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The 1st FMSH-ESF Entre-Sciences

Conference in Environmental Sciences

5-10 November 2008, IGeSA, Porquerolles • France

**New Methodologies and Interdisciplinary
Approaches in Global Change Research**

Chair: Joël Guiot, CEREGE, Aix-en-Provence, France

Vice-chair: Sylvie Thoron, GREQAM, Marseille, France

The conference focuses on new advances in the construction of models of the global change, in Earth sciences and in Economics. Given the issues at stake with Global Warming in terms of impacts and risks, these multidisciplinary approaches are necessarily placed in a public policy perspective, a case apparently unique in the history of science. Chaired by Joël Guiot, climatologist at the European Centre for the Research and Teaching of the Geosciences of the Environment (CEREGE, Aix-en-Provence) and by Sylvie Thoron, economist at the Aix-Marseille Research Group in Quantitative Economy (GREQAM, Marseille), the conference aims at generating intense discussions between scientists coming from various disciplinary horizons, by emphasizing the need for integrative approaches when thinking of our future in terms of sustainable development.

CONTENTS

Conference Programme	p. 7
List of posters	p.19
Invited speakers' abstracts	p.23
Attendees' abstracts	p.37

PROGRAMME

WEDNESDAY, 5 November

Late afternoon / early evening	Registration at the ESF-RC desk
19.00	Welcome Drink
20.00	Supper

THURSDAY, 6 November

9.15-10.00 *Conference Opening*
Alain d'Iribarne (FMSH Director General) & Angela Procoli (Head of FMSH-Entre-Sciences Programme)
Hefin Jones & Volkmar Lauber (ESF representatives)
Joël Guiot & Sylvie Thoron (chair & vice-chair of the conference)

Session I: Paleoclimatology

Chair: Guy P. Brasseur, ESSL Laboratory, US

- 10.00-10.25 André Berger
Université Catholique de Louvain, BE
The start and the end of our interglacial
- 10.25-10.50 Michael Mann
Penn State University, US
Global Climate Change: Past and Future
- 10.50-11.10 Debate
- 11.10 Coffee break
- 11.25-11.50 Joël Guiot
CNRS, FR
Long term climate variability: from past to future and from data to models
- 11.50-12.00 Pierre-Alain Danis
CNRS, FR
Comparison of simulated tree-ring cellulose ¹⁸O at the European scale
- 12.00-12.10 Vincenzo Amato
University of Molise, IT
Holocene climatic changes and their effect on morphodynamics and sedimentation in Campania

12.10-12.30 Debate

12.30 Lunch

Session 2: Climate Change Models at Various Scales

Chair: Michael Mann, Penn State University, US

14.30-14.55 Sylvie Joussaume
CNRS, FR
Climate models : learning from the past long-term climate variability

14.55-15.20 Guy P. Brasseur
ESSL Laboratory, US
From Climate Models to Earth System Models

15.20-15.30 Anni Reissel
UHEL, FI
Cross-disciplinary international research on land atmosphere interactions

15.30-15.55 Debate

15.55 Coffee break

16.10-16.35 Hughes Goosse
Université Catholique de Louvain, BE
Modelling forced and internal climate variability during the last millennium

16.35-17.00 Serge Planton
Météo France, FR
Detection and attribution of climate change to different causes

17.00-17.25 Jesus Fidel Gonzalez-Rouco
Universidad Complutense Madrid, ES
Borehole climatology and model simulations: steps to integrated assessment

17.25-18.00	Debate
18.00-18.10	Joshua Fisher University of Oxford, UK
18.10-18.20	Changhui Peng Université du Québec, CA <i>Data-Model Fusion Approach in Global Change Research: Recent Development and Future Challenges</i>
18.20-18.30	Debate
19.00	Dinner
20.00-21.30	Poster Session I

FRIDAY, 7 November

Session 3: Social, Ecological and Climatic Scenarios

Chair: Sylvie Thoron, GREQAM, FR

- 9.00-09.25 Wolfgang Cramer
Potsdam Institute for Climate Impact Research, DE
Are European ecosystems vulnerable to climate change?
- 9.25-9.50 Michel Dequé
Météo France, FR
Regional Climate change and extremes
- 9.50-10.15 Stephane Hallegatte
Météo France, FR
A Roadmap to Assess the Economic Cost of Climate Change with an Application to Hurricanes in the United States
- 10.15-10.45 Debate
- 10.45 Coffee break
- 11.00-11.10 Kirsten Zickfeld
University of Victoria, CA
Setting cumulative emissions targets to reduce the risk of 'dangerous' climate change
- 11.10-11.20 Alexander Popp
Potsdam Institute for Climate Impact Research, DE
Food demand, productivity growth and the spatial distribution of land and water use: a global modeling approach
- 11.20-11.30 Debate
- 11.30-11.55 Jason Shogren
Univ. of Wyoming, US
Linking adaptation and Mitigation for climate risk reduction

11.55-12.05	Hans-Martin Füssel Potsdam Institute for Climate Impact Research, DE <i>Climate, geography and macroeconomics: revised data, refined analysis and new findings</i>
12.05-12.15	Natalia Lemeshko State Hydrological Institute, RU <i>The largest lakes and reservoirs of Russia as a priority water resource for society</i>
12.15-12.30	Debate
12.30	Lunch
Afternoon	Half-day excursion
19.00	Dinner
20.00-21.30	Poster Session II

SATURDAY, 8 November

Session 4: Impacts of Global Change

Chair: Jean-Charles Hourcade, CIRED, CNRS, FR

- 9.00-9.25 Bernard Seguin
INRA, FR
The impacts of climate change on continental ecosystems
- 9.25-09.50 Philippe Ciais
CNRS, FR
Recent trends and vulnerabilities in the global carbon cycle
- 9.50-10.15 Dominique Chauvin
TOTAL Holding, FR
Industrial and Environmental Policies: reciprocal impacts
- 10.15-10.45 Debate
- 10.45 Coffee break
- 11.00-11.10 Anna Serra Llobet
Universitat Autònoma de Barcelona, ES
Turning hazards into resources? Climate change, floods and coastal wetlands in the Costa Brava (North-East Iberian Peninsula)
- 11.10-11.20 Godwin Anjeinu Abu
University of Agriculture, Makurdi, NG
Social Impact of Global Environmental Change on Farming Communities on the Ogoli River Bank in Otukpo Area of Benue State, Nigeria
- 11.20-11.30 Debate
- 11.30-11.40 Ruthie Arieli
Ben Gurion University of the Negev, IL
The effect of thermal pollution on benthic foraminiferal assemblages, in the Mediterranean shore face adjacent to Hadera power plant (Israel)

11.50-12.00 Zbigniew Zwolinski
Adam Mickiewicz University, PL
Present-day geomorphological changes in polar regions

12.00-12.15 Debate

12.30 Lunch

Session 5: Climate change policies I

Chair: Sylvie Joussaume, CNRS, FR

14.30-14.55 Jean-Charles Hourcade
CNRS, FR
*The Economics of the Climate/Development of the
Gordian Knot; Beyond a Sound Pessimism*

14.55-15.20 Uno Svedin
The Swedish Research Council for Environment,
Agricultural Sciences and Spatial Planning, SE
*Interlocking natural and social systems - resilience,
governance and research policy considerations*

15.20-15.40 Debate

15.40 Coffee break

15.55-16.20 Romain Duval
OECD, FR
Post-2012 options to reduce greenhouse gas emissions

16.20-16.45 Richard Somerville
Scripps Institution of Oceanography, US
*The Intergovernmental Panel on Climate Change and the
Challenges of Climate Policy, Equity and Ethics*

16.45-17.05 Debate

17.05-17.30 Forward Look Session

20.00 Conference Dinner

SUNDAY, 9 November

Session 6: Climate change policies II

Chair: Richard Somerville, Institute of Oceanography, US

- 9.00-9.25 Gaël Callonec
ADEME, FR
How to foster the economic and societal technical solutions?
- 9.25-9.50 Sylvie Thoron
GREQAM, FR
International negotiations on climate change: How to take advantage of risk aversion to improve the conditions for the emergence of a consensus
- 9.50-10.00 Johann Dupuis
IDHEAP, CH
The sustainability of Kyoto's Architecture: Where did the victims of climate change go?
- 10.00-10.30 Debate
- 10.30 Coffee Break
- 10.45-10.55 Augustin Fragnière
University of Lausanne, CH
Carbon offsetting: an ethical and psychological approach
- 10.55-11.05 Okoubi Djedje
Université Paris VIII, FR
The intergenerational equity: a concept to build for sustainability, the case of global warming
- 11.05-11.15 Suraje Dessai
University of Exeter, UK
How can prediction help society adapt to a changing climate? An interdisciplinary exploration of climate science and decision-making under uncertainty
- 11.15-11.30 Debate

- 11.30-11.40 Antony Millner
Magdalen College Oxford, UK
The costs of strategic adaptation in a simple conceptual of climate change
- 11.40-11.50 Komal Raj Aryal
Northumbria University, UK
Climatic hazard mitigation through risk and resilience committees in Nepal
- 11.50-12.00 Debate
- 12.30 Lunch

Session 7: New perspectives on global change research

Chair: Bernard Seguin, INRA, FR

- 14.30-16.00 *Round table*
- 16.00-16.30 Best Poster Award Ceremony
- 19.00 Dinner & Get together

MONDAY, 10 November

Breakfast & Departure

POSTER SESSION I

Paleoclimatology, Climatology, Modeling

THURSDAY, 6 NOVEMBER, 20h00-21h30

Blarquez, Olivier, Trees in the subalpine belt at the extreme end of the Late Dryas: origin, expansion and alteration of the modern forest linked to climate, fire and land-use

Cattiaux, Julien, Regional forcings of the extremely warm European fall of 2006

Damnati, Brahim, Climate changes from the last glacial maximum to the present in Morocco: A record from lake Ifrah (Middle atlas)

Fetter, Eva, Decadal-scale sediment dynamics and environmental change in a coastal area

Garreta, Vincent, Climate and vegetation dynamics reconstructed by inverse vegetation modeling

Gibelin, Anne-Laure, ISBA-CC, a new land surface model simulating the terrestrial carbon cycle

Guin, Ophélie, Bayesian hierarchical modeling of dendrochronological data

Lee, Young-Hee, Model estimate of annual NEE and uncertainty over mixed forest in complex terrain

Meinander, Outi, About diurnal changes in snow albedo

Pancotti, Irene, Recent benthic foraminifera of West Mediterranean Sea and Gulf of Cadiz

Parfenova, Elena, Bioclimatic modeling of vegetation shifts in the altai-sayan ecoregion under climate warming

Rathgeber, Cyrille, Influence of environmental factors on seasonal dynamic of tree-ring formation – Monitoring the present for understanding the past and gauging the future

Salami, Taira, Interactions between atmosphere, ecosystem and marine environment in Nigeria

Servonnat, Jérôme, Intra-annual climate variability in the North Atlantic during the last millennium : influence of the solar forcing in the IPSLCM4v2 climate model

Shmilovici Leib, Armin, A Web-application for local forecasting of micro-climate and particle flow in air

Tanaka, Katsumasa, A new methodology to estimate climate sensitivity

POSTER SESSION II

Impacts of Global Change, economics, environmental policies, multidisciplinary approaches

FRIDAY, 7 NOVEMBER, 20h00- 21h30

Blanchard, Anne, Are the challenges of interdisciplinary science and the challenges of science and policymaking integration the two faces of the same coin? A Global Change Research case study

Bobylev, Nikolai, Assessing the impact of the global change on urban infrastructure under different scenarios

Bréon, François-Marie, The climate science community should show the way through a rapid decrease of its own carbon emissions

Cailleret, Maxime, Forest vulnerability to climate change: example of the silver fir-beech community (Abieto-Fagetum) forest at its southern range

