIQ (Activity)	PIRSIQ	Rupert Klein



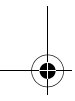
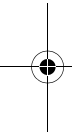
Departments

PIK's interdisciplinary approach is reflected in its five science departments—Climate Research, Global Change and Natural Systems, Global Change and Social Systems, Integrated Systems, and Data & Computation. The first two departments are rooted in the natural sciences, the third in the socioeconomic field, and the last two in what could be classified as "structure science," namely computer science and mathematics.

Every department is organized with a department head and its deputy head. Based on the scientific orientation three to four scientific subgroups, with one subgroup leader, comprises every department.

Within these departments methodological tools, model capabilities, as well as data pools have been developed and maintained. The interdisciplinary work at PIK, which is carried out within the ToPIKs, and their associated PIK Projects, is based on these more disciplinary orientated resources. Other important department tasks include maintaining high quality in scientific pursuit and publications and the promotion of the careers of our young researchers.

The scientific work at the institute is supported by the service department—the administration.



Climate System

Head: Martin Claussen

Deputy Head: Friedrich-Wilhelm Gerstengarbe

Understanding the dynamics of the climate system and the interaction between its components—mainly atmosphere, ocean, biosphere, ice sheets, and soils—is a prerequisite for a comprehensive analysis of a sustainable development of humankind and environment. Therefore the Climate System Department focuses on the statistical analysis of climate data and the construction of climate change scenarios, the development and maintenance of climate-system models, and the investigation of ocean currents, in particular ocean-atmosphere feedbacks.

Climate Analysis and Scenarios

Group Leader: Friedrich-Wilhelm Gerstengarbe

The main task of this group is the statistical analysis of climate and the construction of future climate change scenarios for various regions in the world. For this purpose, a database of climate data has been built up and is continuously expanded and updated. Modern statistical methods have been developed and are continuously being improved, which can be applied to a so-called multivariate analysis of climate, i.e., an analysis of several climate variables in time and space. Moreover, these methods are used to comprehensively validate climate model results. Additionally a dynamical regional model (CLM) is developed on the basis of the non-hydrostatic forecast model of the German Weather Service. Research results in this area provide estimates of climate changes to be expected in the near future. Hence these results are used for assessment of strategies of adaptation to potential climate changes.

Climate System Modeling

Group Leader: Martin Claussen

In the Climate System Department a climate-system model of intermediate complexity, CLIMBER-2 (for CLIMate and BiosphERE, version 2), has been developed to provide an efficient description of the feedbacks between all major components of the climate system on timescales from centuries to millennia. Examples are simulations of the last glacial cycle, changes in the car-

bon cycle during the last 10,000 years, the dynamics of subtropical deserts, especially in Northern Africa, and the analysis of effects of natural and anthropogenic driving forces on the climate change of the past millennium (see PIK Project QUEST). Currently, CLIMBER-2 is being extended to be used as a module for integrated assessment of sustainability. For studies of the natural Earth system which require higher spatial and temporal resolution, a new model framework, CLIMBER-3, is under development in close cooperation with the Ocean Modeling Group and both the Global Change and Natural Systems and the Data & Computation Departments.

Ocean Modeling

Group Leader: Stefan Rahmstorf

Work in the ocean modeling group focuses on understanding the role of the oceans and sea ice in climate change, past, present, and future. A major effort during the past years has gone into developing the ocean component for the new coupled model CLIMBER-3. This ocean model is now fully operational, including a state-of-the-art sea ice model, both stand-alone and coupled to the POTSDAM-2 atmosphere model. Scientific issues that have been looked at were, for example, the role of oceanic mixing and wind forcing for the maintenance of the thermohaline circulation, and the role of ocean circulation changes during past climatic shifts, such as the cold event 8,200 years ago. Further work focused on aspects of the oceanic carbon cycle.

Global Change and Natural Systems

Head: Wolfgang Cramer

Deputy Head: Petra Lasch

The planet's surface is covered by a fine-scaled pattern of land and water ecosystems. These are all sensitive to changes in the environment. To assess such changes, including their importance for human society, as well as feedbacks to the atmosphere, is the primary goal of the department.

Most of our work is concerned with "human" scales of time and space. For ecosystems, we focus on landscape processes, such as tree and canopy development. In hydrological systems we assess the potential and risks environmental change might imply for human land use of river catchments. For the analysis of the entire biosphere we study interactions between human exploitation and the global carbon cycle. In none of these three cases can the direct human influence through management and sometimes destruction be ignored—often it is found to be the primary reason for concern. Our spatial scope is at multiple levels, ranging from the Elbe catchment, through pan-European studies, to global assessments.

Research activities often make use of computer models and large databases. We do, however, also contribute to the coordination of national and international research consortia, and we have found this to be an important element of our activities.

Biosphere

Group Leader: Wolfgang Lucht

The biosphere group is the primary developer of a leading process-based biosphere dynamics model (LPJ), which is validated against observations from space and the ground. The model and supporting databases are used to investigate the role of biospheric processes in the overall Earth system, particularly with respect to its stability on the decadal timescale (see PIK Project BIS).

Ecosystems

Group Leader: Franz Badeck

The ecosystems group uses empirical data and theoretical concepts to assess changes in ecosystem dynamics related to climate and land-use change. It uses a suite of

numerical models at different degrees of complexity, as well as major GIS databases. An important contribution is made to the assessment of the vulnerability of ecosystem services (see PIK Projects EVA and SAFE).

Water

Group Leaders: Axel Bronstert and Zbigniew Kundzewicz

The water group strives to develop a comprehensive understanding of the flow of water and substances transported in it through all stages of the hydrological cycle. The group studies issues of water shortage as well as flood risk, but also broader aspects of land-cover change, such as the implications of economic trends on the use of land (see PIK Project BEST).

Global Change and Social Systems

Head: Carlo Jaeger

Deputy Head: Ottmar Edenhofer

According to current understanding, the global climate problem can only be solved when the global economy achieves the transition to sustainable development. Policy options have to be developed and socio-economic processes need to be linked in a novel way to natural and technical conditions.

Technology and Energy

Group Leader: Ottmar Edenhofer

The group focuses on problems in the area of international climate and energy policy. Model experiments are used to explore ways of transition toward a sustainable global energy system, and the group contributes to the analysis of climate change mitigation options. The development of the multi-sectoral model MIND and the multi-regional model REMIND, together with related modules of the economic and energy systems, constitute a core activity of this platform. One basic theoretical tool is an economic growth model with endogenous technological change. Additional activities aim at the elaboration of an autonomous political decision-making module and the empirical foundation and calibration of all modules.

Lifestyle and Social Discourse

Group Leader: Fritz Reusswig

This platform uses interdisciplinary methods to investigate social consumption and lifestyle patterns and how these change over time. Particular attention is paid to the structures influencing lifestyles and to mechanisms and processes which change them. The potential for sustainable lifestyles in modern societies worldwide is examined. Lifestyle is not restricted to the consumption of private households, but also embraces political preferences and forms of engagement in civil society. The interplay between lifestyle changes and changes in social discourse—in the media, politics, and science—with regard to environmental problems is investigated.

Development and Management

Group Leader: Richard Klein

Research on this platform focused on the development of tools for analyzing public and private decision-making processes for adaptation and management options on climate change. Research embraced investigation of the social response to the cyclone in Orissa, India, in 1998 and analysis of farmers' use of seasonal weather forecasts in Zimbabwe. The group also assessed the effectiveness of international environmental organizations and started to make use of agent-based modeling as a tool to understand adaptive and maladaptive behavior in society. In addition, socioeconomic indicators to estimate the probability of drought-related crisis situations in India were assessed, and the group developed an indicator-based scenario-driven model on adaptive capacity in Europe.

Globalization and the Financial Markets

Group Leader: Carlo Jaeger

Anthropogenic climate change leads to a multiplicity of financial risks, caused, for example, by extreme events such as floods, droughts, and storms. The question arises of how existing insurance markets can protect us against these risks. Climate risks such as the loss of glacier landscapes, coral reefs, coastal towns, and human life cannot be compensated monetarily in an appropriate way. The challenge lies in deploying investments in financial markets in such a way that they contribute to the reduction of climate risks. Socioeconomic modules within the CIAMⁿ architecture are developed in terms of a multi-agent design and will be coupled with other modules.

Integrated Systems Analysis

Head: Gerhard Petschel-Held

Deputy Head: Manfred Stock

The Earth system is a complex dynamic system which is characterized by a multitude of feedback loops. Description of the Earth system involves visions of sustainable development, and it is a major task of the department to define and specify these. The methodological focus of work was an improved conceptualization of uncertainty in Earth system analysis and on building a bridge between the syndrome concept and vulnerability assessments.

Analysis and Uncertainty

Group Leader: Hermann Held

This group aims at the analysis of uncertainty in coupled nonlinear systems and the adequate mathematical representation of various types of uncertainty. These activities not only serve to improve disciplinary quality standards, they also support Integrated Assessment projects in deriving robust statements robust under uncertainty. Multi-criteria decision-making analyses of GLOWA-Elbe, dealing with water budgets in the Berlin area, are an example in this direction (see list of externally funded projects in appendix). In collaboration with the task force GAIM (Global Analysis, Integration and Modeling) within the International Geosphere-Biosphere-Programme (IGBP), the catalog of "critical switch and choke points of the Earth" showing where global change could precipitate an abrupt change to new conditions, was updated. New methods for the early detection of such switches were developed and the results of an adequate representation of non-stochastic uncertainty by random sets rather than traditional probabilities was demonstrated (see PIK Project GRAIN). It was also possible to formulate an objective measure for CLIMBER2-output uncertainty, utilizing Bayesian learning (see PIK Project PRUNE). Other work seeks to develop quantitative measures for the long-term and extreme behavior in empirical hydrological and climatic time series.

Integration and Place-based Approaches

Group leader: Matthias Lüdeke

Here, the method-oriented focus is on two related issues: how can different types and qualities of knowledge from different scientific cultures be formally integrated (see

PIK Project QUIS), and how can local peculiarities of human-nature systems be embedded into a comprehensive study of global change. As a central concept for both tasks the syndrome concept seeks to identify and localize basic, archetypical patterns of human-environment systems. Besides the analysis of specific syndromes (see PIK Project SYNAPSE), a conceptual model for syndrome emergence and evolution has been formulated, which helps to understand and classify the basic mechanisms bringing about syndromes and their positive counterparts, so-called paradigms. This extended conceptualization of syndromes helps to improve present forms of vulnerability assessments.

Modeling

Group Leader: Siegfried Franck

Members of this group seek to develop models of those aspects of the Earth system which are characterized by tight and highly relevant feedback loops. Timescales of feedbacks considered reach from months (e.g., the Indian monsoon), via decades (e.g., the thermohaline circulation, see PIK Project INTEGRATION) to millions of years, (e.g., geological components of the biogeochemical cycles, see PIK Project TRIPEDES). The task of the modeling exercises is not to develop analogous simulation models, but rather to understand the implications of the feedbacks for stability properties of the Earth system. Using this approach, members of the department were not only able to assess the conditions for life on Earth-like planets in so-called habitable zones, but also reveal the possibility of a drastic change in the Indian Monsoon under realistic scenarios of global change.

Data & Computation

Head: Rupert Klein

Deputy Heads: Karsten Kramer and Michael Flechsig

The Data & Computation department manages the institute's IT infrastructure, and maintains its high technological standards. It is responsible for scientific data and metadata management, and it operates a scientific computing division.

IT Infrastructure

Group Leader: Karsten Kramer

The installation of a new IBM p655 cluster with a total of 240 processors at the beginning of 2003 was without doubt the single most important event for our group during the period (see High Performance Cluster Computing @ PIK, page 55). The machine was very rapidly accepted by the scientists. In addition to improvements in computational resources, storage capacity of the attached parallel file system has also been enhanced to about 10 terabyte, based on IBM storage area network technology. However, it is to be expected that capacity limits will be reached again as early as mid-2004 as scientific demand for computational and storage resources remains high. Other milestones for the group have been the redesign of basic Internet services like directories and printing, major upgrades of important applications such as Oracle Database, Tivoli Storage Manager, and Windows Terminal Services, and the inauguration of the group's new web portal for user-oriented as well as technical information (<http://dcit.pik-potsdam.de>). Substantial resources had to be devoted to security issues as the number of attacks has increased in the last two years.

Scientific Data and Metadata Management

Group Leader: Michael Flechsig

PIK's research depends heavily on the availability of a large variety of data, including long-term weather records, various computer simulation results, sociological data, and satellite scenes. The Scientific Data Management group supports PIK research projects in handling these data through its xDat-System. This software flexibly integrates the access to metadatabases by graphic user interfaces and a mapserver-based graphic representation of query results. Entries can be managed directly by the project groups. Importantly, the system also allows direct access to stored data that have been identi-

fied in a metadata search. The system holds information in the group's PIK-CERA-2 metadata model. Data from about 50,000 measurement stations, amounting to 900 million time series data entries, are stored. In total, 30 regular users of the system produced 7,000 logins, and downloaded 400 million data entries from 4,500 stations.

Scientific Computing

Group Leader: Rupert Klein

The group collaborated with the University of Manchester to make the Typed Data Transfer Library (TDT) interoperable with the Tyndall Centre's softIAM framework. The Social Systems department's efforts at establishing their modeling activities within the CIAMⁿ—Community Integrated Assessment Modules for *n* Institutions—framework have been supported in terms of both technical programming and mathematical modeling. The group's unified mathematical approach to meteorological modeling has been an important ingredient in the development of new systematic multiple-scale models for the tropics in cooperation with A. J. Majda from New York. The technique is now being applied to analyze the middle latitudes, atmospheric boundary layers together with Julian Hunt from London, and humidity transport. The numerical methods subgroup has explored various software design concepts and open source libraries for a new joint software platform to solve geophysical citization equations. These investigations were undertaken in preparation for the new PIK Project "S," which begins in 2004.

The group supports the common development of a regional climate model on the basis of a the Local Climate Model (CLM) of the Deutsche Wetterdienst. This will be done in cooperation with partners from the University of Cottbus, the University of Karlsruhe, the GKSS Research Centre, and the PIK Department Climate System.

Administration

Office Manager: Kerstin Heuer



Kerstin Heuer

The aim of PIK's administration is to support the smooth progress of scientific work while putting a minimal administrative load on the specialist departments. The greatest challenge here for the members of the administration is to bring the flexibility needed for successful research activity into harmony with prescribed and sometimes very restrictive rules imposed by a wide variety of funding agencies.

The administration is responsible for management of the finances, buildings and premises, all personnel matters, reimbursement of business travel costs, and provision of other central services.

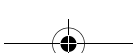
In the period 2002/2003 PIK had 53 planned positions, 22 additional nonpermanent positions, and up to 98 externally funded positions, in which up to 173 members of staff including student assistants were employed. In addition, 14 guest scientists worked at PIK.

The revenue managed in the two-year period amounted to a total of 20.56 million euros. Of this, 10.91 million euros was institutional funding and 9.65 million euros came from project sponsorship and contracts. Although there was a positive development in income for the two years (9.88 million euros in 2002 and 10.67 million euros in 2003), it must be expected that in the future the institute's income will be reduced due to the strained situation in public funding.

During this period cost and activity accounting was introduced with the conception phase ending in the autumn of 2003. A trial period from October to December, 2003 followed, and in 2004 the system came into actual operation. Linked to the introduction of cost and activity accounting, we switched to a completely new data processing system for financial and asset accounting and procurement.



Science Coordination



Science Coordination

BY HEIKE ZIMMERMANN-TIMM

Research in the natural sciences and social sciences research do not "naturally" go hand in hand. The barriers between the two disciplines are difficult to reconcile. Science coordination is therefore fundamental for an institute like the Potsdam Institute for Climate Impact Research (PIK), which is oriented toward interdisciplinary research. Science coordination means getting the overall picture, recognizing the multifariousness of the research, drawing together and harmonizing ideas and projects. In November 2002 the institute's managers established the position of Science Coordinator—a position which has hitherto had something of a shadowy existence in German research institutions, but in institutions in the United States and other European countries is increasingly gaining in significance. With the concept of science coordination PIK is thus sending a signal for greater transparency and networking, thereby supporting truly efficient interdisciplinary research.

Science coordination involves a great variety of responsibilities; the main working focal points are the coordination of research at PIK, scientific collaboration, communication and resource management.

COORDINATION OF RESEARCH AT PIK

As a biologist working in ecosystem science I am well familiar with the demands of interdisciplinary issues on a day-to-day basis. The challenge of bringing together scientists from different disciplines to address scientific questions has always been one of my primary goals. Science coordination is not only interdisciplinary work, it also includes a penchant for organization and communication structures. Both abilities were important for the development of PIK's scientific structure, an activity which dominated PIK's everyday life and my work in 2003.