Coumou, Dim, Development of CLIMBER-3 Earth System model

Chanzy, André, Adaptation to global change in the Mediterranean area: Presentation of the INRA Avignon Initiative

Heikkilä Anu, Marjanna Towards life-time estimations for outdoor polymeric materials in the changing climate

Janjua, Muhammad Saleem, Climate Change Adaptation at the Local Government Level: The Case of Pakistan

Kaptagaeva, Aida, Method and model development for qualitative estimation of ecological consequences of decisions related to environment: Case study of the Issyk Kul Biosphere Reserve in Kyrgyz Republic

Kiwanuka, Ronald Mwanje, The Impact of Climate change on Glaciation, in the Rwenzori mts National Park, Uganda

Kozyatnyk, Ivan, Impact of seasonal changes of the river water on drinking water quality

Lamichhane, Dhananjaya, Decision Making Role of Women in Community Forestry

Lemoine, Marion, Clean Development Mechanism's potential : a juridical approach

Olehowski, Claas, Vulnerability- and Degradation Analysis of semiarid Island ecosystem in the marginal tropics on the example of Fogo (Cape Verde Islands) – a study based on Remote Sensing and GIS

Pacteau, Chantal, Paris Research Consortium CLIMATE-ENVIRONMENT-SOCIETY

Rovenskaya, Elena, Optimal Economic Growth under Stochastic Environmental Impact: Sensitivity Analysis

Samadi, Seyedeh Zahra, Climate Change Impacts on Environmental Resources

Vázquez, Juan, Overview of recent destruction of tufa palustrine systems in Spain. Environmental and anthropogenic causes

Williams, Paul David, Rapid climate change: an overview for economists

INVITED SPEAKERS' ABSTRACTS

BERGER, André

Institut G. Lemaître, Université Catholique de Louvain, Louvain-la-Neuve, Belgium

The start and end of our interglacial

The previous interglacial (Marine isotope stage 5e, peaking at 125 kyr BP) is usually assumed to be a good analogue for our present-day climate. Moreover, as our present interglacial, the Holocene, is already almost 12 kyr long, paleoclimatologists were inclined to predict a quite close entrance into the next ice age. Simulations using the 2.5-D climate model of Louvain-la-Neuve show however that our interglacial will most probably last much longer than any previous one, even without human intervention (Berger and Loutre, 2002). It was suggested that this is related to the shape of the Earth's orbit around the Sun which will be almost circular over the next tens of thousands of years. A circular orbit means indeed that the latitudinal and seasonal distributions of the energy received from the Sun will not vary anymore, a situation which will give more weight to the other forcings, in particular to the forcing by the greenhouse gases.

As the eccentricity variation is primarily related to the 400-kyr cycle, the best and closer analogue for such a forcing is definitively Marine isotopic Stage 11 (MIS-11) some 400 kyr ago and not MIS-5e. Simulations of this MIS-11 interglacial under greenhouse gas and astronomical forcings led indeed also to an anomalous length, a prediction which was later confirmed by the EPICA ice-core record.

Such a relationship between CO₂ and climate is at the basis of the claim by Ruddiman (2003) that the impact of human activities on climate might have already started 10,000 years ago, preventing our climate to have already entered into glaciation. Sensitivity experiments with the LLN model tend to rule out Ruddiman's hypothesis because glacial inception in this model would require CO₂ concentration below 240 ppmv during the Holocene. However, honest estimates of model uncertainties incline us to leave the question open (Crucifix and Berger, 2006).

Our results show not only that the Holocene might last particularly long, but also that the sensitivity of our climate system to the greenhouse gas forcing might be exacerbated. It is therefore not surprising that, in our model at least,

there is a threshold in the greenhouse gas concentration of about 700 ppmv beyond which the Greenland ice sheet melts in about 5000 years and does not recover before a few tens of thousands of years.

All these results confirm that the CO² concentration in the atmosphere plays an important role in shaping the long-term climatic variations and that a detailed reconstruction of the interglacials from land, deep-sea and ice records is urgently needed.

BRASSEUR, Guy

ESSL Laboratory, Boulder, CO, US

From Climate Models to Earth System Models

Complex climate models that describe the evolution of the coupled ocean atmosphere cryosphere system are gradually extended to “non physical” components of the earth system, and account for land vegetation dynamics, ocean biology, global biogeochemistry and atmospheric chemistry. In the future, these models will have to better represent the potential feedbacks with society and therefore to couple the natural bio-physical components with the socio-economic system. The paper will review the present status of complex climate and Earth system models, report some preliminary attempts to include societal aspects, and highlight challenges for future research.

CALLONEC, Gaël

ADEME, Paris, France

How to foster the economic and societal technical solutions?

The presentation will focus on the interplay between economic scenarios (based on energy demand and CO₂ emission reduction) with long run-public policies. The French case will be discussed in more detail.

CHAUVIN, Dominique

TOTAL Holding, Paris, France

Environmental and industrial policies: reciprocal impacts

Total as a key player of the Oil and Gas industry is providing answers to

environmental challenges. In that respect, it has already developed environmental objectives and policies. Its environmental footprints is being assessed, controlled and reduced with a set of concrete means to improve its performance, a better selection of major challenges and a better report to external stake holders.

Energy and climate issues are inextricably interwoven, which means that we have to help to reconcile the objectives of today's society, pursuing economic growth while protecting the climate for future generations. Faced with this predicament, we are assertively exploring two areas, energy management in our own facilities and those of our customers and technical solutions such as CO₂ Capture and Storage to reduce greenhouse gas emissions in the atmosphere. But such policies need support and resources to pursue innovation and conduct research on new technologies. An effective and sufficiently consistent framework needs to be provided in order to align growth strategies with efficiency, innovation and environmental stewardship.

CIAIS, Philippe

Laboratoire des Sciences du Climat et de l'Environnement/IPSL, Gif-sur-Yvette, CNRS, Paris, France

Recent trends and vulnerabilities in the global carbon cycle

We shall address the coupling between atmospheric circulation and the modelling of ecosystems, to have a better understanding of the carbon cycle, perturbed both by land use and Climate Change. The role played by the newly created European Research Infrastructure Integrated Carbon Observing System (ICOS) will be also emphasized.

CRAMER, Wolfgang

Potsdam Institute for Climate Impact Research, Potsdam, Germany

Are European ecosystems vulnerable to climate change?

The relatively simple question posed by this title turns out to be complicated in its implementation, for a number of reasons: First, ecosystems have changed in response to changing climate throughout history - however this has not normally been qualified as "vulnerability". Second, most changes in

ecosystems have multiple forcings, climate change being only one of them. Third, whether changes in ecosystem functioning qualify as “vulnerability” depends largely on the human point of view. Resolving the issue is very urgent today, because it is indisputable that rapid changes are taking place and that some of these are considered “negative impacts of climate change”. Given the complexity of European landscapes, simple extrapolation of observations will not provide the answer in time and with sufficient reliability - instead an integrated experimental and modelling approach has been developed in cooperation with stakeholders. I will present this approach and its latest stages of development which forms the conceptual core of past, present and (hopefully) future integrated projects within the EU framework programmes.

DÉQUÉ, Michel

Météo France, Toulouse, France

Regional Climate change and extreme

Global coupled ocean-atmosphere models, driven by greenhouse gas concentrations according to several hypotheses for the next century, have been used in the last IPCC-AR4 report to depict possible future climates of the planet. It will be shown that a regional atmosphere model is able to represent with some fidelity the different climates over France, thanks to a realistic representation of the main mountains. Local extreme phenomena like intense precipitations are better taken into account. Regional models are an essential link between physical hypotheses (e.g. 2x versus 3x CO₂ concentration) and needs from the impact community.

DUVAL, Romain

OECD, Paris, France

Post-2012 options to reduce greenhouse gas emissions

The presentation will focus on post-2012 options to reduce greenhouse gas (GHG) emissions, putting special emphasis on the need to abate world emissions. The presentation will focus on post-2012 options to reduce greenhouse

gas (GHG) emissions, putting special emphasis on the need to abate world emissions at least cost, which in turn requires the need to select a least-cost set of policy instruments. In particular, model simulations will be presented to discuss whether and how price instruments should be combined with technology-support policies in order to reduce overall mitigation costs. On a more speculative note, the potential implications for climate policy design of the uncertainties surrounding both future damages from climate change and mitigation costs will be discussed.

GONZALEZ-ROUCO, Jesus Fidel

Universidad Complutense Madrid, Madrid, Spain

Borehole climatology and model simulations: steps to integrated assessment. Progress in understanding climate variability through the last millennium leans on simulation and reconstruction efforts. Exercises blending both approaches present a great potential for answering questions relevant both for the simulation and reconstruction of past climate, and depend on the specific peculiarities of proxies and methods involved in climate reconstructions, as well as the realism and limitations of model simulations. This talk addresses the use of millennial simulations with the ECHO-g model to explore three main issues that group most of the interaction between model and geothermal efforts: the use of models as a validation tool for borehole climate reconstructions; comparison of geothermal information and model simulations as a means of either model validation or inference about past climate; and implications of the degree of realism on simulating subsurface climate on estimations of future climate change.

GOOSSE, Hugues

Institut G. Lemaître, Université Catholique de Louvain, Louvain-la-Neuve, Belgium

Modelling forced and internal climate variability during the last millennium
At hemispheric scale, the surface temperature is strongly influenced by the

variations of the natural (solar and volcanic) and anthropogenic (land-use, sulphate aerosols, greenhouse gas concentrations) forcings. By contrast, at regional scale, the internal variability, which is purely due to the internal dynamics of the climate system, can mask the forced response. As a consequence, before the 20th century, cold or warm periods are rarely global, homogenous phenomena. Furthermore, the response to the forcing could be associated with changes in the frequency of some modes of variability. This interplay between the response of the climate system to the various forcings and internal variability makes model-data comparison a complex task for the last millennia. In this framework, simulations in which the model is forced to follow the observations using a data assimilation technique could be very useful. Their goal is to extract the information on the forced and internal variability contained in both the proxy records and model results using a single procedure.

GUIOT, Joël

CEREGE-ECCOREV, CNRS, Aix-en-Provence, France

Long term climate variability: from past to future and from data to models

Data show that climate has always changed in the past, sometimes with a larger amplitude than what we experimented for two decades. But the main signatures of the anthropogenic forcing are the speed of the change and its globality. Paleodata at different scales are used to test the realism of climate model simulations and then their ability to simulate climates very different from the present one. They are used also to test impact models for water, forest resources. This talk aims to illustrate how paleoclimatology can bring a lot to global change studies, because it privileges interdisciplinary approaches.

HALLEGATTE, Stephane

Centre International de recherche sur l'Environnement et le Développement (CIRED) /Meteo-France, Paris, France

A Roadmap to Assess the Economic Cost of Climate Change with an Application to Hurricanes in the United States

This talk presents a methodological roadmap to assess macro-economic damages from climate change. To do so, it explores a single manifestation of climate change in a single location: an increase in hurricane intensity in the United States. The presentation starts from a global climate change, and follows the causal chain to total macro-economic losses. First, the large-scale change is downscaled to a spatial scale pertinent to investigate socio-economic impacts. Here, the Emanuel hurricane model is used to estimate present and future local landfall probabilities. Second, a statistical analysis of historical landfalls is used to translate these probability changes into direct economic losses. The paper also discusses several adaptation strategies that could be implemented to limit these losses. Finally, a modified Input-Output model is used to investigate indirect losses due to macroeconomic mechanisms and feedbacks. This model translates the changes in direct losses into changes in total losses. The model suggests that total losses increase non-linearly, amplifying the role of the most extreme events. The paper then proposes adaptation strategies that can reduce indirect losses by improving the ability of the economy to reconstruct and deal with the consequences of disaster.

HOURCADE, Jean-Charles

Centre International de recherche sur l'Environnement et le Développement (CIRED), CNRS, Paris, France

The Economics of the Climate/Development of the Gordian Knot; Beyond a Sound Pessimism

We will first suggest that costs of meeting ambitious climate targets capable to stabilize global warming below 2°C or 3°C temperature increase have been underestimated so far. The first reason is the underestimation of baseline emission scenarios, the second is the magnitude of transition costs towards a low carbon development profile in emerging economies. Second we will show that this pessimistic diagnosis does not lead to inaction but to a reframing of discussions on future international coordination of climate action. We will insist on the necessity of complementing the conventional approaches relying on the emergence of a world carbon price by a serious consideration of main drivers of the development dynamics at work, including urban planning, infrastructure policies, rural development, trade policies and reforms of international funding. Third we will show the necessity find-

ing innovative tools for an early redirection of international aid and capital flows towards energy, transportation and building infrastructures in emerging economies.

JOUSSAUME, Sylvie

Laboratoire des Sciences du Climat et de l'Environnement, CNRS, Gif-sur-Yvette, France

Climate models : learning from the past long-term climate variability

Projections of future climate change rely on global climate models. Such models simulate the dynamics and physics of the coupled atmosphere-ocean system and move towards models of the full Earth system. These models are evaluated on the present day mean climate as well as on climate variability over the last century. Although climate models agree on the overall patterns of future climate change, discrepancies are still displayed between models, both in amplitude and at the regional scale (e.g., IPCC AR5 (2007)).

Past climates offer an unique opportunity to evaluate climate models on climate conditions different from the present-day conditions thanks to the reconstruction of past climates from paleodata (past vegetation, sea sediments and ice cores). They also allow to investigate the mechanisms of climate change and the importance of feedbacks in the climate system.

The Paleoclimate Modelling Intercomparison Project, endorsed by both the international programs WCRP and IGBP, focuses on these issues (<http://pmip2.lsce.ipsl.fr/>). Main focus is on the last glacial maximum (LGM), ca 20 000 years before present (BP), and the mid-Holocene, ca 6000 years BP. The LGM simulation allows to examine the climate response to the presence of large ice sheets, cold oceans and lowered greenhouse gas concentrations. The mid-Holocene simulation allows to examine the climate response to a change in the seasonal and latitudinal distribution of incoming solar radiation caused by known changes in orbital forcing.

Results show that the models used for future climate change projections are able to simulate the broad-scale features of both the LGM and mid-Holocene climate but that they tend to understand some of these features such as the polar amplification at the LGM and the northward extent of the African monsoon at the mid-Holocene. Debate however still prevails with regards to the change of the thermohaline circulation at the LGM. Paleoclimate modelling

studies have also emphasized the importance of vegetation feedbacks at the regional scale, not yet included in future climate change studies. Other challenging issues with regards to future climate change are offered by long-term paleoclimate modelling studies such as ice-sheet melting at the last interglacial and during the last deglaciation, and understanding the past carbon cycle changes as inferred from ice cores.

MANN, Michael

Department of Meteorology, Penn State University, PA, US

Global Climate Change: Past and Future

My presentation will begin with a review of the now-solid evidence for a human influence on the climate of recent decades. Such evidence includes instrumental measurements available for the past two centuries, paleoclimate observations spanning more than a millennium, and comparisons of the predictions from computer models with observed patterns of climate change. I will then address how the study of paleoclimate can inform our assessments of the potential future impacts of human-induced climate change.

PLANTON, Serge

Météo France, Toulouse, France

Detection and attribution of climate change to different causes

According to the last IPCC report, the most part of the observed increase in globally averaged temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic greenhouse gas concentrations. This statement relies on a long process of demonstration that consisted in evaluating the ability of the successive generations of climate models to reproduce and interpret the climate variability of the last decades. The more and more numerous statistical analyses aiming at detecting and attributing climate change to natural and anthropogenic causes have reinforced the assessment of experts. The recent detection and attribution studies of observed climate change in France also allow to find an anthropogenic contribution at a sub-regional scale. The first aim of these studies

is to look for signals of climate change and identify their sources. But, by analysing the consistency between model simulations and observations at a time scale consistent with the one of climate change projection, these analyses also contribute a lot to model validation in the context of the anthropogenic climate change assessment.

SEGUIN, Bernard

INRA, Avignon, France

The impacts of climate change on continental ecosystem

Climate change will deeply modify the ecophysiological functioning of plants, by creating a set of conditions which could be more favourable (in the sense of biomass production) or not. Among the first, the increase of atmospheric CO₂ will stimulate the photosynthesis (with levels depending upon plants and conditions), with a result of a potential increase in biomass up to 20 % in some cases. Warmer temperatures will also generally be favourable to most of the physiological processes, up to an optimum above which the risk of detrimental or lethal values exists. The (almost) generalized advance in phenology (calendar of development stages) will also have various effects: sometimes increase the risk of spring frost or bad setting for fruit trees, a reduced duration cycle for annual plants but an increased active vegetation season for perennial species (advance in spring occurrence, delay for autumn), positive or negative feedback in terms of the active temperature for the vegetal. Above all, the availability of water will be the key factor for modulating the changes in potential production. The changes in individual behaviour will evidently affect plant communities, which however will also to face changes in their geographical zones of potentialities. They can be approached in terms of potential shift by considering their bioclimatic envelope, but there is a large controversy on this approach in regard of possible biotic interactions. It would be also necessary to consider other components of continental ecosystems like insects and pests, or animals in the case of natural ecosystems, as well as future interactions with human intervention. These general notions will be mainly illustrated by examples in crop and forestry productions, with some complementary details about natural ecosystems.

SHOGREN, Jason

Department of Economics and Finance, University of Wyoming, WY, US

Linking adaptation and mitigation for climate risk reduction

How people privately and collectively adapt to climate risk can affect the costs and benefits of public mitigation policy (e.g., Kyoto); an obvious point often neglected in actual policy making. Herein we use the economic theory of endogenous risk to address this optimal mix of mitigation and adaptation strategies, and examine how increased variability in climate change threats affects this mix. We stress that a better understanding of the cross-links between mitigation and adaptation would potentially make it possible to provide more risk reduction with less wealth. Policies that are formulated without considering the cross-links can unintentionally undermine the effectiveness of public sector policies and programs because of unaddressed conflicts between the strategies.

SOMERVILLE, Richard

Scripps Institution of Oceanography, University of California, San Diego, US

The Intergovernmental Panel on Climate Change and the Challenges of Climate Policy, Equity and Ethics.

The 2007 Intergovernmental Panel on Climate Change (IPCC) report provides clear guidance for the greenhouse gas emissions reductions needed to limit global warming to specific targets such as 2 °C above pre-industrial values, as adopted formally by the European Union. Despite the strong scientific consensus found by the IPCC concerning the reality and seriousness of global warming, worldwide emissions of the greenhouse gases that cause climate change continue to increase each year. The nations of the world are still far from agreement on how to act to reduce emissions.

SVEDIN, Uno

The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning, Stockholm, Sweden

Interlocking natural and social systems - resilience, governance and research policy considerations.

In this presentation the start is made from the 2007 IPCC statement that it now seems consolidated that there is a clear sign of the importance of the anthropogenic factors in the climate change panorama in addition to the natural phenomena. Thus the current situation of civilisation seems to be characterised by the quickly growing interference and to some extent control by humans over natural flows e.g. the carbon or nitrogen cycles to an extent not earlier seen in history. This development is of recent date - maybe half a century - and could be regarded as the beginning of a new era that the Nobel Prize winner Paul Crutzen and others have labelled as the era of the "Anthropocen". This has research policy, risk management, governance and political consequences.

THORON, Sylvie

Groupement de Recherche en Economie Quantitative d'Aix Marseille, Marseille, France

International negotiations on climate change: How to take advantage of risk aversion to improve the conditions for the emergence of a consensus

Climate change is one of the best examples of global environmental problems. Countries are conscious that they have to find a solution to this global problem at the international level. Negotiations on climate change started more than 15 years ago with the signature of the United Nations Framework Convention on Climate Change. Since then, the process went through a series of conferences and protocols. Part of this process, the Kyoto protocol constitutes a major step since it designed country-specific targets defined in terms of CO₂ emissions abatement. The fact is that we should not speak about an international environmental agreement but about a negotiation process to find a solution to an environmental problem. The negotiation starts with general and consensual principles but should evolve towards legally binding and more and more precise commitments from the parties. We can consider the whole process as a series of nested treaties. In this process, the uncertainty is not only in the scientific description of the climate change. It is also a consequence of the strategic negotiation of the different countries.

The way the negotiation is organized conditions the result and the likelihood to reach an agreement. The institution available and the design of incentive mechanism play an important role. Our claim is that it is possible to take advantage of the parties' risk aversion. This is a way to make them conscious of the benefit they can draw from an agreement. We describe a mechanism to implement this idea.

ATTENDEES' ABSTRACTS

ABU, Godwin Anjeinu

Department of Agricultural Economics, College of Agricultural Economics, Extension and Management Technology, University of Agriculture, Makurdi, Benue state, Nigeria.

Social Impact of Global Environmental Change on Farming Communities on the Ogoli River Bank in Otukpo Area of Benue State, Nigeria.

One of the manifestations of the global change in this study area is a marked reduction in the duration and amount of rainfall. This adversely affects the volume of the head waters that ultimately determine the volume of the Ogoli River which is used for irrigation. Consequently, food security and livelihood of the farming communities whose mode of agricultural production is rain-fed is adversely affected. Using Participatory Learning Action (PLA) technique involving three distinct groups of adult male, adult female and youth, the study seek to evaluate the coping mechanisms of these vulnerable group to draught and reduced volume of the Ogoli River occasioned by the global change. The result of the study showed that there are marked shortages in food production and the respondents are shifting from the cultivation of long duration crops like sorghum, rice, maize and yams that have good market potentials to the cultivation of short duration 'hunger' crops like millet, acha (hungry rice) and bricklaying. The study further showed that land is intensely cropped in the study area and bricklaying activities are intense on the River bank, destroying the fragile ecosystem and the attendant's environmental degradation of soil erosion. The study recommends that government should evolve policy measures to ameliorate the adverse effects of this phenomenon.

AMATO, Vincenzo

Dipartimento STAT, Università del Molise, Italy

Holocene climatic changes and their effect on morphodynamics and sedimentation in Campania (Southern Italy)

High-resolution paleoclimatic studies (e.g. ^{18}O , ^{13}C , CH_4 , MS, ect) provide

detailed reconstructions of the Holocene climatic variability, but they don't are unable to provide direct informations about the effects of the climatic changes on landscape and human ecosystems. In order to assess the response of the subaerial geomorphologic/pedo-sedimentary systems to the climatic changes and their potential impact on the ancient human communities, detailed stratigraphical investigations in Campania (southern Italy) have been carried out. In addition to indications provided by litho-pedostratigraphical and geomorphological investigations, the study has recurred to historical, archaeological, and palaeobiological data. Some of the main global cyclical climatic changes, centred at c. 5.5-5.0; 4.0-3.7; 3.0-2.5; 1.5-1.0 ka BP, appear to coincide with significant changes of the morphodynamical processes recognised in the investigated successions. More precisely the climatic variability affected the subaerial environments principally by arresting or enhancing specific pedogenetic, erosional and/or sedimentary processes in different environmental contexts of the Campania.

ARIELI, Ruthie

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The effect of thermal pollution on benthic foraminiferal assemblages, in the Mediterranean shore face adjacent to Hadera power plant (Israel)

Over the past several decades public and scientific awareness to global warming has increased significantly. As a result, many studies have examined the affects of global warming. However, the consequences of global warming on marine living organisms at the Levantine basin of the East Mediterranean has not yet been explored. In this study, we have used the thermal pollution of a power plant at the Mediterranean coast of Israel as an analog for the expected future trend of sea surface temperature (SST) rise. We have performed a sequence of 11 sampling campaigns at 5 stations located along a temperature gradient of approximately 10°C, from the discharge site of the heated cooling seawater to a few kilometers south, where temper-

atures are normal. The large natural variations in seawater temperature (16-30°C) enable us to examine the seasonal impact at relatively extreme conditions, which are intensified during summer, when the temperature anomaly becomes a threat to the environment. Thus, the main objectives of this study were to examine the response of the benthic foraminifera, known as sensitive indicators of environmental changes, to the locally elevated SST and compare it with the response of other groups such as crustaceans, ostracods and mollusks.