In this respect, the year 2003 placed high demands on the science coordinator's commitment, since the research content of the ToPIKs and associated PIK Projects that had been ongoing since 2001 had to be assessed and overhauled. Simultaneously, revision of the research program for 2004-2006 was planned. Modification of the existing program meant initiating discussions within the ToPIKs, to check the coherence of their content and to specify targets. Guidelines were essential to manage this process, and these were developed in agreement with the PIK leadership. A call was made for



Heike Zimmermann-Timm

sketches of ideas. These sketches were then sifted and a workshop which included PIK scientists and guests was organized with the goal to evaluate the ideas. On the basis of the assessment, proposals were solicited. During the phase of formulating these proposals my knowledge of internal resources and possible thematic links within the institute and outside was utilized. At the end of the year decisions on the 2004-2006 project phase were reached, while at the same time I initiated the ToPIK Days 2003, which over two days gave the opportunity to present and conclude selected projects from the 2001-2003 research phase.

SCIENTIFIC COOPERATIONS

Recognition of the fact that global environmental research is an enormous task makes cooperation on a national and international level essential. The intensification of scientific contacts with institutes world-wide as well as on a European and national level is an important aspect of my work.

Noteworthy in this connection was also a presentation of the institute and EU Projects coordinated at our institute (e.g., ATEAM and DINAS-COAST) at a parliamentary evening of the Leibniz Association in Brussels in September, 2003. It was a chance for fruitful discussions and many new contacts. With Hans Joachim Schellnhuber's appointment as Scientific Director of the Tyndall Centre for Climate Research in Norwich, U.K., the European perspective gained a new dimension for our institute. Strengthening the connections between the two institutes and countries, and building up networks with other scientific institutions will be another important

function of science coordination. Scientific experience and circumspection are necessary for such arrangements.

An intensive and regular exchange on management structures and research takes place through the Leibniz Association, particularly within different working groups and sections. The publication of environmental subjects in the publication "Zwischenruf" for politicians and the public is one example of scientific activities within Section E, Environmental Sciences.

Our institute is located in the neighborhood of the Geo-ForschungsZentrum (GFZ), Alfred-Wegener-Institute for Polar- and Marine Research (AWI) Potsdam, and the Astrophysical Institute (AIP). This location provides a considerable potential for strengthening cooperation. Earth system science with different foci is the main research question of all these institutes. For a long time we have had a successful cooperation in research and teaching with the universities of Berlin and Brandenburg - University of Potsdam, Freie Universität Berlin, and Humboldt University of Berlin. One of my concerns is to promote our junior scientists; and this is the reason why I would like to enhance future connections to the universities.

COMMUNICATION

I first needed to get to know and understand the institute's multifarious structures. This overview was essential in order to build links between the institute's leadership, scientists, public relations office and administration and between the ToPIKs and the PIK Projects. My personal mission is to maintain a neutral position between PIK's management and its scientists. To effect optimal communication at PIK I envision my role not only in coordination but also in mediation. My special interests are the fostering of integrative thinking. The fact that scientists from the natural sciences and social sciences work together on global change research and its consequences at one institute is special in the research landscape.

Communication is the foundation for all types of collaboration. Revealing and removing deficits in communication appears to me to be another important task. A start on this was made at the end of 2003 with the establishment of the intranet page "Life @ PIK" where, for example, PIK's annual planning is available for our staff.

A much more active role is played by the seminar series "Trial and Error @ the Palace," in which lectures are given on issues of social interest. These talks, which are combined with the monthly opening of the Error Bar in Building A31, are an important means of bringing scientists of different disciplines together to exchange ideas. While revising the scientific structure in 2003 this communication platform was an important basis to sketch new ideas and to pre-empt problematic developments.

Exchange with persons, institutions, and partners outside PIK needs to be supported as well; and in presenting the institute's scientific work to the public, I need to work closely with the Press and Public Relations office. The planning of the "Long Night of Science," for instance, or the development of PIK's new internet home page, was the result of such fruitful discussions.

RESOURCE MANAGEMENT

An understanding of the institute's resources in terms of personnel, space, and finances is necessary for research management. A complex planning instrument for deployment of personnel was produced; it should be completed and simplified for the leadership.

At the recommendation of the Leibniz Association, PIK started in January, 2004, with the establishment of cost and efficiency calculations. Together with administration and leadership, criteria were developed. The regular update of the data (e.g., involved staff per PIK Project) is also one of my tasks.

PERSPECTIVES

My first year at PIK revealed areas with potential for beneficial change and developments of management-structures and in many respects there are opportunities to achieve results by targeted coordination. In the near future my agenda includes:

- Publication of PIK's Biennial Report for 2002/2003 in cooperation with Press and Public Relations and Data & Computation
- Specifying the ToPIK profile and observing existing PIK Projects
- Support and integration of our junior scientists, e.g., Ph.D. students, and outlining professional perspectives.

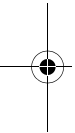


*You need sharp eyes to find it:
Einstein's brain, a bronze sculpture,
which is set into the stone path leading
to the Einstein Tower, Telegrafenberg.*



Awards





Awards

Hans Joachim Schellnhuber, our founding director and the Research Director of the Tyndall Centre for Climate Change Research in Norwich/U.K., was awarded the Royal Society-Wolfson Research Merit Award for his achievements in interdisciplinary integrated climate research. The European integration of environmental science is one of his most important aims. He advises the German and British governments in questions concerning the subject of "Global Change." The Wolfson award with around 500,000 euros will be used for the development of an integrated model of global change.

Stefan Rahmstorf, professor of ocean physics at the university of Potsdam, received a grant of 300,000 euros from the Gary Comer Foundation in 2002. He will use the money to continue his work on stability of climate-relevant marine currents in the South Polar Sea and the stability of the antarctic iceshelf.

Rupert Klein was awarded the Gottfried-Wilhelm-Leibniz-Prize for outstanding work in theoretical hydrodynamics from the Deutsche Forschungsgemeinschaft (DFG) in 2003. With 1.55 million euros the Gottfried-Wilhelm-Leibniz-Prize is the highest German research prize. Since 1997 Rupert Klein has been head of the department "Data & Computation" at PIK and he holds a chair of mathematics and informatics at the Freie Universität Berlin. He is currently working on the mathematical modeling and computational representation of atmospheric fluid mechanics. At the same time he supports interdisciplinary research at PIK with his team by providing services in applied mathematics and scientific computing.

In 2003 Kirsten Thonicke received the Michelson-Prize for the best Ph.D. thesis in 2002/2003 in the faculty of mathematics and natural sciences of the University of Potsdam. "Fire Disturbance and Vegetation Dynamics – Analysis and Models" was the title of her Ph.D. thesis, which analyzed the influence of fire on our climate. The German network for natural hazards uses her results for preventative forest fire control in Brandenburg. Fire is important for the dynamics of our vegetation. Kirsten Thonicke now has a position at the Max Planck Institute for Biogeochemistry in Jena.

In 2003 Till Kuhlbrodt was awarded the Carl-Ramsauer-Prize of the Physikalische Gesellschaft zu Berlin for his excellent Ph.D. thesis, entitled "Stability and Variability of Open-Ocean Deep Convection in Deterministic and Stochastic Simple Models." The deep circulation of water masses in the North Atlantic and changes due to global warming was the subject of his dissertation. Now he studies risks connected with changes in circulation of Atlantic water masses at the Potsdam Institute for Climate Impact Research.



Hans Joachim Schellnhuber



Stefan Rahmstorf



Rupert Klein



Kirsten Thonicke



Till Kuhlbrodt



Martin Claussen

In October, 2003, Martin Claussen, currently deputy director, was appointed a member of the German Academy of Naturalists Leopoldina for his scientific achievements in climate research as well as for his personal attributes. He is one of the first who showed that changes in climate can be caused by changes in vegetation zones.



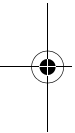
Andreas Güntner

Andreas Güntner was the recipient of the prize for the best doctorate research in 2002/2003 at the University of Potsdam, awarded by the Society of the University of Potsdam. "Large Scale Hydrological Modelling in the Semi-Arid North-East of Brazil" was the title of his Ph.D. thesis. The cooperation between PIK and the University of Potsdam provided a good basis for this interdisciplinary research field. Now he is working in the Hydrology Group at the GeoForschungsZentrum Potsdam.



Networks





Networks

Global Change Research on a National, and International Level

BY HEIKE ZIMMERMANN-TIMM

Global change research is a comprehensive task that cannot be analyzed by one institute or country alone. It requires the collection of data as well as the development of new theories, concepts, and methods, ultimately contributing to the emergence of a new science of integrated system analysis. Advancing an integrated assessment is an intellectual as well as an organizational challenge and is in high demand.

As a member of the Leibniz Association, PIK is an important partner for institutes of this association as well as for other German research communities, e.g., Max-Planck Society, Helmholtz Society, and Fraunhofer Society. Environmental research on a regional or national scale, as requested by the German government, unites our institute with others in the Leibniz Association as well as with the universities in Brandenburg and Berlin. As a member of the German Research Network Natural Disasters (DFNK), PIK is examining the adaptive capacity of extreme river events. In addition, projects like GLOWA-Elbe (See Appendix External Funding), which is coordinated by our institute, form an important basis for further work.

Hans Joachim Schellnhuber's leave of absence to lead the Tyndall Centre for Climate Impact Research as scientific director, the European perspective has given a new dimension at our institute and has strengthened the connection between both institutes as well as to other European scientific centers. As the director/part-time director of both institutes, Hans Joachim Schellnhuber has the unique opportunity to use the scientific networks of both institutes to stimulate the PIK-Tyndall cooperation. This has been motivated by the similar missions of PIK and Tyndall within their national communities; in addition, Germany and the U.K. are prominent protagonists of climate protection policies and cooperate intensively in relevant international areas. This bilateral project received a positive assessment by political representatives from Germany and the U.K. It is recognized as an important and innovative contribution in a policy-relevant scientific field.

One milestone in the PIK-Tyndall convergence process was the first "PIK-Tyndall Summit" held in Norwich in August, 2003. It aimed to identify common scientific interactions for the future, for example, detailed analysis of the European heat wave in 2003; integrative assessment of mitigation and adaptation options for medium-term and long-term climate protection; global change and its impact on vulnerability; disequilibrium economic modeling to assess the effectiveness and efficiency of the climate protection; analysis of uncertainty and its importance; construction of a transnational distributive and modular "integrated assessment modeling system"; and regional simulators. PIK-Tyndall Summits will follow at least once a year. Additionally, in the future PIK's "ToPIK-Days" and "Tyndall's Assemblies" will provide important opportunities for mutual exchange between scientists from both institutes.

A milestone in the advancement of the European perspective was the first "E-VIA-Summit" held in Milan in December, 2003. It was a meeting of the leading European institutions on climate change and sustainable issues and aimed to secure a sustainable critical mass for integrated assessment that blends scientific excellence with political relevance. The primary objective of the Milan Summit was to formulate a general (i.e., strategic) agreement on a concept, aims, and scope of "E-VIA." The proposed name for this alliance is "E-VIA: European Virtual Institute for Integrated Assessment (of Climate Change and Sustainability Issues)." "E-VIA" could serve as the continent's authority for scientific advice on environmental and development policies of the EU with respect to internal decision-making (e.g., EU sustainability strategy) and external cooperation (e.g., the potential realignment of EU climate protection recommendations with those of the US). European funding sources offer opportunities and options for integrated approaches in the relevant research fields. Externally funded projects, such as ATEAM and Dinas-Coast, are important steps to become a part in the European research area. As a European research authority, "E-VIA" will cooperate with comparable networks.

The transinstitutional operation of "E-VIA" requires a number of coordination mechanisms that should be

effective without damaging the autonomy of the consortium partners. Appropriate governance structures, allocation schemes for shared resources, and forums for the advancement of the assessment alliance are some of them. The emerging PIK-Tyndall alliance may offer a supporting element for E-VIA, without establishing any leadership claim.

PIK is also involved in the worldwide discourse on the improvement and further development of climate change and sustainability research. It plays an active role in activities such as the International Geosphere-Biosphere Programme (IGBP), the International Human Dimension Program (IHDP), the Intergovernmental Panel on Climate Change (IPCC), and the Millenium Assessment. PIK is thus a part of a growing global net-

work for sustainability science, dedicated to a common future.

One of the most compelling reasons for the above mentioned networks on the different levels—national, European and international level—is the prospect of creating joint scientific and operational expertise, which provides a much stronger assessment capability than the sum of its parts.

Networks also provide outstanding opportunities for the development of the partner institutions' human resources through exchange of researchers and support staff, common training and information programs, and concerted recruitment of bright young scientists based upon a unique "corporate identity."

European Climate Forum (ECF)

BY CARLO JAEGER & MARTIN WELP

OBJECTIVES

The European Climate Forum (ECF) is a platform for joint studies and science-based stakeholder dialogues on climatic change. It was founded by seven leading European research institutes together with businesses and nongovernmental organizations (NGOs). ECF brings together representatives of different parties concerned with the climate problem: energy industries, companies engaged in renewables, major energy users, insurance and finance, policymakers, environmental NGOs, and scientists. The core activity of the Forum is to define and carry out joint studies; these shall provide arguments for long-term climate mitigation and adaptation policies leading ultimately toward a sustainable development path.

JOINT STUDIES

ECF joint studies focus on problems for which stakeholders have very differing views. The goal is to clarify differences and produce analyses that summarize and advance our state of knowledge in critical problem areas. The Forum cultivates a pluralistic exchange in which different points of view can be freely expressed and debated on a basis of mutual respect. Topics for ECF joint studies are global aspects of the interaction of climate change and the socioeconomic system, regional impacts of climate change, economic and political instruments for controlling greenhouse gas emissions, and technologies for reducing greenhouse gas emissions,

such as more efficient energy use, the introduction of renewable energy technologies, and CO₂ sequestration. The first set of joint study projects focuses on climate policy instruments, extreme weather events, technology assessment, and data needs for global sustainability monitoring.

CONFERENCES AND WORKSHOPS

ECF conferences, workshops, and working group meetings provide a platform for dialogues with stakeholders. The Second Annual Autumn Conference, "Climate Change and Paths to Sustainability," took place on November 14-15, 2002 in Berlin. Sixty-five participants—representatives of industry, NGOs, leading scientists on climate issues and climate negotiators—discussed a range of issues, encompassing climate risks, emission targets, technological learning, and policy perspectives. One outcome of the 2002 Autumn Conference was the ECF discussion paper entitled "The Challenge of Long-term Climate Change." The paper was drafted by a group formed at this conference and led by Klaus Hasselmann. The paper was published in the December, 2003, issue of the *Science* magazine.

The ECF Third Annual Autumn Conference was part of the Third Sustainability Days and was entitled "The Bio-fuels Directive: Potential for climate protection?" It took place on September 8-10, 2003 in Norwich, United Kingdom. Fifty participants representing companies, NGOs, and research institutions took part in the event. A Conference Summary with the main arguments raised

in the discussions was prepared and published on the ECF website.

Harry's Club is a working group looking at the problems of coupling of different kinds of modules. The CIAM'n (Community Integrated Assessment modules to the power of n) was further developed, and free downloadable software was posted on the ECF website. This approach will enable researchers to couple modules prepared at different institutions and thus to be more flexible and faster in responding to the knowledge needs of stakeholders and society.

THE CLIMATE GAME

The climate game was launched in November, 2002, at a special exhibition on climate issues in the Deutsches Museum in Munich. In the game players control future climate policy by adopting the role of either the government, a CEO (Chief Executive Officer) of a global company, or a typical private household of an industrialized country. The players endeavor to maintain a sustainable climate in the future while pursuing their own individual welfare goals. The computer game can be downloaded from the ECF website.