The SST varied between winter, 27°/18°C and summer, 35°/29°C along the transect. The preliminary results show that the maximal abundance of foraminifera, ostracodes and crustaceans occur in winter while that of the mollusks in summer. The total standing stocks (TSS) of foraminifera are negatively correlated with the SST anomaly. The numerical abundance (per g dry sediment) of the common species is negatively correlated to the temperature gradient in both winter and summer. The species diversity increases as the temperature anomaly decreases and during the winter it is significantly higher than during summer. The assemblage is more even and of lower dominance during winter compared to summer, during which ~80% of the assemblage consisted of only two species. Species richness, in the control station, representing normal sea temperature, varied from 8 to 17, whereas in the warmest station it varied from 3 to 10 species. The variation in species diversity between the five stations indicates that some species have adapted to the elevated temperatures better than others.

The preliminary results of this study point towards the conclusion that global warming has a primary negative affect on foraminifera populations and thereby on other marine microorganisms as well.

ARYAL, Komal Raj

Disaster and Development Centre, School of Applied Sciences, Northumbria University, United Kingdom

Climatic hazard mitigation through risk and resilience committees in Nepal
Nepal lies in an ecologically fragile and seismic region with a history of devastating Glacier Lake Outburst Flood (GLOF), landslides and earthquakes. Increases in temperature could increase the frequency and magnitude of cli-

matic disaster occurrences. Winter snow in Kathmandu in 2007 after nearly 65 years absence, frequent flood events since 2000, and an increased number of glacier lakes in the upper Himalayas indicates that climate change may already be having a significant impact. Disaster events in Nepal are known to impact disproportionately on poor and marginalised people who live in more exposed environments during risky times and without adequate forms of protection. With increasing climatic drivers of disaster events this trend is predicted to increase. The challenge of achieving the Millennium Development Goals (MDGs) in Nepal is therefore also a function of mitigating potentially disastrous effects of climatic change. One small initiative to establish local level Risk and Resilience Committees (RRC) has begun with support from the Department for International Development (DFID) and British Council (DelPHE programme) and may exemplify ways in which increasing hazards can be offset by the community. Its institutionalisation is emerging as one of the strategies for building disaster resilient communities in Nepal.

Increased realisation of the frequency and severity of epidemic, fire, storm, landslide, flood, and earthquake risks in Nepal underpins demand for community capacity to prepare, avoid, mitigate and respond to disaster. The RRC institutional framework embraces government structures, traditions and customs, political practices and public awareness to identify best ways of enhancing local disaster resilience. They currently sit within a wider strategy for “People Centred Hazard and Vulnerability Mitigation for Disaster Risk Reduction in Bangladesh and Nepal”. The aim is to enhance disaster resilience by the communities’ self directed establishment of the RRC involving local knowledge sharing and capacity building to assess and manage risk. Two RRC were established in Pachkhal Valley, Kavre District, and Dhankuta Municipality in 2007. Individuals from local government, NGOs, political parties, academics and other bodies were introduced to the fundamentals of disaster reduction through participatory training workshops. Localised risk records in which localised hazards, risks and vulnerabilities are detailed were designed by the RRCs. At Dhankuta participants worked in four heterogeneous groups, each ultimately drafting a risk record based on their previous experiences and needs.

Community based risk records are the beginning of a process whereby local people take the lead in building their capacity to manage their own disaster

risk reduction processes. It is expected that the risk records will form the basis of producing municipality level disaster risk reduction policies and plans. The overall project experience of establishing risk and resilience groups in the community has to date demonstrated that participatory initiatives in communities with a wide-range of stakeholders can produce high-level acceptance, involvement and local knowledge building. This was also found with groups established by members of this team in central Mozambique. Whilst community based development or disaster reduction groups are not new, concerted examples of people centred risk and resilience building remains largely under-utilized to its full potential, awaiting more in depth analysis and a wider set of experiences from around the world. The potential impact of climate change and failure of macro level policy making to address interests of civil society as a whole, suggests risk and resilience community approaches as a way forward in linking basic needs for human rights, representation, and disaster risk reduction.

BAMUTAZE, Yazidhi

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Integrating Geospatial Techniques in the Assessment of Land Use and Land Cover Change Impacts on Livelihoods in the Sio Sub-catchment of the Lake Victoria Basin

The Lake Victoria Basin like many other basins has experienced land use and land cover changes. Although there have been some efforts to assess and map these changes, there is paucity of reliable information on how these changes are affecting the environment and livelihoods of the Lake Victoria communities. The gist of this study was to investigate the effect of changes in land use on the community livelihoods. The study focused on the Sio sub-catchment in the Lake Basin, particularly the downstream and midstream found in Uganda and Kenya respectively. Geospatial techniques were used to delineate the sub-catchment and select the study sites. Field observations coupled with interviews of 400 respondents were used to collect environ-

mental and socio-economic data from the midstream and downstream components of the Sio sub-catchment. The homes of the respondents were georeferenced using a Global Positioning System (GPS). In addition to the socio-economic data, geospatial analysis of satellite imagery was also performed for change detection and quantification. Landsat Images (30m resolution) of 1980 and 2000 were classified using ILWIS 3.4 software and ground-truthed in the field. Results show that land use changes have occurred in the Sio sub-catchment. The conspicuous changes are the encroachment on the river bank resources, conversion of wetlands for cultivation and shifts from perennial to annual crops. Agriculture especially cropping was found to be the dominant livelihood source with over 98% of the respondents engaged in some form of agriculture, but its sustainability is threatened by the land quality perceived to be declining due to degradation by the midstream and downstream communities respectively. The midstream communities generally gave a pessimistic rating of the resource qualities in comparison with the downstream communities. The spatial analysis of images shows that major changes were increment in small scale farming (dominated by annual crops) of up to 115 sq.km. The results underpin the need for integrated natural resource management packages and pathways as well as value chain products that take care of resource management, production, marketing and access to markets so as to abate resource degradation and improve livelihoods.

BAUDOIN, Marie Ange

CEDD, Université Libre de Bruxelles, Belgium

How Does The E.U. Integrate Climate Change Issues In Its Development Aid Policies ? Short Term Reaction Versus “Capacity Approaches”

Climate change and its impacts on human societies exacerbate some development issues. As poverty reduction is declared to be the main goal for development aid initiatives, linking this to climate change has been argued as a necessity by the European Union. This need lies on the fact that growing environmental deterioration will be a strong challenge to short-term gain of poverty reduction. In this context, the “capability approach”, as we argue, should be the base upon which new development strategies should rest.

Most countries are able to promote development policies linked to climate change. What they sometimes lack is either the knowledge to adequately address them or the possibilities to implement them. The capability approach is sensitive to cultural pluralism and takes into account the social, political or economical context in which it is implemented, which makes it more relevant raising questions such as poverty alleviation or environmental protection. Involved in a research on adaptation to climate change in Western Africa, we have performed in-the-field observations. Moreover, we have carefully analyzed the policy papers and funding of EU aid policy and its relations to adaptation to climate change. In summary we argue that the capability approach can be a way to achieve a sustainable development in the context of climate change. We highlight several means through which it could be implemented. How these several points are taken into account in the development aid policies of the E.U. is the subject we will address in this paper.

BLANCHARD, Anne

& Vanderlinden, Jean-Paul,

Centre d'Economie et d'Ethique pour l'Environnement et le Développement, Université Versailles Saint-Quentin-en-Yvelines.

Are the challenges of interdisciplinary science and the challenges of science and policymaking integration the two faces of the same coin? A Global Change Research case study.

This poster will present initial results of the application of a theoretical and methodological framework that is being developed in order to allow for a better joint understanding of the challenges of interdisciplinary global change research and science and policymaking integration. This approach integrates both epistemological foundations, based mainly on the work of Horkheimer and Adorno, and sociological foundation, using the work of Bourdieu as a starting point. Methodologically this approach finds its source in participatory action research framed by an initial analysis entailing qualitative content analysis.

In the theoretical introduction global change interdisciplinary research and global change science and policy integration will first be characterized on epistemological and sociological grounds. Second, these characteristics will be used in order to reframe the analysis of climate change interdisciplinary

research and science and policy integration. Third the key concept of reflexivity will be presented. Its potential contribution to the understanding of interdisciplinary dynamics that are coupled with science and policymaking integration will be analyzed.

In the methodological section, participatory action research combined with an initial scoping, using content (qualitative) analysis will be presented. The strengths and weaknesses of such an approach will be stressed. Its application to the case study will be explained.

Initial results show that the challenges of interdisciplinary global change science and the challenges of science and policy integration may be understood as the two faces of the same coin. What is observed in our initial analysis of this case study is that the barriers and facilitator of both can be reduced to reflexivity and its use to facilitate communications. The concept of reflexivity within global change research is therefore discussed. The conclusion stresses the need, and offers potential pathways, to further operationalize the use of such epistemological and sociological concepts to global change interdisciplinary research facilitation and science and policy integration.

BLARQUEZ, Olivier

Centre for Bio-Archeology and Ecology UMR5059, Institut de Botanique, Montpellier, France

Trees in the subalpine belt at the extreme end of the Late Dryas: origin, expansion and alteration of the modern forest linked to climate, fire and land-use

In the Alps high altitude ecosystems are recognized to be the most sensitive to future climate change. Understanding the Holocene stand dynamics of such ecosystem may represent a key feature for future changes forecasting. Here we present a high resolution macroremains record covering the last 11 200 years, from a small subalpine pond situated in the inner French Alps, at 2035 m a.s.l.. The early presence of trees in this elevation just after the Late Dryas/Holocene transition (11 200 cal BP), i.e. larch (*Larix decidua*) and birch (*Betula* sp.), suggest a possible glacial refuge area for trees located nearby the north-western Alps or an early and rapid tree migration never recorded. The 8300 cal BP event is characterized by a rapid and limited expansion of mountain pine (*Pinus mugo/uncinata*). Mixed stands of larch, birch and cembra pine (*Pinus cembra*) established at 8300 cal. years BP persist through

the Holocene, whereas previous studies emphasize a late development of mixed larch/cembra pine stands since the Roman period. After the Holocene climatic optimum at 5600 cal BP recurrent fires induced an highly dynamic and diversified vegetation with larch, birch, cembra pine, *Pinus* type mugo/uncinata and fir (*Abies alba*). Natural and anthropogenic disturbances, i.e. fires, avalanches, slash-and-burn and agricultural practices, act on subsequent vegetation pattern until last millenniums, where pasture type ecosystems are established around the site. This indicates that the vegetation dominated by open larch woodland dates back from the Middle age (1250 cal BP) until the 19th century when land-use abandonment began, but was already initiated 4000 years ago. The modern vegetation dominated by larch and cembra pine resulting from the land-use abandonment tends to resemble to the vegetation that occurred from 8200 to 4000 cal BP. The plant macroremains analysis provides a unique and precise record of stand-to-local vegetation composition and dynamics to bridge paleobotany and forest management.

BOBYLEV, Nikolai

Russian Academy of Sciences, Saint Petersburg, Russian Federation and Technical University of Berlin

Assessing the impact of the global change on urban infrastructure under different scenarios.

In 2007 about half of the world's population (about three billion people) has been living in urban areas. It is estimated that in the next twenty-five years almost two billion more people will move into cities. Cities were viewed just as sources of adverse impacts on the environment in the past. Recently there has been increasing understanding of the importance to consider cities as an instrument to address global environmental challenges. Cities and megacities are probably the only answer to the need for accommodating growing population of the world and minimizing adverse environmental impact of the population growth.