THE SCIENTIFIC FOUNDING MEMBERS OF ECF:

- Potsdam Institute for Climate Impact Research, Potsdam
- Max Planck Institute for Meteorology, Hamburg
- Tyndall Centre for Climate Change Research, U.K.
- Fondazione ENI Enrico Mattei, Milano
- Nansen Environmental and Remote Sensing Centre, Bergen
- Paul Scherrer Institut, ETH Zürich
- National Center on Environment and Development, Paris

BUSINESSES WORKING WITH ECF:

Munich Reinsurance Company, Deutsche Telekom, Asea Brown Boveri, Alstom, RWE Rheinbraun, NEC, as well as the European Business Council for Sustainable Energy

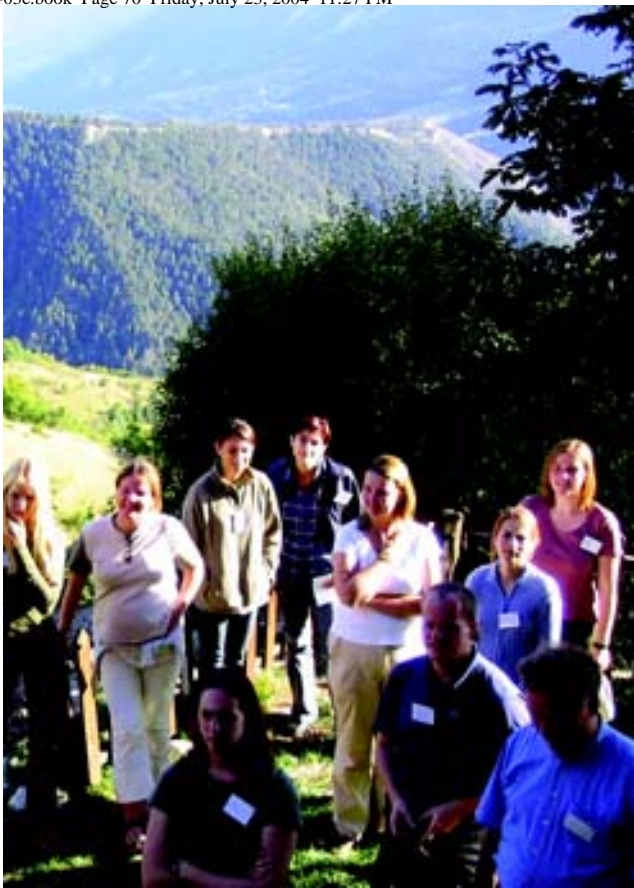
NGOS WORKING WITH ECF:

Greenpeace, WWF, and Germanwatch

ECF WEBSITE:

www.european-climate-forum.net





The participants were introduced to the village and the history of Peyresq in the Provencal part of the French Alps.

National and International Research Lectures

BY HEIKE ZIMMERMANN-TIMM

PIK is more than a research institute that publishes results in scientific journals and gives advice to regional, national, and international authorities. Its priorities also include the transmission of knowledge to students and junior scientists. To accomplish this, PIK scientists, independent of a chair at the university, teach disciplinary and interdisciplinary subjects to a broad, interested community in Germany and other countries. In some cases, PIK scientists have been invited to give research lectures at universities, for example at the University of Potsdam and the FU Berlin, or within summer schools (see Appendix, Research Lectures).

A particular highlight in this regard was the AVEC Summer School, organized by Wolfgang Cramer and initiated in September, 2003. Held in Peyresq, in the French Alps (see photos), this summer school focused on changes in climate, biodiversity, nutrients, and land use as well as their consequences on ecosystems. Vulnerability assessments of these yields were presented to 36 participants by leading scientists from different European research institutes. The summer school was a two-week course



The summer school led by Wolfgang Cramer was a particular highlight in international collaboration. The special atmosphere of Peyresq contributed much to its success.



Working groups met each afternoon to study the vulnerability of regions chosen by themselves.



Participant presenting her project with a poster.

with talks, poster presentations, group work, and excursions. The positive response of teachers and students is a motivation for further international teaching activities in this interdisciplinary research field.

Scientific Location Telegrafenberg

BY ANJA WIRSING

Like other institutes on the Telegrafenberg the Potsdam Institute for Climate Impact Research (PIK) is located in a historic building dating from the late 19th century—the former Astrophysical Observatory. These beautiful old buildings, which were built under functional aspects for research in astronomy and solar physics, add a special atmosphere to the Telegrafenberg. The historical science campus "Albert Einstein" is home to the GeoForschungsZentrum (GFZ) and the Alfred Wegener Institute for Polar and Marine Research (AWI) Potsdam apart from PIK. The Great Refractor and the Einstein tower are a sublocation of the Astrophysical Institute (AIP), which has relocated its main building from the Telegrafenberg to the Babelsberg. The proximity not only implies close points of contact: the research of the Earth System is based in all four institutes, although with a different focus.

The spatial and scientific proximity creates the best possible conditions for cooperation. This is expressed in common infrastructure—such as library, canteen, and lecture rooms—and in scientific exchange at colloquia and conferences. The common link between the institutes PIK, GFZ, and AWI is the library on the Telegrafenberg. Looked at from the point of view of personnel and finances, it offers a service which could not be provided by the small library of one institute alone: a considerable stock of printed and electronic reference books and journals as well as advice and electronic services. It is especially gratifying that, through the library, institutes work together which belong to different scientific organizations. PIK is a member of the Leibniz Association, GFZ and AWI are members of the Helmholtz Association.

A notable partnership with the Long-term Meteorological Station, belonging to Germany's National Meteorological Service, the Deutscher Wetterdienst (DWD), has been established by scientists of the Telegrafenberg (see photo). They want to save this valuable meteorological station, which is in danger of being replaced by a machine.

The Long-term Meteorological Station is the only meteorological station in the world which can boast such a comprehensive observation program going back without gaps over a period of more than a hundred years. By replacing staff with automatic instruments, many meas-



The Long-term Meteorological Station on the Telegrafenberg

urements such as visual observations and special measurements will be discontinued. The change from human to automatic meteorological observation also means that the new data records cannot be compared with the old ones because of the different method of data collection. This unique meteorological series, which even survived the confusion of the Second World War, would be interrupted.

Since this situation became known, Martin Claussen, who is also Chair of the German Meteorological Society (DGM), and Friedrich-Wilhelm Gerstengarbe have committed themselves to establishing the Reinhard Süring Foundation, whose purpose is to raise funds to secure the survival of the Long-term Meteorological Station. In order to call this foundation into being, a basic capital of 50,000 euros is required. The call for donations is running.

"Why does the climate change?" This was the headline of a press release issued by PIK, GFZ, and AWI that announced the "6th German Climate Conference" on the Telegrafenberg. In September, 2003, scientists from different fields of the Earth Sciences discussed new research results in climate variability. The current climate since the beginning of the observational network 150 years ago, the climate of the current warm age of the last 10,000 years, and the climate of the last ice age cycle were topics of the conference. The cooperation of PIK, GFZ, and AWI, which led to an intense exchange between palaeoclimate scientists and climate modelers, was scientifically of great importance: Only by comparing climate data of the past with theoretical simulations of climate processes will it be possible to understand climate change.



In the limelight: the Great Refractor during the "First Potsdam Science Night"

In June, 2003, PIK, GFZ, and AWI took part in the Berlin "Long Science Night." Only three months later they jointly organized the "1st Potsdam Science Night"—an event integrated into the "Potsdam Science Year," in which the AIP was also involved with the observatory on the Babelsberg and the Einstein tower on the Telegrafenberg (see photo). Late into the night visitors were able to experience science in lectures, experiments, guided tours, and exhibitions and have personal contact with scientists. The large number of visitors, the enthusiasm on the spot, and the great press response show the fascination for earth, climate, polar, and marine research as well as astrophysics—a positive for this historic place whose scientific spirit still lives on today, 125 years after the foundation of the first institutes on the Telegrafenberg.



Association of Friends and Supporters of PIK e. V.



Association of Friends and Supporters of PIK e. V.



The Association of Friends and Supporters of the Potsdam Institute for Climate Impact Research e. V. was founded on December 11th, 2002, and now numbers 20 representatives from the spheres of science, politics, and business.

The association is organized along the lines of annual meetings and a permanent management board. Udo Simonis, Berlin, was elected Chair of the board, Klaus Hasselmann, Hamburg, Deputy Chair, and Ursula Kleinhans, Berlin, Treasurer.

The purpose of the association is to support science and research at the Potsdam Institute for Climate Impact Research (PIK) and to promote the image of PIK as an international institution. In this context it seeks to support PIK (in particular through providing financial backing) in the realization of its goals as a tax-privileged, non-profit institution, and in upholding and furthering its reputation through public events, among other means.

Further goals of the association, according to paragraph 2 of its terms of its statutes, are

- to intensify the relationship between PIK and other branches of science, with representatives of business, art, culture, and politics,
- to develop and use forms of communication which help convey scientific thinking to a broader public,
- to provide moral and material support in developing a scientific infrastructure in Central and Eastern Europe and in developing countries,
- and to involve PIK in the public debate on further developments in Potsdam and its surroundings.

In the first year of its existence the association has held four board meetings and one general meeting. It supported various events at PIK, including the activities organized by the institute for the "Long Night of Science."

Awards of prizes for the best doctoral thesis at the institute and for the best collaborative work of the year are being planned. A fund-raising dinner will take place in 2004, which it is hoped will enhance the association's financial situation. The association is keen to gain new members, particularly institutional members.

ADDRESS

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BANKING DETAILS

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*The Öresund Bridge links
Denmark and Sweden. It has
enabled Copenhagen and Malmö to
fuse to a single
region across natural
coastal boundaries.*



Press and Public Relations



Press and Public Relations

BY ANJA WIRSING

WEATHER EXTREMES MARK PRESS EXCHANGES

Record flooding on the Elbe, Mulde, and Danube in 2002, heat waves in Europe in 2003—the last two years were characterized by extreme weather events which intensified the fear of climate change in the public eye. The press reacted with more intensive reporting, which also kept the Potsdam Institute for Climate Impact Research on its toes. Interviews and background discussions between PIK scientists and journalists from newspapers and periodicals, radio and television were day-to-day events at the institute during the peak phase. And even though we could scarcely cope with the very large number of queries, we were pleased to note the high level of interest in our expertise. It was apparent after all that the media are handling the subject of climate change in a more differentiated way, that they no longer simply present it as a catastrophe, but also point to adaptation measures and emission reduction. The quality of reporting has improved; yet it was nonetheless clear again that the greatest level of press interest was on the institute's natural scientists investigating past, present, and future of climate change with statistics and models. They are the favorite interview partners when it comes to the question "Are we experiencing climate change?" or "Is it human-made, or are natural factors really to blame?" Again and again it is necessary to communicate the basics, to point out that anthropogenic climate change is scientifically undisputed. The PIK scientists researching actual climate impacts are often quoted only later in the report—when the facts of climate change have been explained, so that the ecological, social, and economic impacts can be examined.

EMPHASIS ON AN INTERDISCIPLINARY APPROACH

Fundamental to PIK's continuous presence in the media are our press releases, of which we issued 24 in the period 2002/2003. The picture painted above is repeated here: the press releases which discuss climate change from a natural sciences perspective receive the most attention. We therefore see it as one of our aims in discussions with the press, with policymakers, and the public to underline repeatedly the institute's interdisciplinary approach—the investigation by both natural and social sciences of global change in the environment and in society.



Anja Wirsing

It is pleasing how well PIK's research activities have been followed and taken up by the local press. Results on regional climate impacts, especially, received a great deal of interest, combined with PIK's strong presence in the media in Potsdam and Berlin.

The number of press reports in which PIK or its scientists were mentioned in the last two years increased again in comparison to previous years. In this period 820 articles about PIK appeared in mainly German newspapers and periodicals—it was 720 in the years 2000/2001—and there were a hundred reports on radio and television. This increase can be attributed to the strong press resonance during times of weather extremes, when new media contacts were established and existing ones intensified.

DIALOGUE WITH THE PUBLIC

PIK is engaged in an intensive dialogue with the media, policymakers, cultural institutions, and a broad public. This exchange is reflected in the large number of visitors we regularly welcome to the Institute. Among our guests were politicians from Germany and abroad, diplomats, foreign correspondents, delegations of scientific, economic or cultural institutions, and school classes. Highlights among the international visitors were Polish President Aleksander Kwasniewski, members of the Russian Duma, and the Indian Minister for Renewable Energies, Shri M. Kannappan.

During visits and public events the most important role is played by the scientists at PIK themselves: they perform fundamental public relations work for the institute through their presentation of research results. The many



Hans Joachim Schellnhuber in the ARD program "Sabine Christiansen" on 18 August 2002, on the topic "Flood Disaster: the Flood and its Effects ..."

lectures given by the scientists as part of further training for teachers or to school classes—through which they transfer current knowledge in climate change into the education system—deserve notice. Teachers are important "multipliers" of knowledge and through school trips of this kind they constructively counter the problem of outdated schoolbooks.

ART MEETS SCIENCE

A particular kind of dialogue came about in 2002 through the "Blind Date" project. Here, interfaces between the laboratory and the artist's studio were created in association with the exhibition ART & SCIENCE, in an exchange between art and science organized by the Brandenburgischer Kunstverein Potsdam. The artist Tilman Küntzel, working with PIK, produced an installation illustrating global climate-related phenomena and the way in which global environmental changes are linked. For this he used a globe on which he superimposed areas of varying color. The colored areas show which patterns of global change, so-called syndromes (see PIK Project Synapse, p. 32), appear in which regions. The installation was shown in an exhibition at the Potsdam Kutschstall in November, 2002, and was also on display at PIK in 2003. During the Berlin "Long Night of Science" in June 2003, in which PIK took part for the first time, the dialogue between art and science was continued in a discussion forum, in collaboration with the Heinrich Böll Foundation. Since June, 2003, the globe has been on permanent loan to PIK from the Brandenburger Kunstverein and can be seen in PIK's main building.

YEAR OF SCIENCE

2003 was the "Year of Science" in Potsdam. Many activities were organized to make the scientific work being done in Potsdam accessible to the public. The biggest events of this year were the Science Fair which took place as part of the "Brandenburg Day" festival in September, and the "Open Days" organized on different dates at the various science-related sites around Potsdam. PIK took part in both activities: it had an information tent at the Science Fair together with the other institutes of LAUF, the regional association of non-university research institutions in Brandenburg, and contributed to the program with interviews and a quiz. At the end of September, a joint open day by PIK, the Geo-ForschungsZentrum (GFZ), the Alfred Wegener Institute for Polar and Marine Research (AWI) Potsdam, and the Astrophysical Institute (AIP) was organized as the "First Potsdam Night of Science" on the Telegrafenberg and in Babelsberg.

The "First Potsdam Night of Science" and the Berlin "Long Night of Science" were exciting experiences for the institute. The number of people who took part in lectures, guided tours, and experiments, who inquisitively asked questions and who were keen to talk to the scientists, was much greater than we had expected. The two science nights drew about 4,500 people to the Albert Einstein science campus. Not only the high number of visitors, but also the great interest shown in climate research confirmed the importance of our public relations work.



Margret Boysen is PIK's PR Manager on leave-of-absence who is currently broadening her horizons as Visiting Fellow at the UK's Tyndall Centre for Climate Change Research; pictured here with Hans Joachim Schellnhuber and creator of the Gaia Theory James Lovelock.

1



- 1 At the "Long Night of Science" the children were the first to notice the fascination of touching a melting block of ice.
- 2 Alexa Griesel and Susanne Nawrath showing the experiment "What triggers ocean circulation?" during the "Long Night of Science"
- 3 Martin Welp playing Finnish tango at the "First Potsdam Science Night"
- 4 Glance at a joint project: the artist Tilman Kuntzel and the scientist Matthias Lüdeke at the exhibition "Art & Science"
- 5 Friedrich-Wilhelm Gerstengarbe with schoolchildren at the "Wasser Berlin 2003" fair

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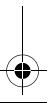


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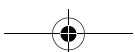
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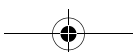






Service





Service

Institute Library

BY BÄRBEL UFFRECHT

The Potsdam Institute for Climate Impact Research has a scientific reference library with a main emphasis on climate and environment-related subjects. The books reflect the specialist disciplines of the institute's scientists. Together, the libraries of PIK, the GeoForschungs-Zentrum, and the Potsdam Research Unit of the Alfred Wegener Institute for Polar and Marine Research make up the library of the Albert Einstein science campus.

In the period 2002/2003 the library's stock of monographs increased to about 7,300 volumes and about 200 CDs and other electronic media. The library subscribes to 83 journals and printed series, which are displayed centrally in the joint library of the Albert Einstein science campus. In this way over 450 printed journals are accessible to the scientists.

PIK's library stock has been cataloged since 1991 using the ALLEGRO electronic library management system and since 2001, the data is transferred to the electronic catalog at regular intervals. The collection can thus be researched in the joint catalog of the scientific campus and also in the Berlin-Brandenburg cooperative library organization (KOBV). Preparations are underway to change from ALLEGRO to the SISIS-Sunrise library management system in 2004.

Articles and books which are not in the joint library can be ordered via the library's intranet.

Copies of articles are obtained directly from libraries in Berlin or as loans from other libraries. In 2002/2003, 2,500 articles were made available. The location of the article can also be researched through the ALLEGRO database, so that it is largely possible to avoid the same article being obtained twice.

Monographs are obtained directly either from Berlin libraries or as library loans. In this way, 920 books were



Bärbel Uffrecht

made available to the scientists in the period 2002/2003. To ensure that books are obtained as efficiently as possible, PIK has cooperation contracts with the three university libraries in Berlin and with the national library.

The joint library also provides a "content service," which, on request, can send out the tables of contents of current journal editions via e-mail.

Contracts with various publishers permitted online access to over 850 journals in this period. Formerly, PIK subscribed to two specialist databases for research purposes. Since January, 2002, PIK has access to the "ISI Web of Science," a database extending back to 1992.

TECHNICAL EQUIPMENT

Available in the reading room of PIK's library are two PC working places with internet access, a black-and-white and a color printer, and a photocopier.

The library of the science campus can be reached through the following internet link:

<http://www.gfz-potsdam.de/bib/>

High Performance Cluster Computing @ PIK

BY KARSTEN KRAMER



Karsten Kramer

Like many other areas of life today, current scientific research is affected by an increasing trend toward digitalization; that is, the collection, storage, processing, and distribution of data, information, and knowledge by means of computer systems. For tasks which are related to the management, organization, collaboration, and publication of results, this trend indeed holds true for all fields of science.

However, there are areas in modern research, i.e., high energy physics, computational biology, astrophysics, climate research, etc. where scientific progress is more directly dependent on the availability of advanced and powerful computer hardware and software (models, algorithms, and programs). Without doubt, this is the case for scientific work done at the Potsdam Institute for Climate Impact Research (PIK), where numerical experi-

ments conducted on advanced computer systems form the indispensable basis of research.

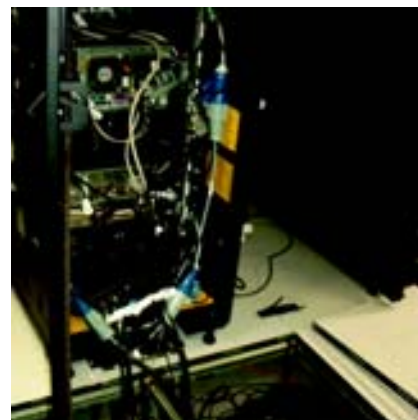
For its computational "grand challenge" applications the institute uses external supercomputers (i.e., the NEC vector supercomputer at the Deutsche Klimarechenzentrum in Hamburg) as well as its own complementary high performance cluster computer facility. Currently, external resources are primarily used for the calculation of high resolution global climate scenario data whereas local resources are indispensable for impact analyses, model development, and statistical evaluations.

In January, 2003, an upgrade to our 200 Power3 processor IBM SP was delivered. The new machine combines 240 IBM Power4 processors into a powerful computer cluster.

Every processor runs at a clock speed of 1.1 GHz. Each eight processors are combined into a single IBM p655 machine with a separate operating system image. All machines have been connected using an IBM SP-Switch2 network and the accompanying parallel programming software. The system uses a total of 400 GByte of Random Access Memory. A parallel file system with a capacity of about 10 TByte is attached via Storage Area Network technology.

Important advantages of the cluster computer installed at PIK are: its flexibility to tackle different problems quickly, the capacity for calculations available per project, its stability and ease of use, and last but not least the comparatively low cost per computing hour.

Together with the attached storage media the high performance cluster is the single most important scientific instrument of the institute today.



January 2003: Delivery and installation of the IBM p655 Teraflop System

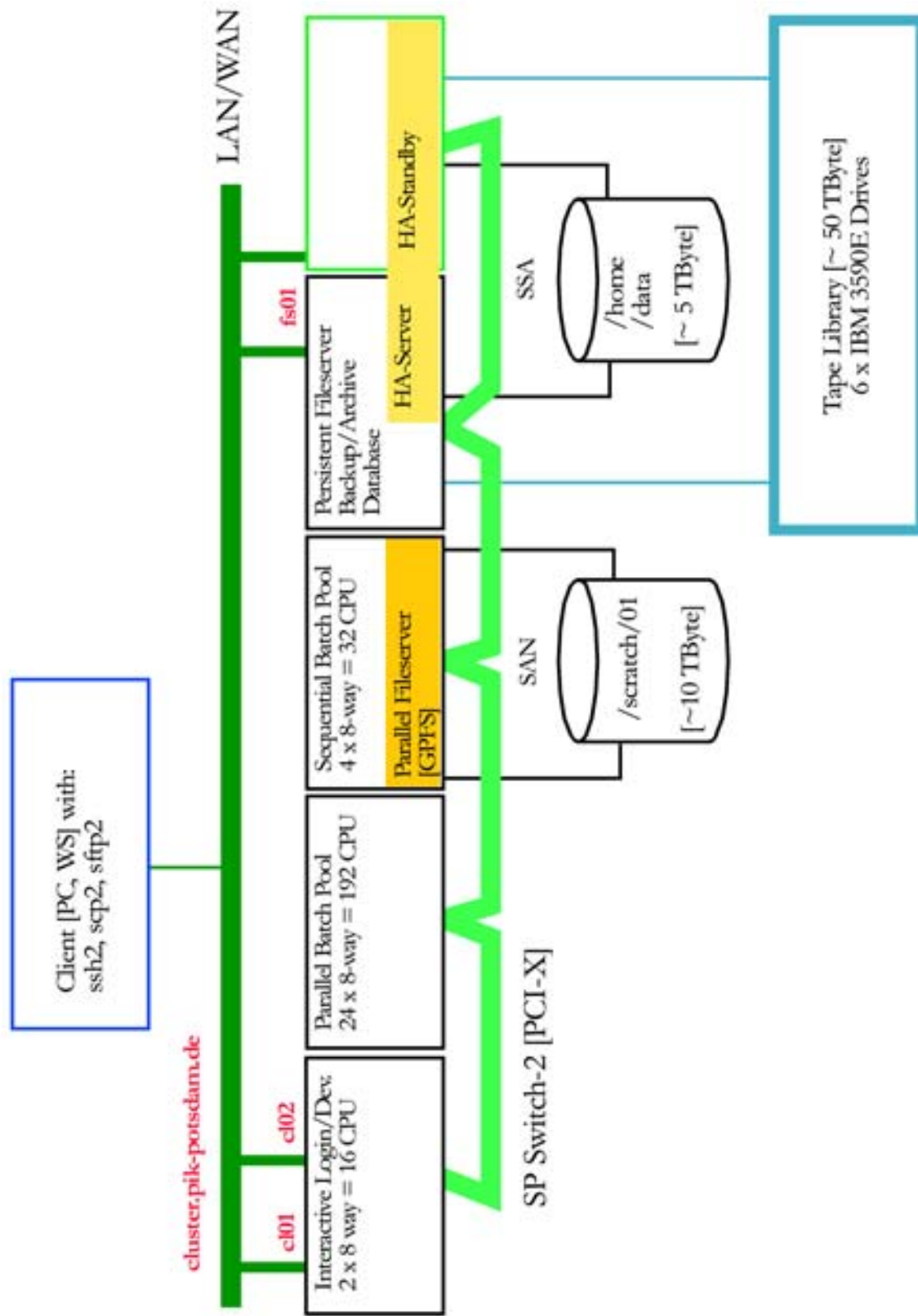


Fig. 1: Schematic View of the IBM Cluster Computer





Internship



Internship

Practical Training in the Summer Heat of 2003

BY BIRGIT LUKAS

The summer break was approaching during my Master of Business Administration course. I wanted to make good use of this lecture-free time, and decided to take up the offer of a practical placement at the Potsdam Institute for Climate Impact Research. My fellow students had not heard of PIK—it would seem that its renown is mainly among specialists. My reasons for going there were simple: PIK's philosophy in viewing ecological, economic, and social aspects equally and in an integrated way matches my own personal and professional outlook. I hoped that here I would be able to bring together the knowledge acquired in my degree course in the area of climate protection and renewable energies and that in economics gained from my current Masters course. I was also interested in learning about the day-to-day work of a research institute and about the scientists employed there.

I arrived, highly motivated, at the Telegrafenberg during the heat wave of August 2003 and discussed the contents of my two-month internship in the Social Systems and Global Change department with scientist Martin Welp. My interest in media perceptions and in the unusually hot summer which was fueling press attention on climate change led to the choice of subject for my project on "The printed media and their handling of extreme weather events—the example of the 2003 heat wave." The study was planned in a way that allowed me to set my own focal points. Each Monday at the departmental meeting there was an opportunity to present the progress of my project and to get helpful suggestions.

The study showed that reports in the printed media on the 2003 heat wave were on the whole relatively well balanced. There was no longer a broad level of "catastrophe"-type reports, as had often appeared previously in the press. Most articles stated the facts and presented climate change for what it is—a significant problem. Frequent mention was made of adaptation strategies, possibilities for the change to renewable energy sources, or increasing energy efficiency. But these things were mentioned quite casually, so that the average reader would seldom consciously notice the strategy. In the future, the press could indeed have a role to play not simply in

describing the dramatic consequences of climate change, but also in pointing toward adaptation and (damage) reduction measures more often. It remains to be seen how newspapers will handle the subject of climate change in the future. Will the approach represented by, for example, the *Bild* newspaper, of playing down climate change, prevail? Or will a more realistic approach, showing the way toward solutions of the problem, win through?

It is planned that part of the study will appear in a media magazine. Here I can again count on constructive help from Martin Welp and from Anja Wirsing, who is responsible for the press and public relations work at PIK. I found both of them—and indeed the whole "Social Systems and Global Change" department—to be very welcoming and supportive. Scientists often have a reputation of being reserved and rather incommunicative. This preconception was not confirmed by my experience at PIK. The scientists I met there were open, helpful, and humorous people.

Apprenticeship @ Data & Computation

BY NINA SCHÜTZ & GREGOR SCHMOLDT

At PIK, you can have everything: if you enjoy being deep down below the surface of earth in caves, vaults and bunkers, you will feel fine at Data & Computation (D&C); if you prefer more open sky than just the view from the window, you can rise from the dark depths and ascend towards the glistening glare of the sun—and straight on to the top, climbing PIK's peak: you can hardly imagine the magnificent panorama that opens (with good visibility) from the main building's cupola over Telegraph Hill, the city of Potsdam, and beyond.

This sounds like ... adventure holidays? Well, by all means quite enjoyable—and agreeable as well as exciting, certainly; but actually we were here to learn. And learn we did, for sure—we just could not resist the temptations of the excellent opportunities offered here.

First of all, this is probably due to the expertise of our colleagues. Whether it is the many new interesting areas we are allowed to explore, or whether it takes them seconds to find the answer we had been seeking in vain for eternities—they always have help and advice ready, take their time to explain things in detail, and cheer us up when we are stuck; we experienced excellent cooperation and team spirit here.

Second, there is an incredibly wide range of IT-related subjects we could get our hands on and explore. It is amazing that this variety of different hard- and software platforms coexists peacefully at PIK; we did not experience any serious incidents throughout the past two years (even though the rise/drop ratio of the critical temperature in the cluster room caused some eyebrows to raise last summer). We are continually astonished that all this is managed by a crew so small, in relation to the steadily increasing number of devices and services.

Given this outstanding initial situation, there have been very interesting and challenging projects with which we were occupied (and sometimes almost absorbed). We assisted in the installation and configuration of a new high-performance parallel computer cluster, were integrated into a project cooperation with ICI in Bucharest, Romania, and made relevant contributions to the Collaboration Environment server (CE) which is also home to

the DINAS-COAST project, a web portal for the Semi-arid Integrated Model (SIM) that we implemented together with a student from Potsdam University, and to the (in parts internal) IT portal of D&C. We gained skills and knowledge in system architecture and infrastructure design, planning, implementation, deployment, maintenance and expansion of resources and services, whether related to hardware, networks, software, user management, or further areas. What we noticed: the main focus here is always on our actual clients, the users.

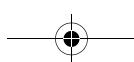
The schooling part took place at Oberstufenzentrum Technik (OSZT) in Teltow. Facing the local circumstances, the commitment of our teachers was beyond comparison. They even tried to convince us to become teachers in Teltow after successful completion of our apprenticeship ... To be honest, school weeks sometimes were inconvenient interruptions—at PIK, there was much more to learn (and it was far more interesting). Maybe a university entrance qualification and four terms of computer science did not really prepare us for everyday life at the vocational school ... On the other hand, our grade level was also one of the first to participate in after-school courses for the Cisco CCNA certificate. And we had the opportunity to pass a language certificate for IT professional English.

In practice, beside contacts to IT companies there were also opportunities to extend one's scope to other domains in presentations, seminars, and similar events. For example there was the dense local concentration of earth sciences, but also other natural and social sciences. The science campus highlights were festivities like the Long Night of Sciences in Berlin/Brandenburg, the Potsdam Night of Sciences, the Girls Day, and guided tours for visitors and school classes so we could contribute to communicating the activities of our scientific institution to the public.

After we have passed the final exam of the IHK (German Chamber of Industry and Commerce) and can hopefully refer to ourselves as “IT specialists in system integration,” we will be able to look back on lots of impressions and experiences. We shared two remarkable years with wonderful colleagues at PIK.



In Remembrance of Gerd Bruschek







In Remembrance of Gerd Bruschek

BORN FEBRUARY 16, 1941
IN BERLIN-CHARLOTTENBURG

Our colleague, the geographer Gerd Bruschek, passed away on Wednesday May, 19th, 2004. While it was evident that he was seriously ill, we were shocked to hear of his death.

Gerd Bruschek had been at PIK since its foundation. Due to poor health, he was sometimes unable to work for lengthy periods. He returned to work each time full of élan and new ideas and was immediately able to link in with the scientific work at PIK. This was due in no small degree to the fact that his passion for geography was undiminished, even while at home or ill in bed.

Gerd Bruschek was one of PIK's first staff members. He was somebody who in his daily journeying from Charlottenburg in Berlin, over the Glienicker Bridge to Potsdam could be especially glad about the restored unity between the city and the neighboring state of Brandenburg. As a Berliner he was immediately affected by the division of the city: his grandfather, who had brought him up and filled the role of a father during and after the war, had stayed in East Berlin.

Straight after joining PIK he was involved in the conception and details of the institute's first large-scale project, which dealt with impacts of the 1992 summer drought on society and the environment in northern Germany. During this time he developed a forest fire index which, while simply structured, explained the effects of summer drought on forest fire events very well. This index (which is named after him) has since been used comprehensively in climate impact studies examining the impacts of climate scenarios on land use in Brandenburg.

In recent years the wheel came full circle for Gerd Bruschek in a theme that in his younger years as a student had taken him to Africa. He had discovered his love of geography during a mining apprenticeship and consequently in 1962 began to study geography at Berlin's Free University. After his intermediate examinations he went in the Tibesti region as deputy head of the Free University's research station from 1965 to 1967. Important results of his work there were drawn together in his diploma thesis, entitled "Volcanic phenomena and their types and post-volcanic activity in the Tarso Voon area of the Tibesti Mountains (central Eastern Sahara)."

The exceptional scientific quality of this diploma thesis led in 1979 to his gaining second position - although he had no Ph.D. - for a professorship in cartography and geography at the Karlsruhe Polytechnic. From 1976 until 1983 Gerd Bruscek worked as a scientific team-member and editor at Afrika-Kartenwerk (a thematic map project edited on behalf of the German Research Society), from 1978 on as its general manager. He was joint editor of a comprehensive geographical yearbook on African geography. He was able to link up with this work in his last years at PIK. Since the end of the 1990s he had been investigating the consequences of climate fluctuations on agriculture and agricultural markets, looking particularly at Morocco. He worked out a series of relatively robust empirical links by which it is possible to predict cereal harvests in Morocco before sowing in the same year.

In the last few weeks of his life he worked intensively on a manuscript coherently presenting (after meticulous checking) the results of his research on Morocco. Sadly, he will no longer be able to witness the publication - or the appreciation - of his work.

We knew Gerd Bruscek as a warm-hearted and humorous person, who entertained us with his love of long, complicated German sentences, but from whom we will also remember many a pithy one-liner. We will miss him, and extend our sympathy to his wife and daughter.

Potsdam, May, 24th, 2004

His friends and colleagues of the Potsdam Institute for Climate Impact Research.