Sustainability and vulnerability analysis of urban areas has been an issue of increasing concern due to global change, including climate and increased frequency and impact of natural hazards. Urban infrastructure includes utility and transport networks, water and flood management structures, underground networks, etc. These different types of infrastructure are interrelated,

interconnected, and interdependent. Some of the urban infrastructure elements can be considered as critical ones, which means that city as a system depends on uninterrupted provision of their services.

This research will consider several scenarios of global change, including urban population growth, changes in precipitation and sea levels, and ecosystem services. Urban infrastructure (a case of underground supply networks will be used) will be assessed using sustainability and vulnerability criteria. Alternatives will be presented as global change scenarios. Multiple criteria decision analysis (AHP method) will be used to compare impacts under different scenarios.

BREON, François-Marie

& Labonne, M.

Commissariat à l’Energie Atomique, CEA/DSM/LSCE, Gif sur Yvette, France

The climate science community should show the way through a rapid decrease of its own carbon emissions.

The climate science community has clearly demonstrated the reality of climate change, the human responsibility, and the risks for the 21st century and beyond. There is now a wide consensus that global carbon emissions should be reduced by half, or even more, to limit the consequences of climate change to an acceptable level. The Kyoto protocol is a very little step toward this objective, with Carbon emission reduction of a few percent compared to 1990 levels. Besides, these objectives only concern developed countries, while the emissions of developing countries, in particular China, are increasing rapidly.

The urgency of emission reductions appears clearly. Several prominent climatologists have argued for a reductions of Carbon emissions much larger than those suggested by the Kyoto protocol. Yet, although there is a wide and general agreement in the climate science community that Carbon emissions should be reduced, there is no sign of significant effort on its part. In particular, air travel is widely used, contributing to a large fraction of climate research related emissions, with no apparent effort to reduce it.

We argue that the climate science community may loose its credibility if it does not “show the way” towards a very significant reduction of its Carbon

emissions. We suggest several ways for such reduction, the first of which is a limitation of air travel. The poster will show an estimate of Carbon emissions directly associated to climate research and potential for reductions.

CAILLERET, Maxime

& Hendrik D., & Amm A., Rachedi, S.

INRA-URFM Mediterranean Forest Ecology-Avignon-France.

Forest vulnerability to climate change: example of the silver fir-beech community (Abieto-Fagetum) forest at its southern range

Forest growth in Mediterranean mountains is limited by two major factors: summer drought at low elevation and low temperatures at high altitude (Korner 2007). As a consequence of climate change, observed trends would be the consequence of the contradictory effects of reduced frost and increased drought (Badeck et al. 2004; Jump et al. 2006). We chose a model ecosystem where both warming and drought trends will be measurable: the silver fir-beech community (*Abieto-Fagetum*) forest at its southern Alps margin. We analyze the effects of climate changes on these forests by (i) using dendroclimatological analysis, (ii) measuring growth variability along an altitudinal transect, (iii) analysis of recent growth trend, and (iv) studying tree health.

Climate-growth relationships show that silver fir is more sensitive to summer drought than beech, which is confirmed by a growth optimum at higher altitude. Common beech is more sensitive to climate events (2003 heat-wave and late frost), due to the non-persistence of its leaves. Forest productivity is positively affected by global change. But with the recent warming (0.4°C by decade since 1960 in the study area) and accumulation of summer drought, an upward shift in altitude of growth optima is already noticed.

At low elevation silver fir is declining with a high spatial variability which depends on tree characteristics (age, height, climatic sensitivity, past growth...), abiotic conditions (superficial and deep soil, stand composition, microclimate, and altitude) and biotic factors (pathogens). Beech vitality should be less affected except if heat-waves increase in intensity and frequency as expected (Meehl and Tebaldi 2004).

At high elevation, the upward shift of beech would be limited by late frosts damage contrary to silver fir which would take advantage of higher carbon assimilation due to rising temperature and lengthening of the growing season.

To conclude the decline / resistance of forest to climate change is a complex process which depends on species-specific effects, and on site characteristics, and which needs an interdisciplinary approach to be understood. It also shows that the frequency and intensity of extreme events must be taken into account, because their effects differ between co-occurring species.

CATTIAUX, Julien

& R. Vautard, P. Yiou

Laboratoire des Sciences du Climat et de l'Environnement, Gif sur Yvette, France

Regional forcings of the extremely warm European fall of 2006

We investigate the mechanisms driving the recent fall temperatures warming over Europe, which understanding is a key issue in the climate change context, as the climate of fall season significantly interacts with biosphere and carbon fluxes. The unprecedented warm 2006 fall season pointed the fact that the European temperatures are not driven only by the atmospheric circulation as it was until the 1990s [Yiou et al., 2007]. However the origins of this anomaly have not been addressed so far. From a statistical analysis and regional modeling experiments we estimate the contributions of both regional atmospheric circulation and North-Atlantic SST anomalies on the continental surface temperatures. Both the regression and the dynamical models attribute about 50% of the temperature anomaly can be attributed to the atmospheric flow conditions, 30% to the SST warm anomaly, while the 20% remain unexplained, but are consistent with the global air temperature increase since about 30 years. Assuming such a decomposition the contribution of trend components would explain about 1/3 of the anomaly, a fraction which should increase in the future.

CHANZY, André

UMR Environnement méditerranéen et Modélisation des AgroHydrosystème (EMMAH), INRA, Avignon, France

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Adaptation to global change in the Mediterranean area: Presentation of the

INRA Avignon Initiative.

The Mediterranean area will likely be strongly influenced by global change. Climatic scenarios have shown that the area will be affected by a decrease in precipitation and it is expected that the modification in land use (urbanization, farming activities suspension) that occurred in past will continue in the next decades. These changes will lead to reconsider management practices in different fields as water resources, biodiversity, pest dissemination, agricultural and forest production, forest fire protection. There is a need of developing tools and knowledges to prioritize the problems (pressure scenarios, indicator, prospective model) and propose adaptation strategies (technical solutions, regulation rules, economical measures).

The ACG (Adaptation to Global Change) project is a recent INRA initiative aiming at building an interdisciplinary project on the evolution of ecological services (as defined in the Millenium Ecosystem Assessment) in a context of global change. The considered services will be linked to biomass productivity of the ecosystems (are future needs as energy or food production can be fulfilled, vegetation mortality and fire risk assessment), crop and forest productions (food and fiber production, contribution to greenhouse gaz emission, contribution to ground water resource through irrigation), and biological dynamics (pest, biodiversity, pollinisation).

The overall approach is to work on given area (a small region between Mont Ventoux, Camargues and Ste Baume massif). Four axes will be developed:

- 1) Pressure scenarios (regionalization of climatic change scenarios, extreme event statistics, land use).
- 2) Indicators development characterizing the ecosystems services dynamic and accounting for ecosystem plasticity (soil function, vegetation development). Historic variations of these indicators will be collected when possible.
- 3) Biological dynamics. The spatio temporal dynamic of biological systems will be investigated considering the biology of the organism, the physico-chemical properties of the environment, the biotechnic operations and the socio-economic dimension. The aim is to estimate the response time of biological considering the natural regulation and the adaptation measures. The study will focuss on a limited number biological systems including pests (carpocapse), forest biodiversity and bees.
- 4) Water and the consequences of water scarcity in vegetation production.

COUMOU, Dim

Potsdam Institute for Climate Impact Research, Potsdam, Germany

Development of CLIMBER-3 Earth System model

We present the planned development of the next-generation Earth system model of intermediate complexity (EMIC), CLIMBER-3, which will replace our current in-house code CLIMBER-2. The basis of CLIMBER-3 will consist of GFDL's MOM-4 3D ocean circulation model and an in-house developed statistical dynamical (SD) atmospheric model. To these core modules land vegetation (LPJmL) and sea and land ice (SICOPOLIS) modules will be coupled. Due to the SD approach, the model will be computationally efficient while capturing the key atmospheric climate characteristics. This, in combination with the use of parallel computing techniques, should make it fast enough to efficiently study paleoclimates over multimillennia timescales as well as potentially dangerous tipping elements under anthropogenic forcing.

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Climate changes from the last glacial maximum to the present in Morocco: A record from lake Ifrah (Middle atlas).

The continental reconstruction of climatic variations in past implies the study of continuous sedimentary sequences and that these sequences are well dated. The most interesting sequences for this type of studies are taken in wet zones such as lakes or peat bogs. In the Middle Atlas of Morocco, there are sites answering these criteria of bases, such as the lake Tigalmamine, the lake Sidi Ali, the lake Ifrah, and the lake Iffer. One core 9 m long was collected in the lake Ifrah.

The record from this lake seems to cover the late glacial maximum. The geochemistry and sedimentology shows three climatic phases.

* Phase >21 000 yr B.P, with variable content of sediment in SiO_2 , Al_2O_3 and Fe_2O_3 . The total organic carbon is low. This period is correlated with variable climatic conditions (dry and humid).

* Phase between 21000 and 16000 years B.P, with high contents in SiO_2 , Al_2O_3 , and K_2O . This high values would be connected probably to an important aeolian contributions charged in detritic minerals during a relatively dry period. The total organic carbon is very low (1 % on average). During this phase the climatic conditions were unfavorable for an autochthonous production. Preliminary palynological study indicates steppic vegetation to more than 90 % of plants composing landscape around the lake during this same period.

* Holocene phase (from 8500 yr B.P to the present) settled during a wet period when contributions charged in stemming carbonates directly from the lake drainage basin are more important. During this period, one attends a progressive return of the lacustrine productivity to reach the most elevated values of the whole sequence on average toward the summit of the contents of 6%. The SiO_2 and Al_2O_3 record are very weak and correlated with a very low aeolian contribution. The C/N (12 on average) indicates the predominance of an autochthonous organic matter produced by the phytoplankton and the aquatic algae during humid period. The conservation of this organic matter would be in relation with the increase of the lake depth.

DANIS, Pierre-Alain

CEREGE, Europole de l'Arbois, Aix-En-Provence, France

Comparison of simulated tree-ring cellulose d18O at the European scale

In order to investigate factors involved in the inter-annual variability of d18O in tree ring cellulose (d18OTRC), we simulated the d18OTRC from 1960 to 2001 over Europe. We used 1) simulated climate and water isotope fields of REMOiso, a meso-scale circulation model, 2) hypotheses of the distribution of roots and soil hydrology, and 3) a mechanistic model of oxygen-isotopes in tree ring cellulose (d18OTRC). Sensitivity tests show that relative humidity of the air and soil water d18O contribute differently to the d18O in tree ring cellulose according to regional climate. In the commonly observed

hydrological situation, humidity of the air may contribute to 70% to the d18O_{TRC} at a given site, but only to 40 % at a warmer and drier site experiencing. We conclude that comparing time series of d18O in tree ring cellulose at the continental scale is questionable.

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The intergenerational equity: a concept to build for sustainability, the case of global warming

Defined as “the relation that each generation has with the last or future generations in the use... of the natural or cultural resources of planet”, Intergeneration equity (here I.E) imposes rules of optimal use of these resources on each generation. But it still remains a vague concept which needs a clear definition and poses some philosophical problems. Its emergence in right of the environment followed the scientific awakening on the ecological threats, in the years 1960 and led to a greater implication of the United Nations to coordinate international actions in environment field. The conferences of Stockholm in 1972 and Rio in 1992 answered this requirement and adopted the concept of sustainable development already mentioned in the 1987 Brundlandt report. With this concept, one attends “to provide for the needs of the present generation without compromising those of the future generations” trough the integration of the political economy and the environmental measures. This concept includes different aspects : the anguish of the present generation, the uncertainty characterizing the future one and also the practical difficulty to transmit the planet under conditions that ensure the survival of mankind and the defence of the common interest. So, its implementation should not be let to the individual actions of the States nor any bilateralism and multilateralism often in conflict with the “common interests of humanity” because principle of States sovereignty. Two possible ways can be explored to solve this institutional problem politically : The creation of a representative for the future generations to mitigate the absence of these generations in the current decision-making processes; or the creation of an international institution charged to protect the interests from the future generations and equipped with capacity higher than that of the States, as for the convention of Montego Bay signed in 1982 to control the activities of the

States in open sea and take care of the “common inheritance in the interest of the whole humanity”. The existence of such institutions would make it possible to force the States as well as the private individuals by preventing any contrary project with the interests of the future generations. How is this question perceived by the economic analysis? What are the philosophical background and the consequences on the analysis of global warming? In other words, is the choice of a discount rate efficient to solve the problem of different time periods posed by sustainability? To answer these questions, I suggest to analyze a typical long-term problem: the climate change, recently evoked in the Stern report (2006) and show that the policies of climate can lead to different models of consumption in time. And the very chosen strategy will depend on its effects on the households, today and in the future, evaluated through the impacts on the main indicators of wellbeing.