Appendix



Chronicle

2002

- 22 January Visit of the president of the "Thüringer Landesanstalt für Umwelt und Geologie," Klaus-Rainer Hoffmann
- 22 January Visit of the Federal Foreign Office
- 1 February Visit of the Swedish foundation MISTRA
- 7 - 8 March Visit of the Polish President, Aleksander Kwasniewski
- 9 - 10 March Conference on water-supply and distribution, in cooperation with the "Naturschutzbund Brandenburg"
- 16 May German Conference of Environment Ministers at the PIK main building
- 2 - 3 September Visit of a Polish delegation on scientific-technical cooperation
- 3 September Visit of the Ukrainian First Secretary of the Embassy, Volodymyr Didukh
- 5 September Award of the Gary Comer grant to Stefan Rahmstorf
- 13 September Visit of foreign correspondents
- 1 November Opening of the exhibition "Art & Science" in the "Kutschstall" in Potsdam, presentation of the installation of Tilman Kuentzel (see photo) which the artist developed in cooperation with PIK



4 November	Award of the Royal Society-Wolfson Research Merit Award to Hans J. Schellnhuber
7 - 8 November	Meeting of the Scientific Advisory Board
27 November	Visit of a Chinese delegation
27 November	Meeting of the Board of Trustees
6 - 7 December	2002 Berlin Conference on the Human Dimensions of Global Environmental Change at PIK: "Knowledge for the Sustainability Transition: The Challenge for Social Science"



The conference was organized by the PIK Project Global Governance. Pictured in the photo are Jürgen Scheffran (1st row, 1st from the left), Robert Marschinski (1st row, 2nd from the left), Frank Biermann (2nd row, 1st from the right), and Gerhard Petschel-Held (1st row, 2nd from the right)

17 - 18 December	ToPIK-Days
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2003

30 January	Visit of members of the Russian Duma
17 February	Award of the Leibniz Prize to Rupert Klein
24 February	Visit of Katherina Reiche, member of the Bundestag (CDU), spokeswoman for education and science of the parliamentary party CDU/CSU
26 - 27 February	12 th meeting of the German-French environmental council at the PIK main building
22 March	Information stand at the "open house" of the waterworks "Potsdam/Leipziger Straße" in the context of the "World Water Day 2003"
9 April	Visit of science attachés from German embassies, together with representatives of the Leibniz Association and the Federal Ministry of Education and Research

7 - 11 April

Information stand "Water is future" at the fair "Wasser Berlin 2003" (see photo) in cooperation with the Institute of Meteorology of the Freie Universität Berlin



28 April

Visit of Andrea Wicklein, member of the Bundestag (SPD) and member of the commission for education and research

8 May

"Girls' Day" – Future day for girls and boys in Brandenburg

14 May

Visit of the Indian Minister for Non-Conventional Energy Sources, Shri M. Kannappan (5th from the left), with a delegation of Indian energy experts



25 - 30 May

91st Workshop of the Dahlem Konferenzen "Earth Systems Analysis for Sustainability", organized by William C. Clark, Paul J. Crutzen, and Hans J. Schellnhuber

14 June

"Long Night of Science"

26 June

Visit of science attachés of foreign embassies in Berlin

26 June

Award of the Michelson Prize to Kirsten Thonicke for the best doctorate of the year 2002/2003 at the Faculty of Mathematics and Sciences at the University of Potsdam

1 July

Visit of the president of the "Bundesamt für Naturschutz," Hartmut Vogtmann

10 July

Award of the Carl Ramsauer Prize of the Physical Society of Berlin to Till Kuhlbrodt for his excellent doctorate

- 13 August Visit of foreign correspondents
- 28 - 29 August First "PIK-Tyndall-Summit" in Norwich
- 1 September Evening reception of the IPCC at the PIK main building:
Welcoming by Martin Claussen, Rajendra K. Pachauri, chairman of IPCC, and Karsten
Sach (BMU;from the left)



- 6 September Information stand at the science market of the "Brandenburg Day"
- 10 September Visit of an Indian delegation from the Ministry of Agriculture and the central government
- 11 - 12 September Workshop: ToPIK process 2004+
- 18 September Visit of Indonesian environmental experts
- 22 - 25 September "6th German Climate Conference" in cooperation with the GeoForschungsZentrum and
the Alfred Wegener Institute for Polar and Marine Research

23 September

Participation in the parliamentary evening of the Leibniz Association in Brussels



Rupert Klein, Rainer Gerold (European Commission Director for "Science and Society" in the Research Directorate General), Richard Escritt (European Commission Director for "Coordination of Community Activities" in the Research Directorate General and Leibniz Association Senator), Hans-Olaf Henkel (President of the Leibniz Association), Heike Zimmermann-Timm (left to right)

26 September

"First Potsdam Science Night"

8 October

Visit of a Chinese economic delegation

18 October

Award to Martin Claussen of the Membership Diploma of the German Academy of Natural Scientists Leopoldina

22 October

Participation in the parliamentary evening of LAUF (organization of non-university research facilities in Brandenburg) in the permanent representation of the Federal State of Brandenburg in Berlin

6 - 7 November

Meeting of the Scientific Advisory Board

2 December

Meeting of the Board of Trustees

7 December

"Sunday Lecture" by Martin Claussen within the lecture series "Heads of Potsdam"

9 - 10 December

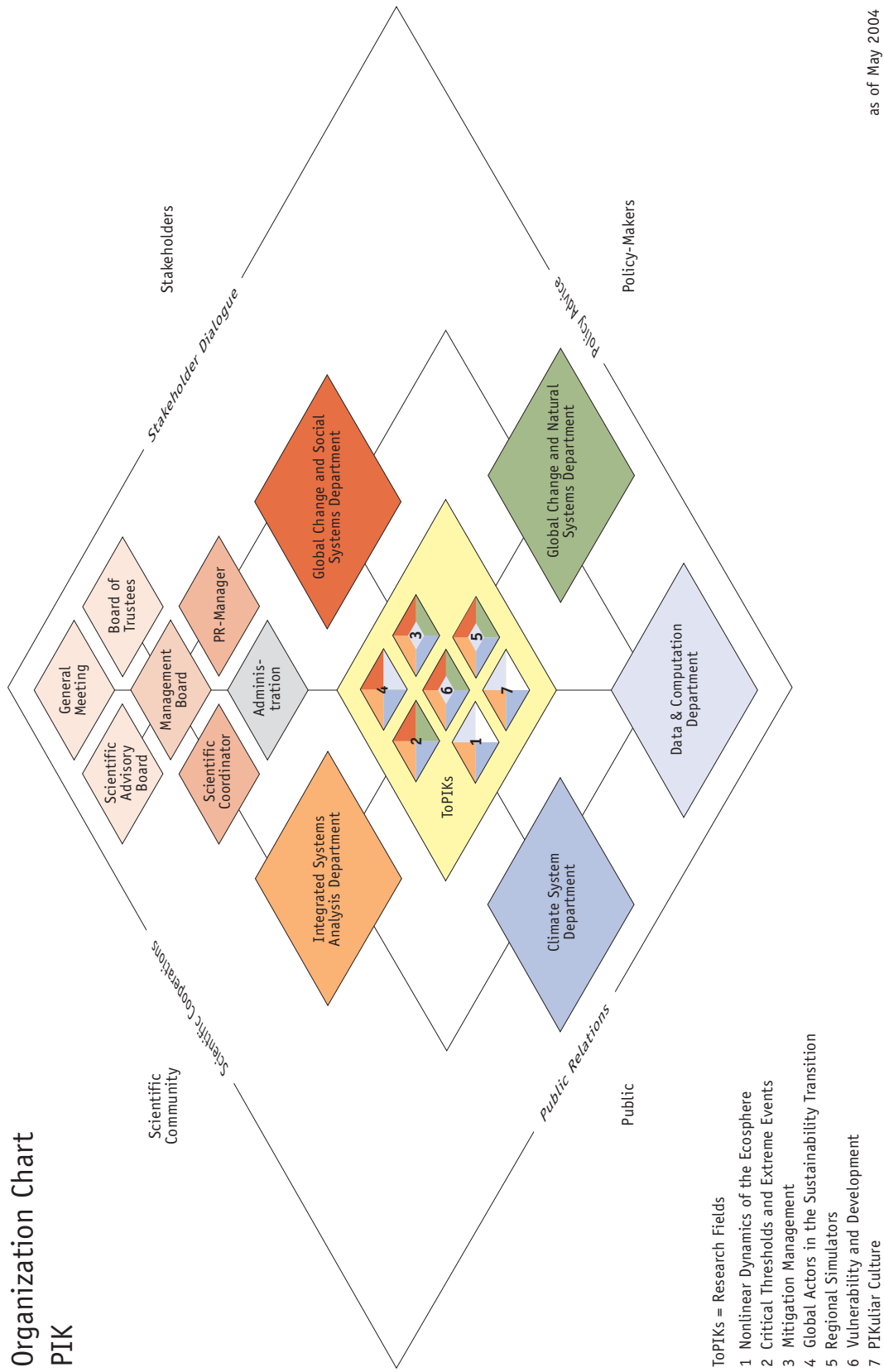
First "E-VIA Summit" in Milan

11 - 12 December

Conference on "Waste, Energy and Climate" in the context of "Potsdam's Waste Day 2003"

15 - 16 December

ToPIK-Days and "Drinking to an exciting year"



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Name	Institution	Term in Office
Chair: Prof. Dr. Marina Fischer-Kowalski	Institute for Interdisciplinary Studies, Vienna	01.01.2002-31.12.2005
Vice-Chair: Prof. Dr. Roger E. Kasperson	Stockholm Environment Institute	01.01.2002-31.12.2005
Prof. Dr. Guy Brasseur	Max-Planck-Institute for Meteorology, Hamburg	01.01.2000-31.12.2003
Prof. Dr. Dr. Carlo Carraro	University of Venice	01.02.2002-31.12.2005
Prof. Dr. William C. Clark	John F. Kennedy School of Gov- ernment, Harvard University, Cambridge	01.01.2000-31.12.2003
Prof. Dr. Mike Hulme	Tyndall Centre for Climate Change Research, Norwich	01.01.2002-31.12.2005
Prof. Dr. Karin Lochte	Leibniz Institute for Marine Research, Kiel	01.01.2002-31.12.2005
Prof. Dr. Andrew Majda	Courant Institute of Mathe- matical Sciences, New York	01.01.2002-31.12.2005
Prof. Dr. Ernst-Detlef Schulze	Max-Planck-Institute for Biogeo- chemistry, Jena	01.01.2002-31.12.2005
Prof. Dr. Ulrich Trottenberg	Fraunhofer Institute for Algo- rithms and Scientific Computing, Sankt Augustin	01.01.2002-31.12.2005

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Dr. Heinz-Ulrich Schmidt <i>[State]</i>	Ministry of Science, Research and Culture of the State of Brandenburg	up to 31.12.2002
MinR. Dr. Norbert Binder <i>[Federal]</i>	Federal Ministry of Education and Research	from 25.04.1996
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Dr. Ignacio Campino	Deutsche Telekom	from 01.01.2003
Prof. Dr. Marina Fischer-Kowalski	Institute for Interdisciplinary Studies, Vienna	from 01.01.2002
Prof. Dr. Hartmut Grassl	Max Planck Institute for Meteorology, Hamburg	from 01.01.2001
Prof. Dr. Helmut Keupp representing Prof. Dr. Dieter Lenzen	Freie Universität Berlin	from 30.09.2003
Prof. Dr. Jürgen Kurths representing Prof. Dr. Wolfgang Loschelder	University of Potsdam	from 30.09.2003
Prof. Dr. Peter Lemke	Alfred Wegener Institute for Polar and Marine Research, Bremerhaven	from 01.01.2001
Dr. Stephan Singer	World Wildlife Fund, European Office	from 01.01.2003
Prof. Dr. Bernd Walz representing Prof. Dr. Wolfgang Loschelder	University of Potsdam	up to 29.09.2003

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Alumni since January 2002

Dr. Lilibeth Acosta-Michlik	Ina Meyer
Dr. Wilfried Ahrens	Peter Mohr
PD Dr. Frank Biermann	Dr. Marisa Montoya
Dr. Gerd Bruschek, deceased	Dr. Miguel Morales-Maqueda
Dr. Gerd Bürger	Matthias Münch
Dr. Youmin Chen	Valerie Pomaz
Daniel Doktor	Tanja Rixecker
Thies Eggers	Jörg Schaber
Pavel Egorov	Jan Peter Schäfermeyer
Dr. Markus Erhard	Heiko Schmidt
Maren Ewald	Daniel Schwandt
Dagmar Galda	Julia Schwarzkopf
Katrin Gerlinger	Wilhelmine Seelig
Dr. Sergey Grafutko	Jun.-Prof. Dr. Bernd Siebenhüner
Arnulf Günther	Dr. Stephen Sitch
Barbara Hannappel	Dr. Susanne Stoll-Kleemann
Holger Hoff	Bernhard Ströbl
Annekatriin Jaeger	Dr. Frank Thomalla
Dr. Beate Klöcking	Dr. Soenke Titz
Dr. Eva Koscielny-Bunde	Prof. Dr. Ferenc Tóth
Dr. Maarten Krol	Dr. Markus Uhlmann
Thomas Kuhlow	Dr. Sergey Venevski
Susanne Langenberg	Martin Wattenbach
Dr. Marcus Lindner	Reinhard Weng
Dr. Karl-Michael Meiß	Thomas Zenker

as of May 21, 2004

Chairs and Final Examinations

Master's Thesis

Name	Year	University	Title of the Work
Björn Brüsch	2002	University of Potsdam, Faculty of Mathematics and Natural Science	Evaluierung von Simulationsstudien zur Rege- neration nach Sturmwurf im Nationalpark Bayerischer Wald
Irina Fast	2002	Freie Universität Berlin, Geosciences Department	Modelltheoretische Analyse der Wechselwir- kungsprozesse im Klimasystem des Holozäns
Anja Hünnerbein	2002	Freie Universität Berlin, Geosciences Department	Vulkanismus – ein externer Klimafaktor. Modellstudie zum Einfluss des Vulkanismus auf das Klima der letzten tausend Jahre
Diana Reckien	2002	Dresden Technical University, Geography Department	Verkehr - CO ₂ Eine empirische Untersuchung am Beispiel Berlins
Matthias Zoeller	2002	Freie Universität Berlin, Institute for Meteorology	Zur Klimatologie und Extremwertstatistik von Temperatur und Niederschlag im Mittelmeer- raum
Ralf Thorsten Arnold	2003	University of Oldenburg, Fac- ulty of Mathematics and Infor- mation Technology	Exploring the meso scale: Embedding case studies into a dynamic framework - A qualita- tive model in tropical Mexico
Anne Biewald	2003	Ernst-Moritz-Arndt- Univer- sity of Greifswald, Faculty of Mathematics and Natural Science	Climate Change, Land Use and the Insurance Industry
Holger Braun	2003	University of Heidelberg, Faculty of Physics and Astronomy	Einfluss der Bewölkung auf glaziale Erwär- mungen im Klimasystem-Modell CLIMBER-2
Daniel Doktor	2003	Westfälische Wilhelms-Univer- sity of Münster, Geoscience	Raumzeitliche Analyse und Modellierung von phänologischen Daten mit Hilfe von Geo- informationssystemen und geostatistischen Verfahren
Hannah Förster	2003	University of Potsdam, Faculty of Economic and Social Science	The Life Cycle Hypothesis
Frank Meißner	2003	University of Potsdam, Faculty of Economic and Social Science	Monetäre Wachstumstheorie
Fabian Pieper	2003	Technical University of Berlin, Institute for Electrical Engi- neering	Das Konzept von Lernkurven erneuerbarer Energietechnologien: Beschreibung, Modellie- rung und Aggregation

Ph.D. Thesis

Name	Year	University	Title of the work
Uta Fritsch	2002	University of Potsdam, Faculty of Mathematics and Natural Science	Entwicklung von Landnutzungsszenarien für landschaftsökologische Fragestellungen
Andreas Güntner	2002	University of Potsdam, Faculty of Mathematics and Natural Science	Large Scale Hydrological Modelling in the Semi-Arid North-East of Brazil
Till Kuhlbrodt	2002	University of Potsdam, Faculty of Mathematics and Natural Science	Stability and Variability of Open-ocean Deep Convection in Deterministic and Stochastic Simple Models
Jörg Schaber	2002	University of Potsdam, Faculty of Mathematics and Natural Science	Phenology in Germany in the 20 th Century: Methods, Analyses and Models
Richard Klein	2003	Christian-Albrechts-Univer- sity of Kiel, Faculty of Mathe- matics and Natural Science	Coastal Vulnerability, Resilience and Adapta- tion to Climate Change: An Interdisciplinary Perspective
Kirsten Thonicke	2003	University of Potsdam, Faculty of Mathematics and Natural Science	Fire Disturbance and Vegetation Dynamics – Analysis and Models

New Chairs

Name	Year	University	Title of the chair
Martin Claußen	2002	University of Potsdam, Fac- ulty of Mathematics and Nat- ural Science, Institute for Geoecology	C4-Professur, Climate Physics
Wolfgang Cramer	2003	University of Potsdam, Fac- ulty of Mathematics and Nat- ural Science, Institute for Geoecology	C4-Professor, Global Ecology

Scientific Events

Date	Venue	Event	Organization
2002			
10 - 11 January	Potsdam	DINAS-COAST Working Visit	Richard Klein
22 February	Delft (Netherlands)	DINAS-COAST Workshop	Richard Klein
15 - 17 April	Barcelona (Spain)	1 st Annual ATEAM Meeting	Dagmar Schröter, Wolfgang Cramer
18 - 20 April	London (UK)	2 nd DINAS-COAST Annual Meeting	Richard Klein
22 - 24 April	Nice (France)	3 rd EMIC Workshop: Land Surface Experiments and the Last Glacial Inception, EGS XXVII, General Assembly 2002	Victor Brovkin, Martin Claußen, <i>Gilles Ramstein (Laboratoire des Sciences du Climat et de l'Environnement)</i>
25 April	Nice (France)	Climate Models: Nonlinear Response and Thresholds, EGS XXVII, General Assembly 2002	Martin Claußen, <i>Ulrike Feudel (Carl von Ossietzky Universität Oldenburg, ICBM)</i>
15 July	Potsdam	Vulnerability. Panel Discussion with William C. Clark, Sheila Jasanoff, Hans Joachim Schellnhuber, and Carlo Jaeger	Carlo Jaeger, Dagmar Schröter
11 - 12 September	Potsdam	2 nd ATEAM Stakeholder Workshop	Dagmar Schröter, Anne de la Vega-Leinert, Wolfgang Cramer
16 - 18 October	Boston (USA) John F. Kennedy School of Govern- ment, Harvard Uni- versity	Vulnerability Methods and Models Workshop	Dagmar Schröter, <i>Colin Polsky (Harvard University)</i> , Anthony Patt (Boston University & PIK)
24 - 25 October	Potsdam	Workshop: Last Glacial Inception	Martin Claußen
6 - 7 November	Potsdam	Geoscope, EU FP6 Planning Workshop (1): A Tool for Managing the Sustainability Transition	Carlo Jaeger, Hermann Lotze-Campen
14 - 15 November	Berlin	2 nd ECF Autumn Conference: Climate Change and Paths to Sustainability	Carlo Jaeger, Martin Welp