DUPUIS, Johann

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The sustainability of Kyoto's Architecture : Where did the victims of climate change go?

I have just begun a doctoral project on the possible uses of the juridical concept of “expropriation” in the case of territories exposed to a rise in sea levels. The premise of my project is that although future generations in all countries will be affected by climate change, the inhabitants of poor countries and small island states will be especially hard hit in less than 30 years; however, their situation has been neglected by the current international regime. This neglect can be demonstrated and explained using approaches from political science (mainly policy analysis and the Advocacy Coalition Framework by Sabatier), which says that the decisions behind privileged tradable pollution rights and the valuation of mitigation over adaptation strategies, among other policy instruments, have been pushed forward by powerful actors who clearly benefit from this institutional framework. Emission markets and mitigation strategies will not have any short or middle term effects in attenuating the damages that will hit poor and coastal countries. Thus, it is necessary to empower these territories by adding juridical arguments to the ethical ones that have already been advanced in

requiring compensation from states that are historically responsible for the short- and intermediate-term rise in sea levels.

Actually there isn't any property right to the climate system. Therefore, the possibility of protecting this resource is quite limited because without ownership no legal action can be undertaken in the case of third party damages. Thus, a "right to a stable climate" seems to be currently inadmissible in any court of justice.

One way to deal with this problem is the use of the concept "expropriation". According to many national laws the state must provide compensation when land owners are restricted in their uses of their property as a result of state activity. In principle, such a legal provision could reinforce the position of those who will suffer from a loss of use rights due to a rise in sea levels. Although there are still many political obstacles to suing a state or a private actor on the grounds that it is emitting GHG, the concept of "expropriation" emphasises the need for a form of compensation for the victims of climate change, a new burden-sharing agreement and open doors to legal and political actions.

FETTER, Éva

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Decadal-scale sediment dynamics and environmental change in a coastal area

One of the main interests in reconstructing the evolution of past environmental conditions is to place the present environmental situation in its historical context. Marine sediments represent a good repository for environmental tracers and during the last decades multi-proxy studies combined with geochronology of sediments have provided valuable information on the respective contribution of marine, terrestrial and anthropogenic inputs through the past century. Rapid modifications in the nature and quantity of deposited sediments are a major source of environmental changes and sedimentary records have been successfully used to infer the history of anthropogenic effects such as nutrient enrichment. The present work combines

results on sedimentation rates, organic carbon and nitrogen signatures, and selected trace metals in sediment cores from a developed coastal area located on the North Adriatic Sea surrounding the town of Ravenna. In 1958, a total of almost 210 ha of land was reclaimed from the nearby lagoons and pinewoods for the development of a petrochemical complex. Industrial development, groundwater and natural gas extraction have been greatly changed this stretch of the coast resulting in increasing shore erosion and saltwater intrusion, as well water pollution. The main changes recorded in recent sedimentation were compared to striking recent episodes of sea level elevation, river floods, and rainfall recorded in the past decades, each of one leads to a change in mass sedimentation and subsequently a change in sediment supply. The highest C/N (atomic) ratios were found in the upper 12 cm sediment layers (20.9 and 13.9). The environment reflected by the 0-10 cm depth interval, has generally the low C/N ratios, between 5.4 and 7.6, and may record variations in the sediment supply suggesting that although human impact appears to be the proximal cause of organic carbon input into the coastal area, recent river floods and climatic effects, as well as algal blooms may have also been important in the last decades.

FISHER, Joshua

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The state of UK climate modelling

The UK recently invested £23 million (~US\$40 million) in a program in Quantifying and Understanding the Earth SysTem (QUEST). The final product of this investment is the state-of-the-art QUEST Earth System Model (QUESM), which is comprised of the most comprehensive modeling and understanding of terrestrial, atmosphere, and marine processes ever built. QUESM is to be linked with the world-leading Hadley Centre's GCM to assess and understand changes in the Earth system with respect to climate and global change.

Here, I present the state of UK climate modeling, an overview of the QUEST Earth System Model, and detail the individual sub-models of the terrestrial ecosystems modeling component (QUERCC). The key questions we seek to address in QUEST are: (i) What and how large are biosphere feedbacks to

climate change? (ii) How is atmospheric composition naturally regulated? (iii) How much climate change is dangerous, and can be avoided through biosphere management?

FÖRSTER, Hannah

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A Model of Thermoelectric Energy Production in view of Climate Change
Freshwater availability is a regional and national concern for meeting future power generation needs. Continuing climate change will have adverse impacts on freshwater availability, and this increasing freshwater scarcity will lead to competition between different sectors (Hightower and Pierce [2008]). This problem will be more accentuated in the Mediterranean countries than elsewhere in Europe, since freshwater already is a scarce resource in this region (Iglesias and Quiroga [2007], Iglesias et al. [2003], Moneo [2007]). Following the increased scarcity will come serious allocation problems - who gets to use what amount of water, and at what time? The freshwater scarcity is be further aggravated by the current over-use of fossil water resources, especially serious in the SEMC, which must be reduced and at least in the mid-term completely stopped. In the future, choices will have to be made regarding the most valuable use of this limited resource. In this paper, a basic model of thermoelectric power generation is introduced. Its purpose is to provide a base for investigating how conventional thermal electricity production (nuclear, coal) may be constrained by future climate change. The model provides an understanding on how and when thermoelectric electricity generation may be constrained, due to changing natural preconditions and the restrictions from environment protection legislation.

FRAGNIERE, Augustin

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Carbon offsetting: an ethical and psychological approach.

The carbon offset market is becoming more and more popular. However,

until now few studies have attempted to approach the phenomenon from a social sciences' perspective. By distinguishing three levels of analysis – the technical, psychological and ethical aspects – this work has a double objective: to better understand the mechanisms underlying the offsetting phenomenon and to evaluate its effectiveness as a greenhouse gas emissions mitigation tool. The comments made about the system concern the voluntary carbon offset market mostly, with a special focus put on its application in developing countries. Some observations however are valid for the Clean Development Mechanisms of the Kyoto Protocol as well. The three levels of analysis are considered to form a coherent whole, leading to a chain of problems related to how the marketplace is organised today. From a technical perspective, the calculation methods are based on scenarios anticipating how emissions are going to evolve, and as such are prone to strong uncertainties, contrasting dramatically with the over-simplified way that offsetting companies tend to present their services. By claiming to offer a perfect equivalence between compensated emissions and corresponding carbon reductions, such companies reinforce the competitive attractiveness of offsetting over true behavioural changes, banking on the low psychological and economic involvement it requires from individuals. At the ethical level finally, the idea that one can “neutralize” his/her greenhouse gas emissions, here and now, by helping implement reduction projects elsewhere and at another time, is in accordance neither with the responsibility that developed countries ought to undertake, nor with a certain aspiration for ecological justice. After a synthetic presentation of the various criticisms addressed to the offset system, this work proposes some adjustments and modifications to be applied, so that the system may become more just and more effective in the studied contexts. Notably, getting rid of the terms “offsetting” (to which one will prefer “contribution”) and “neutrality”; giving up the claim of perfect equivalence between emissions and reductions and limiting “offsetting” to domestic projects. Financial flows directed at projects in developing countries remain necessary, but they should not be dependant on, and proportioned to, the North's emissions any more. It is the only way for western developed countries to assume their responsibilities fully.

FÜSSEL, Hans-Martin

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Climate, geography and macroeconomics: revised data, refined analysis and new findings

Assessments of social and economic impacts of climate change are primarily based on the results of biophysical climate impact models, which are aggregated, extrapolated and/or valued in monetary terms. Another potential source of information on climate impacts are spatial and/or temporal analogues, such as Ricardian analysis of climate impacts on agriculture. Another recent effort to this end involves the development of the G-Econ database (Nordhaus, 2006), which describes the relationship between climatic and geographic factors on the one hand and regional economic productivity on the other. A multivariate regression derived from this database has been used to estimate global economic impacts of climate change in a recent version of the DICE model.

The reanalysis presented here was motivated by some counterintuitive results in Nordhaus (2006). I have developed a modified version of the G-Econ database, which corrects several inconsistencies in G-Econ, and which is available at two different spatial resolutions (grid cells and subnational administrative units). This database is applied to reanalyze key results in Nordhaus (2006) and to perform additional analyses, focussing on the influence of climate on population density, density of economic output, and output per capita. I discuss the implications of several statistical problems in the G-Econ data (skewness, heteroskedasticity, excess zeros, different weights of data points, different spatial resolutions of predictors and predictands) for statistical analysis and assess the sensitivity of results to variations in statistical estimators, aggregation units, and weighting schemes.

This reanalysis finds that the counterintuitive results in Nordhaus (2006) can be largely explained by flawed methods for data aggregation and analysis, and by incomplete data in the G-Econ database. Given that several statistical problems have been inadequately addressed by Nordhaus (2006), the validity of estimates of global climate impacts based on G-Econ remains doubtful.

GAILLARD, Marie-Jose

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Global Holocene land-cover change inferred from pollen records using models of pollen dispersal and deposition -challenge and potentials

The “Landscape Reconstruction Algorithm” (LRA) approach (Sugita 2007a,b) is a new framework to quantify past plant abundance at various spatial scales, based on an up-to-date and theoretically-sound understanding of pollen representation of vegetation. One of the major problems of quantitative vegetation reconstructions using pollen data has been the definition of the spatial scale of reconstruction. The relevant source area of pollen (*sensu* Sugita, 1994) is thus far the most useful concept to specify quantitatively the spatial scale of vegetation represented by pollen in heterogeneous and patchy vegetation. Simulations indicated that pollen loading coming from beyond the relevant source area of pollen (i.e. background pollen) becomes consistent for all taxa among similarly-sized sites, and that it is possible to quantify the background pollen once regional vegetation composition in a 104- 105 km² area is known. Therefore, quantitative reconstruction of regional vegetation becomes a critical step for reliable estimates of local vegetation within the relevant source area of pollen for smaller sites (1-10 ha). The REVEALS (Regional Estimates of VEgetation Abundance from Large Sites) model was developed to predict regional vegetation abundance (e.g. in percentage cover or in proportions) from pollen assemblages in large lakes and bogs (100-500 ha) (Sugita 2007a). Estimates of past regional vegetation abundance are a necessary step of the LRA, as they are required to infer the past “background pollen” component. Quantitative estimates of regional vegetation is also important for its own sake, because some of the recent controversial hypotheses in climatology (e.g. Ruddiman, 2003) as well as climate and vegetation models, in order to be tested, require reliable estimates of past regional vegetation abundance/cover. The potentials and requirements implied by the application of the LRA using pollen data will be illustrated by a few examples. The challenge of producing maps of past landcover at the continental to global scale will be discussed.