Date	Venue	Event	Organization <i>italics: externally organized</i>
27 - 29 November	Hamburg	3 rd DINAS-COAST Project Meeting	Richard Klein
2003			
7 - 8 January	Washington, D.C. (USA)	Global Water System Project (GWSP) for the Americas	Holger Hoff
22 - 24 January	Potsdam	Geoscope Workshop: Socio-Economic Metabolism Methodology	Hermann Lotze-Campen
29 - 30 January	Delft, Amsterdam (Netherlands)	DINAS-COAST Interim Meeting: Adaption Modelling	Richard Klein
31 January - 1 February	Potsdam	1 st International Workshop on Scaling and Trend Analysis in Hydrometeorological Time Series Data	Jürgen Kropp
12 February	Potsdam	Bewirtschaftungsmöglichkeiten im Einzugsgebiet der Havel	Axel Bronstert, Werner Lahmer, <i>Sibylle Itzerott (GeoForschungsZentrum)</i>
17 - 18 February	Potsdam	1 st AMS Planning Workshop	Ottmar Edenhofer, Armin Haas
24 - 25 February	Potsdam	Bereichstreffen des Deutschen Klimaforschungspro- gramms des BMBF (DEKLIM): Klimavariabilität und Vorhersagbarkeit	Wolfgang Lucht
6 - 7 March	Wageningen (Nether- lands)	Vulnerability Meeting	Dagmar Schröter, <i>Marc Metzger, Rik Leemans (Wageningen University)</i>
18 - 19 March	Kyoto (Japan)	Global Water System Project (GWSP) for Asia	Holger Hoff
20 - 21 March	London (UK)	DINAS-COAST: Interim Meeting on DIVA Database and Integrated Model	Anne de la Vega-Leinert
8 April	Nice (France)	4 th EMIC Workshop: Land Surface Experiments at EGS- AGU-EUG, General Assembly	Martin Claußen
8 April	Nice (France)	Emergent Properties of the Natural and Human-Impacted Earth System: Insights From the Full Spectrum of Model Complexities, EGS-AGU-EUG, General Assembly 2003	Martin Claußen, <i>Dominique Bachelet (Oregon State University), Peter Cox (Hadley Centre), Pierre Fried- lingstein (Laboratoire des Sciences du Climat et de l'Environnement)</i>

Date	Venue	Event	Organization <i>italics: externally organized</i>
9 April	Brussels (Belgium)	Interim meeting on the project EUROSION and potential links with DINAS-COAST	Anne de la Vega-Leinert
10 - 11 April	Potsdam	Frühjahrstreffen AIX-Arbeitskreis	Karsten Kramer
10 - 12 April	Samos (Greece)	AVEC Workshop: Vulnerability of European Ecosystems Facing an Increasing Drought Risk	Wolfgang Cramer, Uta Fritsch
24 - 25 April	Wageningen (Netherlands)	Adaptive Capacity Workshop: Toward a Quantitative Indicator of Adaptive Capacity	Dagmar Schröter, <i>Marc Metzger (Wageningen University)</i> , Richard Klein
5 - 8 May	Évora (Portugal)	2 nd Annual ATEAM Meeting	Dagmar Schröter, Wolfgang Cramer
8 - 9 May	Delft (Netherlands)	Global Water System Project (GWSP) for Europe and Africa	Holger Hoff
22 May	Hamburg	DINAS-COAST Model Integration Interim Meeting	Richard Klein
24 - 30 May	Berlin	Dahlem-Workshop: Earth System for Sustainability	Hans Joachim Schellnhuber, Martin Claußen, <i>William C. Clark (Harvard University)</i> , <i>Paul J. Crutzen (Max-Planck-Institut für Chemie)</i>
16 - 17 June	Potsdam	General Methodology for Model Supported Integrated River Basin Management in Europe	Alfred Becker, Fred Hattermann
19 - 21 June	Berlin	The US, the EU, and Precaution: A Comparative Case Study Analysis of the Management of Risk in a Complex World	Martin Welp, <i>Michael Rogers (European Commission)</i> , <i>Csaba Chikes (U.S. Mission to the EU)</i> , <i>Marianne Ginsburg (German Marshall Fund of the U.S.)</i> , <i>Jonathan Wiener (Duke University)</i> , <i>Bruce Ballantine (The European Policy Centre)</i>
25 - 27 June	Amsterdam (Netherlands)	4 th General DINAS-COAST Meeting	Richard Klein
3 - 4 July	Potsdam	3 rd Coordination Meeting, cCASHh	Richard Klein, Hans-Martin Füssel
8 - 10 September	Norwich (UK)	3 rd ECF Autumn Conference — The Biofuels Directive: Potential for Climate Protection? Hosted by the Tyndall Centre for Climate Change Research	Carlo Jaeger, Martin Welp

Date	Venue	Event	Organization <i>italics: externally organized</i>
11 - 12 September	Potsdam	Blick in PIKs Zukunft — Forschungsperspektiven in Berlin und Brandenburg	Rupert Klein, Heike Zimmermann-Timm
14 - 27 September	Peyresq, Alpes de Haute-Provence (France)	Integrated Assessment of Vulnerable Ecosystems under Global Change (AVEC) — International Summer School	Wolfgang Cramer, Uta Fritsch, Sabine Lütke-meier
22 - 25 September	Potsdam	6. Deutsche Klimatagung	Martin Claußen, Friedrich-Wilhelm Gerstengarbe, <i>Jörg Negendank (GeoForschungsZentrum), Klaus Dethloff (Alfred-Wegener-Institute for Polar- and Marine Research)</i>
6 - 9 October	Portsmouth, New Hampshire (USA)	Global Water System Project (GWSP) Open Science Conference	Holger Hoff, <i>Charles Vörösmarty (University of New Hampshire)</i>
3 - 4 November	Potsdam	DINAS-COAST Interim meeting on DIVA development	Anne de la Vega-Leinert

External Funding

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Dynamic response of the forest-tundra ecotone to environmental change	DART	ENV4-CT97-0586	European Union	€ 268,700	01.04.1998-31.03.2002	Wolfgang Cramer
James S. McDonnell Foundation	McDonnell	99-5 CF-SPE .03	James S. McDonnell Foundation	\$ 1,000,650	01.04.1999-31.03.2005	Stefan Rahmstorf
Grobrasteranalyse zu den Möglichkeiten für umweltentlastende Landnutzungsänderungen in Folge des globalen Wandels	VW-Stiftung	II/75141	VolkswagenStiftung	€ 281,200	01.10.1999-28.02.2003	Wolfgang Cramer
Kleinskalige Instabilitäten als Bausteine der turbulenten Energiekaskade	Instabilitäten	KL611/10/1	Deutsche Forschungsgemeinschaft	€ 43,900	01.11.1999-11.03.2003	Rupert Klein
Vom Eem ins <u>Holozän</u> : Modellierung des letzten Warm-Kaltzeitzyklus mit Hilfe eines Klimasystemmodells mittlerer Komplexität	Holozän	CL 178/2-1 CL 178/2-2	Deutsche Forschungsgemeinschaft	€ 150,400	01.01.2000-31.03.2003	Martin Claußen
Wissenschaftliches Sekretariat zur Unterstützung des neuen Vorsitzenden von <u>IGBP-GAIM</u>	IGBP-GAIM	07 GCH 02	Bundesministerium für Bildung und Forschung	€ 184,000	01.03.2000-28.02.2003	Hans Joachim Schellnhuber, Hermann Held
Einrichtung eines „Deutschen Forschungsnetzes Naturkatastrophen (<u>DFNK</u>)“	DFNK	01SF9970/1	Bundesministerium für Bildung und Forschung	€ 538,600	01.01.2000-30.06.2003	Hans Joachim Schellnhuber, Lucas Menzel

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Sequentielle indikatorbasierte <u>Regelungsstrategien</u> im Rahmen des Leitplankenansatzes in der integrierten Klimaschutzanalyse	Regelungsstrategien	II/76186	VolkswagenStiftung	€ 152,100	01.03.2000-31.01.2004	Thomas Bruckner
Simulation der langfristigen Variabilität im Klimasystem des Holozäns mittels eines gekoppelten Atmosphäre-Ozean-Biosphäre-Modells mittlerer Komplexität	CLIMBER-KIHZ	01LG9906	Bundesministerium für Bildung und Forschung / Deutsches Luft- und Raumfahrtzentrum	€ 172,700	01.04.2000-31.03.2003	Martin Claußen
Integrierte Analyse der Auswirkungen des globalen <u>Wandels</u> auf die Umwelt und die Gesellschaft im Elbegebiet	GLOWA	07 GWK 03	Bundesministerium für Bildung und Forschung / Forschungszentrum für Umwelt & Gesundheit in der Helmholtz-Gemeinschaft	€ 4,588,200	01.05.2000-31.10.2003	Alfred Becker
Lebensstile und Naturschutz	BFN	80081005	Universität Gesamthochschule Kassel	€ 35,800	15.08.2000-14.02.2002	Fritz Reusswig
EUROPA - Modelling, Reflecting and Communicating Possible Futures of Europe in the Context of Global Change	CLUSTER	EMO 0005	Bundesministerium für Bildung und Forschung / Deutsches Luft- und Raumfahrtzentrum	€ 2,567,900	01.10.2000-30.09.2005	Carlo Jaeger
Szenarien hydrologischer Extreme - Zweidimensionales Downscaling von Klimamodellen auf tägliche Niederschläge mit Anwendungen in der Hydrologie	SYE	BU 728/2-1	Deutsche Forschungsgemeinschaft	€ 57,900	01.11.2000-30.10.2002	Gerd Bürger

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Response Strategies to Global Climate Change in Forest Management for Sustainable Forest Production, Carbon Sequestration and Biodiversity in the European Forests	SilviStrat	EVK2-CT-2000-00073	European Union	€ 220,392	01.12.2000-30.11.2003	Franz Badeck
Entwicklung eines Sustainability-Portfolios für die Deutsche Telekom	Telekom	44474049	Telekom	€ 189,178	13.07.2001-31.12.2002	Carlo Jaeger
Projektbezogener Personenaustausch mit Portugal	AL	314/AL-p-dr	Deutscher Akademischer Austauschdienst	€ 6,100	01.01.2001-31.12.2002	Wolfgang Cramer
<u>E</u> uropean <u>P</u> henology <u>N</u> etwork	EPN	EVK2-CT-2000-20005	European Union	€ 45,420	01.01.2001-30.09.2003	Michael Flechsig
Statistisch-Physikalischer Zugang zur Atmosphären-Variabilität	-	SCHE 234/9-1	Deutsche Forschungsgemeinschaft	€ 42,900	01.10.2001-30.09.2003	Hans Joachim Schellnhuber
Asymptotisch adaptive Verfahren zur Simulation von <u>Mehrskalenproblemen</u> der Strömungstechnik	Mehrskalenprobleme	KL 611/6-3 KL 611/6-4	Deutsche Forschungsgemeinschaft	€ 163,300	01.01.2001-31.12.2003	Rupert Klein
Befristete Einrichtung einer Doktoranden-Nachwuchsgruppe im Zusammenhang mit den EU-Projekten ATEAM/SILVISTRAT/DINAS-COAST	Doktoranden-Nachwuchsgruppe	24/2598-04/323-2000	Ministerium für Wissenschaft, Forschung und Kultur des Landes Brandenburg	€ 223,800	01.01.2001-31.12.2003	Wolfgang Cramer, Carlo Jaeger, Marcus Lindner

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Stabilität der Selbstregulation im System Erde	-	24/2598-04/325-2000	Ministerium für Wissenschaft, Forschung und Kultur des Landes Brandenburg	€ 305,200	01.01.2001-31.12.2003	Siegfried Franck
<u>Advanced Terrestrial Ecosystem Analysis and Modelling</u>	ATEAM	EVK2-CT-2000-00075	European Union	€ 2,851,823	01.01.2001-30.06.2004	Wolfgang Cramer
Modellvalidierung und <u>Ignoranzdynamik</u>	Ignoranzdynamik	01LG0002	Bundesministerium für Bildung und Forschung / Deutsches Luft- und Raumfahrtzentrum	€ 170,500	01.02.2001-31.04.2004	Hermann Held
F & E Vertrag: Koordination des Arbeitskreises und Erstellung einer Textvorlage für den Band des Elbe-Ökologie-Kompends	Kompensum	U/861.11/3694	Bundesanstalt für Gewässerkunde	€ 34,800	01.04.2001-01.02.2002	Alfred Becker
F & E Vertrag: <u>Security Diagrams</u> - Ein innovativer Ansatz zur Abschätzung der Gefährdung durch extreme Klimaereignisse	Security Diagrams	01LD001	Universität Gesamthochschule Kassel	€ 84,400	01.04.2001-31.03.2003	Carlo Jaeger
<u>INTEGRATION</u> - Integrated Assessment of Changes in the Thermohaline Circulation	INTEGRATION	UFLD01096900	Bundesministerium für Bildung und Forschung / Deutsches Luft- und Raumfahrtzentrum	€ 1,341,800	01.04.2001-31.03.2005	Stefan Rahmstorf
Modelltheoretische Untersuchung des Einflusses von Änderungen der Leuchtkraft der Sonne auf das Klima der letzten 12.000 Jahre	PAST12K	01LD0039	Heidelberger Akademie der Wissenschaften	€ 23,500	01.04.2001-31.03.2005	Martin Claußen
Klima, Vegetation und Kohlenstoff: Jahreszeitliche und langfristige gekoppelte Dynamik	CVECA	01LD0008	Bundesministerium für Bildung und Forschung / Deutsches Luft- und Raumfahrtzentrum	€ 1,007,647	01.04.2001-31.03.2006	Wolfgang Lucht

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Indikatoren für rezente und zu erwartende <u>W</u> irkungen des anthro-pogenen <u>K</u> limawandels in <u>E</u> uropa	WAKE	201 41 256/0	Umweltbundesamt	€ 125,600	01.05.2001-30.06.2003	Markus Erhard
<u>D</u> ynamic and <u>I</u> nteractive <u>A</u> ssessment of National, Regional and Global Vulnerability of <u>C</u> oastal Zones	DINAS-COAST	EVK2-2000-22024	European Union	€ 1,412,903	01.05.2001-30.04.2004	Richard Klein
Climate change and adaption strategies for human health in Europe	cCASHh	EVK2-CT-2000-00070	European Union	€ 66,020	01.05.2001-30.04.2004	Richard Klein
Variabilität und Dynamik des Klimasystems während der letzten Interglaziale	EEM	01LD0041	Bundesministerium für Bildung und Forschung / Deutsches Luft- und Raumfahrtzentrum / Universität Mainz	€ 307,000	01.06.2001-31.05.2006	Martin Claußen
PPP-Norwegen 2001	PPP	313/PPP-N1-1k	Deutscher Akademischer Austauschdienst	€ 10,100	01.07.2001-30.06.2003	Detlef Sprinz
F & E Vertrag: Hydrologische Flussgebietsmodellierung unter Berücksichtigung von Steuerungsmöglichkeiten zur Prognose der anthropogenen salinaren Belastung der Unstrut	Flussgebietsmodellierung	330028	Dresdner Grundwasserforschungszentrum	€ 147,700	01.07.2001-30.06.2004	Beate Klöcking
<u>P</u> rogramme for <u>I</u> ntegrated Earth <u>S</u> ystem <u>M</u> odelling	PRISM	EVR1-2000-00511-PRISM	European Union	€ 40,246	01.09.2001-31.08.2004	Rupert Klein

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Integrated Assessment of Vulnerable Ecosystems under Global Change	AVEC	EVK2-CT2001-00074	European Union	€ 652,508	01.10.2001-30.11.2004	Wolfgang Cramer
F & E Vertrag: GIS-basierte Szenarioanalyse im Havelgebiet und integrierende Bewertungen	FGM	330227	Universität Potsdam	€ 284,718	01.10.2001-30.09.2004	Werner Lahmer
Verlängerung und Aufstockung: Extreme hydrologische Ereignisse in Mitteleuropa seit 1500 - Prozesse und Wirkungen	EXEME1500	WE 2356/1-3	Deutsche Forschungsgemeinschaft	€ 28,100	01.11.2001-31.10.2002	Peter C. Werner
Werkvertrag: Erstellung von Teilkonzepten für Befragungen und Durchführung von Analysen	Monitoring	405-537.141	Land Schleswig-Holstein	€ 6,100	06.11.2001-31.11.2002	Fritz Reusswig
Biospheric Aspects of the Hydrological Cycle	BAHC	BAHC 9901	Bundesministerium für Bildung und Forschung	€ 126,289.80	01.01.2002-30.09.2002	Holger Hoff
Urban Sprawl: European Patterns, Environmental Degradation and Sustainable Development	URBS PANDENS	EVK4-CT-2001-00052	European Union	€ 1,165,054	01.01.2002-31.12.2004	Gerhard Petschel-Held
Multi-Sensor Concepts for Greenhouse Gas Accounting of Northern Eurasia	SIBERIA II	EVK1-2001-00158	European Union	€ 45,346	01.01.2002-30.06.2005	Wolfgang Lucht
Wirksamkeit und Lernfähigkeit internationaler Organisationen in der Umweltpolitik	MANUS	II/77 932	VolkswagenStiftung	€ 535,500	01.02.2002-31.01.2005	Frank Biermann

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Weiterentwicklung multivariater statistischer Analysemethoden, Anwendung auf meteorologische Parameter zur Beschreibung hydrologischer Vorgänge, Einsatz von N/A-Modellen zur Erzeugung von Basisdaten für die Fluktuationsanalyse	Skalenanalyse	330271	Bundesministerium für Bildung und Forschung / Forschungszentrum Jülich	€ 643,559	01.03.2002-28.02.2005	Jürgen Kropp, Hans Joachim Schellnhuber
<u>European Forum on Integrated Environmental Assessment</u>	EFIEA II	EVK2-CT-2001-20011	European Union	-	01.04.2002-31.03.2005	Carlo Jaeger
Nachhaltigkeitsbeirat	-	21-8809.00/28	Ministerium für Umwelt und Verkehr Baden-Württemberg	Annually € 7,500	from 22.04.2002	Stefan Rahmstorf
F & E Vertrag: LPJ <u>Spurengase</u>	Spurengase	9525	Max-Planck-Institut für Biogeochemie Jena	€ 30,000	01.05.2002-01.12.2002	Wolfgang Cramer
Typische Ursache-Wirkungsmuster der Landnutzungsänderung und deren qualitative Modellierung in ausgewählten Entwicklungs- und Schwellenländern	Synapse	SCHE 234/10-1	Deutsche Forschungsgemeinschaft	€ 110,310	01.05.2002-30.04.2003	Gerhard Petschel-Held
<u>Koevolution</u> von Bio- und Geosphäre auf langen Zeitskalen	Koevolution	FR 910/10-1; FR 910/10-2	Deutsche Forschungsgemeinschaft	€ 48,514	01.06.2002-31.05.2004	Siegfried Franck
Study of the Atlantic thermohaline circulation in a highly efficient global ocean-atmosphere model	CLIVAR	03F0377G	Bundesministerium für Bildung und Forschung / Forschungszentrum Jülich	€ 117,356	01.06.2002-31.08.2005	Stefan Rahmstorf

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Projektbezogener Personenaustausch mit Großbritannien	ARC	313/ARC-XVI-1k	Deutscher Akademischer Austauschdienst	€ 8,034	01.07.2002-30.06.2003	Rupert Klein
Projektbezogener Personenaustausch mit Großbritannien	ARC	313-ARC-Ik D/02/29217	Deutscher Akademischer Austauschdienst	€ 5,060	01.07.2002-30.06.2004	Hans Joachim Schellnhuber
<u>Comer Science</u> & Education Foundation	Comer Science	CC13	Comer Science & Education Foundation	\$ 300,000	01.10.2002-30.09.2005	Stefan Rahmstorf
Harmonised Modelling Tools for Integrated Basin Management	HarmoniCA	EVK1-CT-2002-20003	European Union	€ 396,249	01.10.2002-30.09.2007	Alfred Becker
Szenarien hydrologischer Extreme - Zweidimensionales Downscaling von Klimamodellen auf tägliche Niederschläge mit Anwendungen in der Hydrologie	SYE	BU 728/2-2	Deutsche Forschungsgemeinschaft	€ 22,398	12.10.2002-11.06.2003	Gerd Bürger
Multi-source inventory methods for quantifying carbon stocks and stock changes in European forests	CARBO-INVENT	EVK2-CT-2002-00157	European Union	€ 147,237	01.11.2002-31.10.2005	Marcus Lindner
Auswirkungen klimatischer Veränderungen auf das Land Brandenburg	Brandenburgstudie		Ministerium für Landwirtschaft, Umweltschutz und Raumordnung des Landes Brandenburg	€ 20,000	01.01.2003-30.06.2003	Manfred Stock

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Gottfried-Wilhelm-Leibniz-Preis	Leibniz-Preis	KL 611/14	Deutsche Forschungsgemeinschaft	€ 752,000	01.01.2003-31.12.2007	Rupert Klein
F & E Vertrag: Actors, Coalitions, Complex Networks—Integrated Modelling of Decisionmaking and Cooperative Management in Sustainable Environmental Transitions	IANUS	9527	Interdisziplinäre Arbeitsgruppe Naturwissenschaft, Technik und Sicherheit, IANUS e. V., Technische Universität Darmstadt	€ 46,000	01.01.2003-30.09.2003	Jürgen Scheffran
<u>Development</u> and Climate—Contribution from PIK	Development	M7728001/26/BB-178562	National Institute of Public Health and the Environment	€ 33,000	01.01.2003-31.12.2003	Richard Klein
F & E Vertrag: <u>PolitikON</u>	PolitikON	08NM110A	Universität Trier	€ 10,000	01.01.2003-31.12.2003	Detlef Sprinz
Perspektiven der <u>Klima</u> änderung bis 2050 für den Weinbau in Deutschland	Klima 2050	8502.187/2-1	Forschungsring Deutscher Weinbau	€ 27,500	01.02.2003-31.12.2003	Manfred Stock
F & E-Vertrag: Scientific <u>Framework</u> for Global Water System Project	Framework	9533	Zentrum für Entwicklungsforschung, Bonn	€ 5,000	01.03.2003-30.06.2003	Holger Hoff
Schutz klimasensitiver Systeme in Deutschland: Empfehlungen zum Schutz und zur Anpassung durch den Klimawandel gefährdeter Systeme in Deutschland	Vulnerabilität	201 41 253	Umweltbundesamt	€ 149,760	01.03.2003-28.02.2005	Wolfgang Cramer

Project name	Acronym	Reference No.	Sponsor	Total funding	Period of funding	Project leader
Regional meeting of the <u>Global Water System Project</u> for Europe and Africa	GWSP	800.00.504	Netherlands Organisation for Scientific Research; Earth and Life Sciences	€ 10,000	05.2003	Holger Hoff
<u>Ozean-Sequestrierung</u> von CO ₂ und die Transformation des Energiesystems	Ozean-Sequestrierung	II/78470	VolkswagenStiftung	€ 661,600	01.05.2003-30.04.2006	Hermann Held, Ottmar Edenhofer
F & E Vertrag: Bereitstellung von digitalen Informationen und Unterstützung bei der Erweiterung des Modells HBV-D für das Einzugsgebiet Elbe	Pilot-DSS	M/3098/03	Bundesforschungsanstalt für Gewässerkunde	€ 20,000	01.07.2003-30.06.2004	Lucas Menzel, Valentina Krysanova
Indikatoren des anthropogenen Klimawandels in Europa - <u>WAKE II</u> - Bewertung von gegenwärtigen und zukünftigen Klimamaßnahmen in Europa im Kyoto Prozess	WAKE II	20341252/01	Umweltbundesamt	€ 124,170	01.09.2003-31.08.2005	Wolfgang Cramer
Modelltheoretische Untersuchung zur Rolle mineralischen Staubes im Klimasystem des späten Quartärs	SKY	CL 178/3-1 CL 178/3-2	Deutsche Forschungsgemeinschaft	€ 156,600	01.09.2003-31.08.2005	Martin Claußen
Statistisch-Physikalischer Zugang zur Atmosphären-Variabilität	-	SCHE 234/9-2	Deutsche Forschungsgemeinschaft	€ 25,700	01.10.2003-31.03.2004	Hans Joachim Schellnhuber
Verbundvorhaben Klimawandel - Auswirkungen, Risiken, Anpassungen - Analyse spezifischer Verwundbarkeiten und Handlungsoptionen	KLARA	50047467/23	Landesanstalt für Umwelt Baden-Württemberg	€ 199,500	01.11.2003-31.12.2004	Manfred Stock

Cooperation—Scientific Information and Data Exchange

Institution / Location	Cooperation Details
Australia	
Bureau of Meteorology Research Centre, Climate Dynamics Group, Melbourne	
Austria	
Internationales Institut für Angewandte Systemanalyse, Laxenburg	BMBF Project: INTEGRATION
Joanneum Graz	EU Project: CarboInvent
Österreichisches Institut für Nachhaltige Entwicklung	Cooperation Agreement
Technische Universität, Institut für Photogrammetrie und Fernerkundung, Vienna	
Universität für Bodenkultur, Institut für Waldbau, Vienna	EU project: SILVISTRAT
Universität Wien, Fakultät für Interdisziplinäre Fortbildung und Forschung, Vienna	Scientific Advisory Board / Board of Trustees PIK: Marina Fischer-Kowalski
Bangladesh	
Bangladesh Centre for Advanced Studies, Dhaka	PIK Project: COAST
Belgium	
Fondation Nicolas-Claude Fabri de Peiresc	EU Project: AVEC
Université Catholique de Louvain, Louvain-la-Neuve: Institut d' Astronomie et de Géophysique Département de Géologie et de Géographie	EU Project: ATEAM
Brazil	
Center for Weather Forecasting and Climate Studies, Cachoeira	
Canada	
McGill University, Department of Atmospheric and Oceanic Sciences, Montreal	
University of Victoria, School of Earth and Ocean Sciences	BMBF Project: INTEGRATION
Czech Republic	
Institute of Atmospheric Physics, Dept. of Climatology, Prague	
Department of Geography, Masaryk University, Brno	
Denmark	
Danish Centre for Earth System Science, Nils Bohr Institute for Astronomy, Copenhagen	
Danish Institute of Agricultural Sciences, Department of Agricultural Systems, Tjelle	
Institute for Fisheries Management and Coastal Community Development, Hirtshals	
Risoe National Laboratory	EU Project: AVEC
Fiji	
University of the South Pacific Marine Affairs Programme	
Finland	
European Forest Institute, Joensuu	EU Project: ATEAM
University of Joensuu, Faculty of Forestry	EU Project: SILVISTRAT
France	
Centre d'Ecologie Fonctionnelle et Evolutive, Montpellier	EU Project: ATEAM
Centre de Recherche en Epistémologie Appliquée, Paris	
Centre d'Etudes Spatiales de la Biosphère, Toulouse	EU Project: Siberia-II
Centre International de Recherche sur l'Environnement et le Développement, Paris	European Climate Forum (ECF)
Ecole Normale Supérieure, Paris	Guest Professorship: Rupert Klein, "Well-balanced schemes for the shallow water equations"
Laboratoire d'Ecologie Alpine, Université Joseph Fourier, Grenoble	EU Project: AVEC
Laboratoire d'Ecophysiologie végétale, Université de Paris-Sud XI, Orsay	
Laboratoire des Sciences du Climat et de l'Environnement, Gif-sur-Yvette	

Institution / Location	Cooperation Details
MEDIAS France, Toulouse	Scientific Advisory Board: Wolfgang Cramer
Université de la Méditerranée GREQAM, Marseille	
Germany	
Adelphi Research, Berlin	
Akademie für Raumforschung und Landesplanung, Hannover	Arbeitskreis "Raumorientiertes Risikomanagement"
Alfred-Wegener-Institut für Polar- und Meeresforschung, Bremerhaven and Potsdam	Board of Trustees PIK: Peter Lemke BMBF Project: CLIMBER-KIHZ, INTEGRATION
Bayerische Julius-Maximilians Universität Würzburg, Geographisches Institut	DFG Project: EXTREME - 1500
Bayreuther Institut für Terrestrische Ökosystemforschung, Bayreuth	BMBF Project: Skalenanalyse
Bayerisches Landesamt für Wasserwirtschaft, München	BMBF Project: Skalenanalyse
Bayerische Landesanstalt für Wald und Forstwirtschaft, Freising	Cooperation agreement
Büro für Angewandte Hydrologie, Berlin	BMBF Project: GLOWA - Elbe
Bundesamt für Gewässerkunde, Koblenz und Berlin	BMBF Project: GLOWA - Elbe DFG Project: EXTREME 1500 Deutsches Forschungsnetz Naturkatastrophen
Bundesforschungsanstalt für Forst- und Holzwirtschaft, Institut für Ökonomie, Hamburg	
Carl-von-Ossietzky Universität Oldenburg	VolkswagenStiftung Project: MANUS
Christian-Albrechts-Universität zu Kiel	BMBF Project: CLIMBER-KIHZ Scientific Advisory Board (Chair): Wolfgang Cramer
Deutsche Telekom	Board of Trustees PIK: Ignacio Campino
Deutscher Wetterdienst, Offenbach und Potsdam	
Deutsches Institut für Wirtschaftsforschung, Berlin	PIK Project: SPARK
Deutsches Klimarechenzentrum, Hamburg	Scientific Advisory Board: Rupert Klein
Deutsches Krebsforschungszentrum, Heidelberg	
Deutsches Rotes Kreuz, Berlin	PIK Project: COAST
Deutsches Zentrum für Luft- und Raumfahrt, Deutsches Fernerkundungs-Datenzentrum, Oberpfaffenhofen	
Deutsches Zentrum für Luft- und Raumfahrt, Institut für Atmosphärenphysik, Weßling	BMBF Program: DEKLIM
Eberhard Karls Universität Tübingen, Institut und Museum für Geologie und Paläontologie	
Ecologic GmbH, Berlin	
Europäische Akademie, Bad Neuenahr - Ahrweiler	UBA Project Article 2 UNFCCC
Förderverein "Haus der Natur," Potsdam	Cooperation agreement
Forschungsanstalt Geisenheim	PIK Project: CLAWINE
Forschungsring des Deutschen Weinbaus, Mainz	Membership: Manfred Stock
Forschungszentrum Jülich Institut für Chemie und Dynamik der Geosphäre Programmgruppe Systemforschung	BMBF Project: CLIMBER-KIHZ
Forschungszentrum Karlsruhe, Institut für Meteorologie und Klimaforschung	
Fraunhofer-Institut für Algorithmen und Wissenschaftliches Rechnen, Sankt Augustin	Scientific Advisory Board PIK: Ulrich Trottenberg
Freie Universität Berlin	Cooperation Agreement Board of Trustees PIK: Gerhard Braun, Helmut Keupp Joint appointment: Rupert Klein - Scientific Computing / Modeling and Computing of Global Environmental Systems BMBF Project: EEM, CLIMBER-KIHZ, GLOWA Elbe Volkswagenstiftung Project: MANUS