GARRETA, Vincent

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Holocene Climate and vegetation dynamics reconstructed through the inversion of a dynamic vegetation model using pollen data

Numerous studies have produced statistical palaeoclimate reconstructions based on pollen data. One of the major assumptions they assume is the climate independence in time. We present a novel statistical framework composed of a hierarchical model and its associated Sequential Monte Carlo inference algorithm to inverse the Dynamic Vegetation Model LPJ-GUESS. We show that this new reconstruction method provides a temporal, i.e. consistent in time, explicit reconstruction of climate and vegetation dynamics. We validated the method on 30 modern European sites and apply it to the sediment core of Meerfelder Maar (Germany) covering the Holocene with a temporal resolution around one sample per 30 years. We demonstrate that reconstructed temperatures are well constrained and different of reconstruction obtained using other methods. The reconstructed precipitations are less constrained, due to the dimension considered -one precipitation per season- and the uncertainty in their modeling through LPJ-GUESS.

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ISBA-CC, a new land surface model simulating the terrestrial carbon cycle

The land surface model (LSM) ISBA-A-gs (Interactions between Soil, Biosphere and Atmosphere, CO₂-reactive) is specifically designed to simulate leaf stomatal conductance and Leaf Area Index (LAI) in response to climate, soil properties, and atmospheric carbon dioxide concentration. It simulates gross primary production, allowing to calculate leaf biomass and leaf area index. The growth module is modified to simulate all plant biomass

pools and all terms of autotrophic respiration. The model is then coupled with a soil heterotrophic respiration parameterization in order to represent the whole terrestrial carbon cycle. The new model simulates litter and soil carbon reservoirs as well as respiration fluxes towards the atmosphere, allowing to calculate net ecosystem carbon exchange. The model is validated by comparing the simulated energy and carbon fluxes against the FLUXNET data set.

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Bayesian hierarchical modeling of dendrochronological data

Dendrochronology is the scientific dating method based on the analysis of tree-ring growth patterns. It has been frequently applied in climatology. The basic premise is that tree-rings can be viewed as a climate proxy, i.e. rings are assumed to contain some hidden information about past climate. From a statistical perspective, this extraction problem can be understood as the research of an hidden variable which represents the common signal within a collection of tree-ring width series. Classical average-based techniques used in dendrochronology have been, with different degrees of success (depending on the tree specie, the region and the statistical method), applied to estimate the average behavior of this latent « climatic » variable. Still, a precise quantification of uncertainties associated to the hidden variable distribution has been lacking. In this presentation, we represent such a hidden variable using a Bayesian hierarchical model. We apply this method on simulated data from the ORCHIDEE model and observations from a European tree-ring database. We also use this model to examine the impact of some extreme climate events on tree growth.

HEIKKILÄ, Anu Marjaana

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Towards life-time estimations for outdoor polymeric materials in the changing climate

Polymeric materials are increasingly adopted everywhere in the modern infrastructures. Ever since the first indications on their degradation, extensive research on the mechanisms behind the phenomenon has been conducted. Rather surprisingly, many questions related to the subject have remained elusive. Investigations performed on different materials with different methods seem to be often incomparable. The global change with the changing environmental agents encourages the different disciplines to join their expertise for finding answers to the questions still open in the field of material weathering.

In spring 2005, the Finnish Meteorological Institute with its partners launched a material research project named UVEMA (UV radiation Effects on MAterials). Within the framework of the project, a weathering network of seven European sites was established. The network extends from the Canary Islands of Spain (latitude 28.5°N) to the Lapland of Finland (latitude 67.4°N), covering a wide range of weathering conditions. Since autumn 2005, the sites of the network have been maintaining weathering platforms of specimens of different kinds of polymeric materials, ranging from natural and synthetic rubbers to fibre reinforced plastics. Tests of the weathered samples have provided valuable information on the degradation of the materials in outdoor applications. Environmental data collected from the test sites over the weathering experiment will also enable estimation of the correlation between accelerated test environments and the natural service environments. We will present the objectives and methodology of the interdisciplinary project aiming at more reliable life-time estimations for polymers. First results of the five-year project will be overviewed.

JANJUA, Muhammad Saleem

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Climate Change Adaptation at the Local Government Level: The Case of Pakistan

Changes in climate and the extreme events are one of the greatest global

challenges. These global challenges have many implications at the local level. Even a small change in climate of an area has many implications for the existing infrastructure including: built systems; natural systems; and human systems. The local governments need infrastructure that can withstand future climate conditions to ensure it is dependable and maintain a long-term safety.

Pakistan introduced a devolution plan in August 2001. Although the local governments in Pakistan did exist in periods prior to the devolution in 2001 but they were practically inactive. Most of the local functions were carried out at the provincial and federal levels. Now, after devolution, the vast majority of public services (including environmental protection/climate change) have been transferred to the local governments, substantially increasing their scope and responsibilities.

This paper examines the concept of 'local governance and institutional performance', a relatively new topic in the climate change adaptation inquiry that explains why the quality of governmental institutions working at the local government level is important for implementing climate change adaptation. By taking an example of Pakistani local governments, the paper attempts to identify barriers and opportunities to climate change adaptation at the local government level in Pakistan. The author believes that by increasing the capacity to adapt at the local government level will definitely reduce vulnerability to the effects of climate change at provincial and national level in Pakistan.

KAPTAGAEVA, Aida

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Method and model development for qualitative estimation of ecological consequences of decisions related to environment: Case study of the Issyk Kul Biosphere Reserve in Kyrgyz Republic

In conditions of economic and political instability there is paid an insufficient attention to ecological situation in the Kyrgyz Republic.

For the last several years of instability and insufficient control for the part of the state, on a biosphere territory of Issyk-Kul there has been a great number of negative phenomena for ecology. A rush for increase of economic welfare of population of Issyk-Kul leads to that woods are being cut down, there are

being conducted mining operations without estimation of negative consequences for ecological balance, built new tourist complexes which often do not meet the requirements of a sanitary inspection that entails air pollution and contamination of water of Issyk-Kul. And also there happens an uncontrolled reorganization of arable lands for construction that is also negatively told on the ecology of Issyk-Kul oblast.

On the other hand there are being held projects both on preservation of ecological balance, on restoration of forest covers, on water purification and on the development of agriculture, tourism and industry and so on. But there is no united base and centralized management for estimation of influence of the given projects on the ecology of Issyk-Kul biosphere reserve.

This research aims at establishing closer cooperation between ecologists and economists by way of working out of a method and model used for determination and quantitative estimation of ecological consequences of decisions connected with environment and estimation in money terms of both positive and fatal consequences of such decisions by example of Issyk-Kul Biosphere reserve.

The concept of the sustainable development appeared as a result of unification of three main points of view: economic, social and ecological one. Coordination of these different points of view and their interpretation into the language of concrete measures being the means for achieving sustainable development is a task of a great difficulty because all three elements of the sustainable development should be treated in balance. The mechanisms of interaction of the three concepts are also important.

Having developed a mathematical model of a biosphere territory on the above mentioned components it will be possible in future to evolve it to a more complicated level of the development program of the whole country. Systems Dynamics can be a very important support, in the form of logical and mathematical tools, for decision taking and policy making under a sustainable development paradigm.

KIWANUKA, Ronald Mwanje

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The Impact of Climate change on Glaciation, in the Rwenzoli mts National Park, Uganda

Rwenzori Mountains National Park commonly referred to as “Mountains of

the Moon”, is a UNESCO World Heritage Site in Uganda, known for its vegetation, ranging from tropical rainforest through alpine meadows to snow; and for animal population, like forest elephants, primates and endemic birds. However a subject of concern is the impact of climate change on Rwenzori’s glaciers. In 1906 the Rwenzori had 43 glaciers distributed over 6 mountains with a total area of 7.5km². Now, less than half of these survive, on only 3 mountains, with an area of about 1.5 km². Similarly the area covered now by ice and snow is less than 4km², while in the earliest glaciations, it covered half the area of the Rwenzoli mts (996 km²). Consequently the vegetation has changed, the soils are acidic and infertile and some parts have been modified by tuff spread from the explosion craters, creating a need to invest in climate change mitigation technologies.

KOZYATNYK, Ivan

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Impact of seasonal changes of the river water on drinking water quality

Global climate change leads to changes in rivers water balance, especially in Eastern Europe. These changes emerge in deterioration of water source quality. Increasing of colour and total organic carbon satisfied about such processes. A considerable part of Ukraine uses storages along the Dnieper River as centralized water supply sources. The cascade of the Dniper storages features a high content of natural organic matter and its significant fluctuations depending on seasonal phenomena

It is shown that data on the origin of NOM in water can be obtained by comparing the ratio of color and oxidizability. A higher value of this ratio indicates a predominant content in the water of stable humic substances of marsh origin. The ratio of humic compounds of marsh or plankton origin depends on seasonal or annual climatic conditions. Humic substances of plankton origin prevail in the period of floods, while humic substances of plankton in arid periods of the year.

For example, the lowest value of color-to-oxidizability ratio of 2.5-3 was registered in the dry 2002. This fact indicated a predominant content in the water of humic matter of plankton origin. A sharp rise in the ratio during certain periods of 2001 (up to 5.2) and 2003 (up to 5.0) is the evidence of the

growing content of humic matter of marsh origin. This statement is corroborated by correlation of these indicators with the rise of ammonia content and the reduction of oxygen content in the water. It is related to the intensive summer rains during this period of the year in the upstream region of the Dnieper River. Owing to rains the overflow land areas were flooded. In order to reduce the area of flooding and prevent the penetration of radioactive nuclides into the water of upper reservoir, its water was rapidly discharged in forced manner.

Conclusion:

-Critical analysis of hydrochemical and hydrobiological conditions of water makes it possible to establish the regularities of variation of the water quality during different periods of the year and the reasons of its deterioration owing to natural and anthropogenic factors.

-Processes of water self-purification in the reservoir should be intensified during different periods of the year by using aeration in the region of drinking water intake.

-Estimation of barrier capabilities of each water treatment process must be linked with changes of hydrochemical properties of water in reservoirs and with due regard for conditions of flood or drought.

LAMICHHANE, Dhananjaya

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Decision Making Role of Women in Community Forestry

Community Forestry program was initiated in Nepal in the late seventies and Nepal has been practicing it most effectively since last two decades after the commencement of Master Plan of Forestry Sector in Nepal 1988 and consequently the Forest Act 1993. Forest user groups in Nepal are characterized by a comparatively high level of women's participation. As a result several forest user groups are predominantly or entirely composed of women. The findings of the study has indicated that Forest User Group-related variables are more responsible for increasing women's participation in Community Forestry activities rather than sociocultural characteristics but economic aspect is still occupying a decisive position. In contrast, the Forest User

Groups which have been organizing extension and awareness programs for its members have proven active women's participation. Hesitation due to caste and gender in participation is being faded away and there is an increasing trend of female's involvement in public sphere. However, the level of women's participation is low in Brahmin homogenous society where socio-cultural norms and values are strongly practiced in such consanguineous communities. Subsistence economy of users is to hinder the participation so that weakening the decision making role. Illiterate but experienced women have actively participated in discussion rather than literate who are withdrawal and hesitate to speak. No women are first contacted by extension workers from outside. They have still depended on their husbands to get information about community forestry. The community forests handed over to the women-Forest User Groups are small in area that is 2.35 ha in an average and either open or plantation in nature.

Forest User Group-related characters like good communication, motivation, extension, training/ workshops, income-generating activities, frequent meetings, opportunity and support by males may considerably increase women's participation enhancing decision making role. Therefore, it has been recommended that such activities should be run in order to increase role of women in decision making on community forestry. For instance, women often miss the HRD programs requiring outside stay so package programs in clusters should be provided. Short periodic but frequent programs are useful to them as they need frequent refresh because of their busy in household activities.