Institution / Location	Cooperation Details
Friedrich-Schiller-Universität Jena	EU Project: SIBERIA-II
GeoForschungsZentrum, Potsdam	BMBF Project: CLIMBER-KIHZ Deutsches Forschungsnetz Naturkatastrophen
Gesellschaft für Wasserwirtschaftliche Planung und Systemforschung mbH, Berlin-Bohnsdorf	BMBF Project: GLOWA-Elbe
GKSS-Forschungszentrum Geesthacht GmbH	BMBF Project: CLIMBER-KIHZ, EEM
GSF-Forschungszentrum für Umwelt und Gesundheit, Institut für Atmosphärenphysik, Neuherberg	BMBF Project: CLIMBER-KIHZ
Heidelberger Akademie der Wissenschaften, Institut für Umweltphysik	BMBF Project: EEM, DEKLIM-Program
Humboldt-Universität zu Berlin	Joint Appointment: Friedrich-Wilhelm Gerstengarbe - Climatology
IBM Deutschland Informationssysteme GmbH, Stuttgart	Cooperation Agreement University chair (Stiftungsprofessur): Rupert Klein
Institut für Gewässerökologie und Binnenfischerei, Berlin	BMBF Project: GLOWA Elbe
Institut für Ökologische Wirtschaftsforschung, Berlin	
Institut für Regionalentwicklung und Strukturplanung, Berlin	
Institut für sozial-ökologische Forschung GmbH, Frankfurt/M.	
Johannes-Gutenberg-Universität Mainz, Institut für Geowissenschaften	BMBF Project: CLIMBER-KIHZ, EEM
Johann Wolfgang Goethe-Universität Frankfurt am Main	Cooperation Agreement
Justus-Liebig-Universität Gießen	Cooperation Agreement EU Project: AVEC BMBF Project: Skalenanalyse
Konrad-Zuse-Zentrum für Informationstechnik, Berlin	Cooperation Agreement
Landesamt für Geowissenschaften und Rohstoffe Brandenburg, Kleinmachnow	
Landesforstanstalt, Eberswalde	Cooperation Agreement
Landesumweltamt Brandenburg, Potsdam	
Landesvereinigung Außeruniversitärer Forschungseinrichtungen, Potsdam	Board Membership: Manfred Stock
Leibniz-Institut für Meereswissenschaften, Kiel	Scientific Advisory Board PIK: Karin Lochte
Leibniz-Institut für Pädagogik der Naturwissenschaften an der Universität Kiel	
Max-Planck-Institut für Biogeochemie, Jena	Scientific Advisory Board PIK: Ernst-Detlef Schulze Scientific Advisory Board: Hans Joachim Schellnhuber Millennium Ecosystem Assessment EU Project: ATEAM
Max-Planck-Institut für Meteorologie, Hamburg	Board of Trustees PIK: Hartmut Graßl European Climate Forum (ECF) BMBF Project: CLIMBER-KLIWA, EEM, GLOWA Elbe
Ministerium für Landwirtschaft, Umweltschutz und Raumordnung, Potsdam	Member of the Advisory Board for Environment and Landuse in Brandenburg: Manfred Stock
Münchener Rückversicherung, Forschungsgruppe "Geowissenschaften"	
Nationalpark Bayerischer Wald	EU Project: CarboInvent
Ökologie-Zentrum für Internationale und Europäische Umweltforschung, Berlin	BMBF Project: Security Diagrams
Rheinische Friedrich-Wilhelms-Universität Bonn	Cooperation Agreement BMBF Project: CLIMBER-KIHZ, EEM
Sächsische Akademie der Wissenschaften zu Leipzig, Freiberg	BMBF Project: EEM
Technische Universität Berlin	BMBF Project: GLOWA-Elbe
Technische Universität Cottbus	BMBF Project: GLOWA-Elbe Deutsches Forschungsnetz Naturkatastrophen

Institution / Location	Cooperation Details
Technische Universität Darmstadt, Interdisziplinäre Forschungsgruppe IANUS	
Technische Universität München, Lehrstuhl für Botanik	EU Project: CarboInvent
Thüringer Landesanstalt für Landwirtschaft, Jena	BMBF Project: GLOWA-Elbe
Thüringer Landesanstalt für Wald, Jagd und Fischerei, Gotha	Cooperation agreement
Umweltbundesamt, Berlin	Advisory Discussions Integration of WBGU ICLIPS research results
Umweltforschungszentrum Leipzig-Halle GmbH	BMBF Project: GLOWA-Elbe
Universität Bremen, Fachbereich Geowissenschaften	BMBF Project: CLIMBER-KIHZ
Universität Hamburg	BMBF Project: CLIMBER-KIHZ, INTEGRATION
Universität Kassel	Scientific Advisory Board, Zentrum für Umweltforschung: Wolfgang Cramer BMBF Project: Security Diagrams, GLOWA-Elbe
Universität Leipzig, Institut für Geologie und Geophysik	BMBF Project: EEM
Universität Potsdam	Cooperation Agreement Board of Trustees PIK: Jürgen Kurths, Bernd Walz Joint appointments: Martin Claussen - Climate Physics Wolfgang Cramer - Global Ecology Siegfried Franck - Coevolution of Geo- and Biosphere Carlo Jaeger - Modeling and Social Systems Stefan Rahmstorf - Physics of the Ocean Hans Joachim Schellnhuber - Theoretical Physics BMBF Project: GLOWA Jordan
Universität Rostock, Institut für Ostseeforschung	BMBF Project: CLIMBER-KIHZ
Universität Trier	
Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen, Geschäftsstelle am Wissenschaftszentrum Berlin für Sozialforschung	Membership: Hans Joachim Schellnhuber
Wissenschaftszentrum Berlin	
World Wildlife Fund, European Office	Board of Trustees PIK: Stephan Singer
Wuppertal Institut für Klima, Umwelt, Energie	Scientific Advisory Board: Hans Joachim Schellnhuber
Zentrum für Agrarlandschafts- und Landnutzungsforschung, Müncheberg	Scientific Advisory Board: Wolfgang Cramer BMBF Project: GLOWA-Elbe
Greece	
Biodiversity Conservation Laboratory, University of the Aegean	EU Project: AVEC
Hungary	
Regional Environmental Centre, Szentendre	
India	
Anna University, Institute for Ocean Management, Chennai	
Indian Institute of Technology, Bombay	PIK Project: COAST
Madras School of Economics	PIK Project: COAST
The Energy and Resources Institute, Delhi	PIK Project: COAST
Ireland	
University College, Centre for Hydrology, Micrometeorology and Climate Change, Cork	EU Project: CarboInvent
Israel	
Bar Ilan University, Ramat Gan, Minerva Center for Mesoscopics, Fractals and Neural Networks	BMBF Project: Skalenanalyse
Ministry of Science and Technology	

Institution / Location	Cooperation Details
University of Tel Aviv	BMBF Project: GLOWA-Jordan
Italy	
Fondazione Eni Enrico Mattei, Milano	European Climate Forum (ECF)
Italian Agency for New Technology and Environment, ENEA/T6, Rome	
SAR Servizio Agrometeorologico Regionale della Sardegna	
Università degli Studi di Napoli Federico II, Facoltà di Agraria	EU Project: AVEC
Università di Firenze, Dipartimento di Scienze Agronomiche e Gestione del Territorio Agro-Forestale	PIK Project: CLAWINE
Università di Padova - Agripolis, Dipartimento Territorio e Sistemi Agro-Forestali	EU Project: CarboInvent
Università di Roma "La Sapienza," Dipartimento di Fisica	
Università di Venezia	Scientific Advisory Board PIK: Carlo Carraro
World Health Organisation, European Center for Environment and Health, Rome	EU Project: cCASH
Japan	
Institute for Global Environmental Strategies, Hayama, Kanagawa	Scientific Advisory Board: Manfred Stock, Martin Claussen
National Institute of Environmental Studies, Tsukuba	
Netherlands	
Commission for Hydrology of the River Rhine, The Hague	Deutsches Forschungsnetz Naturkatastrophen
National Institute of Public Health and Environmental Protection, Bilthoven	PIK Project: CLAWINE
Royal Dutch Meteorological Institute, DeBilt	
Vrije Universiteit Amsterdam	EU Project: DINAS-COAST VolkswagenStiftung Project: MANUS
Wageningen University	EU Project: ATEAM, AVEC, Silvestrat PIK Project: QUEST
WL Delft Hydraulics, Delft	EU Project: DINAS-COAST
Nigeria	
University of Lagos, Faculty of Environmental Sciences, Lagos	Multilateral agreement: Northern Africa Initiative
Norway	
Department of Political Science and CICERO, Oslo	
Institute of Marine Research, Bergen	BMBF Project: INTEGRATION
Nansen Environmental and Remote Sensing Center, Bergen	VolkswagenStiftung: Ocean Sequestration European Climate Forum (ECF)
Norsk institutt for skogforskning, Ås	BMBF Project: Skalenanalyse
Pakistan	
Aquaculture and Fisheries Research Institute, Animal Sciences Department, Islamabad	
Philippines	
National Disaster Reduction Branch, Weather and Flood Forecasting Centre, Philippine Atmospheric Geophysical and Astronomical Services Administration, Quezon City	PIK Project: COAST
Poland	
Research Centre of Agricultural and Forest Environment, Polish Academy of Sciences, Poznań	
Warsaw Agricultural University, Dept. of Silviculture	Cooperation Agreement
Warsaw University, Institute of Geophysics	PIK Project: TRIPEDES
Portugal	
Universidade de Trás-os-Montes e Alto Douro, Vila Real	EU Project: CarboInvent
Romania	
National Institute for Research and Development in Informatics, Bucharest	Cooperation Agreement

Institution / Location	Cooperation Details
Russia	
All-Russia Research Institute of Hydrometeorological Information, World Data Centre, Obninsk	
A.M. Obukhov Institute of Atmospheric Physics, Russian Academy of Sciences, Moscow	
Russian Academy of Sciences, Vernadsky Institute	
Spain	
Laboratorio Ecología, Facultad de Medio Ambiente, Universidad Castilla-La Mancha, Toledo	EU Project: ATEAM
Universitat Autònoma de Barcelona, Centre de Recerca Ecològica i Aplicacions Forestals	EU Project: ATEAM, SILVISTRAT
Sweden	
Lund University	EU Project: ATEAM
Stockholm Environment Institute	Scientific Advisory Board PIK: Roger E. Kasperson
Sveriges Lantbruksuniversitet, Uppsala	EU Project: CarboInvent, SILVISTRAT
Switzerland	
Eidgenössische Technische Hochschule Zürich	EU Project: ATEAM PIK Project: SAFE
Universität Basel, Botanisches Institut	EU Project: AVEC
Paul Scherrer Institut, Villigen	VolkswagenStiftung: Ocean Sequestration European Climate Forum (ECF)
Universität Bern	DFG Project: EXTREME - 1500
Universität Genf	
United Kingdom	
Center for Ecology and Hydrology, Edinburgh	PIK Project: TRIPEDES
Centre for Environment and Hydrology, Edinburgh Research Station	EU Project: AVEC
Central Laboratory of the Research Councils, Computational Science & Engineering, Daresbury	
Climate Research Unit, UEA, Norwich	EU Project: ATEAM
Envision LLP, Hexham	
European Centre for Medium Range Weather Forecasts, Berkshire	
IACR Rothamsted, Soil Science Department, Harpenden, Hertfordshire	EU Project: ATEAM
Institute of Hydrology, Wallingford	Multilateral Agreement: Northern Africa Initiative
International Institute for Environment and Development, London	
Middlesex University, Flood Hazard Research Centre	EU Project: DINAS-COAST
University College London	
University of East Anglia, Tyndall Centre for Climate Change Research, School of Environmental Sciences, Norwich	Research Director: Hans Joachim Schellnhuber Scientific Advisory Board PIK: Mike Hulme PIK Project: PRUNE, SPARK European Climate Forum (ECF)
University of Durham	EU Project: AVEC, DART
University of Greenwich, Natural Resources Institute, Livelihoods and Institutions Group	
University of Newcastle, Department of Tropical Marine Sciences	
University of Sheffield, Department of Animal and Plant Sciences	EU Project: ATEAM
University of Southampton	EU Project: ATEAM, DINAS-COAST
USA	
Boston University, Center for Remote Sensing, and Department of Geography	
Carnegie Mellon University, Pittsburgh	Scientific Advisory Board, Center for International Study of the Human Dimension of Global Change: Carlo Jaeger BMBF Project: INTEGRATION

Institution / Location**Cooperation Details**

Center for Political Studies, Institute for Social Research, University of Michigan, Ann Arbor	
Clark University, Department of Geography, Worcester, MA	
Courant Institute of Mathematical Sciences, New York	Scientific Advisory Board PIK: Andrew Majda Book Project: "Viscous Vortical Flows", Lu Ting and Rupert Klein
Geophysical Fluid Dynamics Laboratory, Princeton	
Goddard Space Flight Center, NASA, Greenbelt, Maryland	
Harvard University, Center for International Development, Cambridge, MA	Scientific Advisory Board PIK: William C. Clark
Johns Hopkins University, Baltimore, Maryland	Uncertainty Quantification for Unelastic Flows; Friedrich-Wilhelm-Bessel-Preis der Alexander-von-Humboldt-Stiftung for Omar M. Knio
Marine Biological Laboratory in Woods Hole, MA	BMBF Project: INTEGRATION
Massachusetts Institute of Technology, Department of Earth, Atmosphere and Planetary Sciences, Cambridge	
Joint Program on the Science and Policy of Global Change	
New York University, Department of Political Science	
Northwestern University, Evanston, Department of Political Science	
Rensselaer Polytechnic Institute, Department of Economics, New York	
Stanford University, Hoover Institution	
University of Chicago, Department of Geophysical Sciences	PIK Project: QUEST
University of Texas at Arlington	PIK Project: TRIPEDES
University of New Hampshire, Durham, New Hampshire	Scientific Cooperation within IGBP Task Force GAIM
U.S. Dept. of Energy, Oak Ridge National Laboratory, Tennessee	
U.S. National Oceanic and Atmospheric Administration, Office of Global Programs (NOAA-OGP), College Park, MD	Secondment to the EVA and VME Project at PIK
Usbekistan	
Central Asian Hydrometeorological Research Institute, Glavgidromet Sanigmi, Tashkent	

Publications 2002

Journals (ISI Journals)

Benabdellah, B.; Albrecht, K.-F.; Pomaz, V. L.; Denisenko, E. A.; Logofet, D. O. (2002): Markov chain models for forest successions in the Erzgebirge, Germany. *Ecological Modelling*, 159, 2-3, 145-160.

Biermann, F. (2002): Johannesburg and beyond: Outline of a reform strategy for global environmental governance. *Politics and the Life Sciences*, 21, 2, 72-77.

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Bronstert, A.; Menzel, L. (2002): Advances in flood research. *Journal of Hydrology*, 267, 1-2.

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Brovkin, V.; Bendtsen, J.; Claussen, M.; Ganopolski, A.; Kubatzki, C.; Petoukhov, V.; Andreev, A. (2002): Carbon cycle, vegetation and climate dynamics in the Holocene: Experiments with the CLIMBER-2 model. *Global Biogeochemical Cycles*, 16, 4, 1139.

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Claussen, M.; Mysak, L. A.; Weaver, A. J.; Crucifix, M.; Fichefet, T.; Loutre, M.-F.; Weber, S. L.; Alcamo, J.; Alexeev, V. A.; Berger, A.; Calov, R.; Ganopolski, A.; Goosse, H.; Lohman, G.; Lunkeit, F.; Mokhov, I. I.; Petoukhov, V.; Stone, P.; Wang, Z. (2002): Earth system models of intermediate complexity: Closing the gap in the spectrum of climate system models. *Climate Dynamics*, 18, 7, 579-586.

Dargaville, R.; Heimann, M.; McGuire, A.; Prentice, C.; Kicklighter, W.; Joos, F.; Klein, J.; Esser, G.; Foley, J.; Kaplan, J.; Meier, R.; Melillo, J.; Moore, B.; Ramankutty, N.; Reichenau, T.; Schloss, S.; Sitch, S.; Tian, H.; Williams, L.; Wittenberg, U. (2002): Evaluation of terrestrial carbon cycle models with atmospheric CO_2 measurements: Results from transient simulations considering increasing CO_2 , climate, and land-use effects. *Global Biogeochemical Cycles*, 16, 4/1092, 39-1-39-15.

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List of Acronyms

AIP	Astrophysical Institute Potsdam
AWI	Alfred Wegener Institute for Polar and Marine Research
BMBF	Federal Ministry of Education and Research
DEKLIM	German Climate Research Programme
DFG	German Research Foundation
DFNK	German Research Network Natural Disasters
DKRZ	German Climate Computing Centre
DMG	German Meteorological Society
DWD	National Meteorological Service of Germany
ECF	European Climate Forum
EU	European Union
E-VIA	European Virtual Institute for Integrated Assessment
FAO	Food and Agriculture Organization of the United Nations
FDW	Research Community of the German Vinery
GFZ	GeoForschungsZentrum Potsdam
GLOWA	Global Change in the Hydrological Cycle (BMBF program)
HSP	Hochschulsonderprogramm, funding program of the MWFK
HSP-N	Hochschulsonderprogramm-N, follow up funding program of the MWFK
ECMWF	European Centre for Medium-Range Weather Forecasts
ICBM	Institute for Chemistry and Biology of the Marine Environment, Carl von Ossietzky University Oldenburg
ICI	National Institute for Research and Development in Informatics, Bucharest
IGBP	International Geosphere Biosphere Programme
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
KOBV	Berlin-Brandenburg Cooperative Library Organization
LAUF	Regional Association of Non-University Research Institutions in Brandenburg
MLUR Brandenburg	Ministry for Agriculture, Environmental Protection and Regional Planning of the State of Brandenburg

MRLU Sachsen-Anhalt	Ministry for Regional Planning, Agriculture and Environment of the State of Saxony-Anhalt
MWFK Brandenburg	Ministry of Science, Research and Culture of the State of Brandenburg
PIK	Potsdam Institute for Climate Impact Research
UBA	Federal Environmental Agency
UN	United Nations
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
WCRP	World Climate Research Programme
WMO	World Meteorological Organization
WWF	World Wide Fund For Nature

Campus Map

Albert Einstein Wissenschaftspark Telegrafenberg, Potsdam

- Potsdam Institute for Climate Impact Research
- Astrophysikalisches Institut Potsdam
- Alfred Wegener Institute for Polar and Marine Research
- GeoForschungsZentrum Potsdam