LEE, Eungul
Madison, USA

Highly improved predictive skill in the forecasting of the East Asian summer monsoon

The East Asian summer monsoon greatly influences the lives and property of about a quarter the people in the world. However, the predictive skill of the monsoon is very low in comparison with that of the Indian summer monsoon because of the complexity of the system which involves both tropical and sub-tropical climates. Previous monsoon prediction models emphasized ocean factors as the primary monsoon forcing. Here we show that pre-sea-

son land surface cover is at least as important as ocean indices. New statistical forecast models of the East Asian summer monsoon using land cover conditions in addition to ocean heat sources double and triple, respectively, the predictive skill of the northern and southern East Asian summer monsoon forecasting models relative to models using ocean factors alone. This work highlights the, as yet, undocumented importance of seasonal land cover in monsoon prediction and the role of the biosphere in the climate system as a whole. We also detail the physical mechanisms involved in these land surface forcings.

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& Lim, Hee-Jeong

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Model estimate of annual NEE and uncertainty over mixed forest in complex terrain

A process based model has been used to examine seasonal variation of gross primary production(GPP) and net ecosystem exchange (NEE) and to estimate annual NEE over mixed forest in complex terrain under the influence of Asian monsoon. We have calibrated modified Soil-Plant-Atmosphere model (mSPA model) with eddy covariance data to calculate GPP and used empirical formula to estimate ecosystem respiration.

The simulation shows that the GPP shows broad maximum in summer, which is consistent with the seasonal pattern of plant area index(PAI).

Ecosystem respiration shows peak in August when soil temperature is maximum.

Therefore, maximum carbon uptake shows in early June when GPP is high but respiration is not large yet.

In winter, the forest is weak carbon source.

The estimated annual NEE is about $-296 \text{ gC/m}^2/\text{yr}$ which is comparable to other studies over mixed forest in East Asia.

The uncertainties of estimated annual NEE have been discussed in terms of large energy imbalance and underestimation of nighttime flux due to decoupled flow between below and above the canopy in complex terrain.

LENNARD, Christopher

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Identification and simulation of extreme precipitation in a topographically complex region - a computationally inexpensive approach.

An investigation into changes of the characteristics of extreme rainfall in Cape Town, South Africa is presented. The investigation used two approaches. The first is an empirical methodology which explored historical attributes of extreme rainfall and the second very high resolution simulations of case studies. These are used to demonstrate a technique to produce high resolution forecasts of extreme precipitation if computational resources are scarce. Initially, self organizing maps are used to identify synoptic circulations that are associated with extreme precipitation over the region. Thereafter, days whose synoptic state matched those of the synoptic circulations associated with extreme rainfall were simulated at a resolution of one kilometer to capture regional topographic modification of extreme precipitation. These approaches were tested over Cape Town, South Africa which has complex topography where extreme rainfall is not well predicted. As this methodology is computationally relatively inexpensive, it has applicability to regions of the world where these resources are limited, more especially Africa where the state of climate science is poor.

Self organizing maps successfully identified synoptic circulations associated with extreme precipitation over the region and trends in these showed an increase in those associated with extremes rainfall. Case studies of extreme rainfall were successfully simulated at high resolution and the simulated rainfall fields reflected a large degree of topographic modification. The results compared favourably with radar and station data.

Using these approaches, days associated with extreme precipitation were successfully identified by the self organizing map and these were successfully simulated at very high resolution. The development and regional refinement of the methodology could make accurate, qualitative forecasts of extreme precipitation available to regions where the computational capacity for these is currently not available.

LEMESHKO, Natalia

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The largest lakes and reservoirs of Russia as a priority water resource for society

Global change for the last 25 years drives to important changes in hydrometeorological regime in different regions, reflecting water resources change of the largest reservoirs and lakes of Russia and of lakes' district with more than 460,000 small and middle size lakes (North-western part of Russia and Finland).

Interdisciplinary approaches in water resources research include as methods of traditional hydrology and climatology as paleoclimatology and economy.

Decrease in the water level of largest Lakes (Ladoga, Onega, Ilmen) by 35-70 cm has been registered over the 1990s, the warmest decade in the time series. At the same time inflow to the largest reservoirs of Volga River and of Kama River increased by about 30%. Only inflow to the Tsimlyanskoye Reservoir (River Don) exhibits tendency to decrease (10% lower than normal).

In spite of the fact that reservoirs are water bodies with a regulated water level, catastrophic inflow to reservoirs or lack of inflow can cause serious economic and social after-effects. The observed increase of inflow to the Volga-Kama Reservoirs results in occurrence of situations when dams have not been able to regulate water storage carefully last decades. As a result, the inflow to reservoirs of the Volga-Kama cascade was 50 % higher in 1991 than mean value and vast areas have been flooded, 102 dams have been destroyed, total economic losses has been equal to 552,5 million rubles.

Therefore we shouldn't ignore the up-to-date and expected changes in the hydrological regime of inland water bodies as one of the most sufficient elements of the sustainable development of human society.

A steady-state hydrological model has been developed for evaluation of changes in inflow to reservoirs and lakes with the progress of global warming (Lemeshko, 2002). The paleoclimatic reconstruction for global warming on 2 deg. have been used as empirical scenario. This scale of climate change corresponds to warm epoch of the past, considered as analog of future climate: the Last Interglacial-Eem (125 KA B.P.) (Borzenkova, 1992).

Calculations have shown, that average annual runoff from the catchment of

Ladoga and Onega should increase for 80 mm, inflow to reservoirs of Volga-Kama cascade should increase by 35-60 mm, and to the Tsimlyanskoye Reservoir (River Don) for 50 mm.

The combined assessment of regional peculiarities for the period of hydro-metric observations with the data of paleoclimatic scenario of Last interglacial, makes it possible to decrease existing sufficient uncertainty in the forecast of future changes in the hydrological regime of lakes and reservoirs. Changes of lakes' level and inflow to reservoirs can have both positive and negative consequences for economic and social life. And, decrease of lakes' level and inflow to inland water bodies, as a rule, has negative after-effects. First of all it is connected with deterioration of water supply. The increase of river runoff and inflow to reservoirs and a high lakes' level can have both positive and negative consequences. So, it is favorable for water supply of the population, an agriculture, water-power engineering, etc., especially for the southern regions of European Russia. But it can result in flooding settlements, agricultural lands, erosion of the reservoir's coasts, to bogging and degradation of a soil cover.

LEMOINE, Marion

CERIC/GREQAM, Marseille, France

The Kyoto Protocol's Clean Development Mechanism: potential and juridical approach

Both the *Framework United Nations Convention on Climate Change* (1992) and the *Kyoto's Protocol* (1997) set up the international legal architecture of the global warming challenge facing the international community. The *Kyoto Protocol* allows three trading mechanisms, which are a prominent example of an attempt to deal with an international environmental problem using a market-based approach, defined by international legal rules. This poster offers to present one of them: the Clean Development Mechanism, which lies on the boundaries between law, economy and sciences. At the juridical level, what are the stakes of the mechanism? What does law protect: human-based approach ecosystems or the biosphere in itself? Furthermore, on which concept of equity or environmental justice lies the Clean Development Mechanism? What new model of development is implied for developing countries? Given the current negotiations on a future treaty, the time is ripe for such an analysis.

MAKMUR, Erwin

Indonesia Meteorological and Geophysical Agency, Jakarta, Indonesia

Analyze of climate change In Java as impact global warming

Meteorological and Geophysical Agency (BMG) of Indonesia releases two kinds of Seasonal Forecasts every year namely Dry Season Forecast which is released every early March and Rainy Season Forecast which is released every early September.

Based on classified monthly average rainfall distribution pattern, BMG identifies whole Indonesia region as follows :

- Area which has noticeable difference between the dry and rainy seasons according to the seasonal criteria, namely Seasonal Area (SA).
- Area which has no clear difference between the dry and rainy seasons according to the seasonal criteria, namely Non Seasonal Area (Non SA).

Onset of Dry Season is determined based on the cumulative rainfall within 10 (ten) days is less than 50 millimeters successively. The onset of dry season is probably earlier, equal, or late than normal.

Onset of Rainy Season is determined based on the cumulative rainfall is equal or more than 50 millimeters successively. The onset of rainy season is probably occur earlier, equal, or late than normal.

Dasarian are time period for ten days. It is divided into 3 (three) “dasarian”, i.e. : 1st “dasarian” from 1st date until 10th date, 2nd “dasarian” from 11th date until 20th date and 3rd “dasarian” from 21st date until the end of the month.

The Cumulative Rainfall Respectives to Normal is comparison of cumulative rainfall during particularly period (one rainy season period or one dry season period) and normal, It is divided into 3 (three) categories, i.e. :

- Above Normal (AN) if the cumulative rainfall is greater than 115% toward the average
- Normal (N) if the cumulative rainfall is between 85% and 115% toward the average
- Below Normal (BN) if the cumulative rainfall is smaller than 85% toward the average

Climate condition in Indonesia depends on the atmosphere dynamics condition such as monsoon circulation and the sea surface temperature over Indonesia pool, it is also influenced by regional and global climate phenomenon

Based on normal data (average 1950 – 2000), we analyze that area over the Java island have changed for long period of season (dry and wet season), the onset of season, and cumulative rainfall within particularly period.

MEINANDER, Outi

Finnish Meteorological Institute, Erik Palmeninaukio, Helsinki, Finland

About diurnal changes in snow albedo

Snow albedo on ultraviolet (UVA, UVB, erythemally weighted UV) and visible (VIS) region, at wavelengths of photosynthetically active radiation (PAR, 400-700 nm), has been measured in at Sodankylä (67° N, 26° E, 179 m a.s.l.).

Ancillary data on snow height, air temperature and snow grain size have been recorded. The midday erythemally weighted UV albedo has been found to vary from 0.6 to 0.8 in the accumulation period and from 0.5 to 0.7 during melting. During the snow melt period, under cases of an almost clear sky and variable cloudiness, an unexpected diurnal decrease of 0.05 in albedo soon after midday, and recovery thereafter, has been detected. This diurnal decrease in albedo has been found to be asymmetric with respect to solar midday, thus possibly indicating a change in the properties of the snow. The results of two independent radiometers confirm the finding. These results are discussed and compared with corresponding Antarctic results, too.

Antony MILLNER

Magdalen College, Oxford, United Kingdom

The costs of strategic adaptation in a simple conceptual of climate change.

A simple theoretical model of the process of strategic adaptation to climate change is proposed. Climate change is represented by a non-stationary Markov process on the space of climate states, and strategic adaptation by a simple resource allocation task in which agents incur costs when moving resources from one activity to another. A stationary analysis allows diagnostics that quantify the net costs of climate change, and the long-run benefits to adaptation, to be defined. A full dynamic analysis of the model

allows for the computation of the costs of negotiating the transition between two stationary climate regimes. We analyze the dependence of these adaptation costs on the behavioural parameters of the model, and the costs of adjusting resources from one activity to another. We find that adaptation costs have a complex and counterintuitive dependence on adjustment costs, and can be more sensitive to the details of the climate change process than adaptation benefits are. This has important implications for adaptation planning, and understanding the linkages between adaptation and climate change mitigation.

NAVARAJ, Samy Iyyah Konar

Yadava college, Narayanapuram, Madurai, India

Impact of climatic changes in the aquatic organisms - A study

The research work was carried out from 2003-2007 in Madurai regions of Tamilnadu, India. The extreme fluctuation in the weather pattern was analysed with the help of meteorological station and its result was analysed with the fish population. The quantity of fish population in the aquatic habitat gets disturbed due to extreme temperatures, the physiology and biochemical analyses also reveal an interesting result with respect to growth, respiratory mechanism, nutritional quality, enzyme assay.

This interesting observation has illustrated that the climatic change will definitely affect the human also.

Further research is highly required in this line.

A lot of discussion is also anticipated in this line.

OLEHOWSKI, Claas

& Prof. Dr. Alexander Siegmund

Dipl.-Geogr, University of Education (Pädagogische Hochschule), Heidelberg, Germany

Vulnerability- and Degradation Analysis of semiarid Island ecosystem in the marginal tropics on the example of Fogo (Cape Verde Islands) – a study based on Remote Sensing and GIS.

Due to the high variability of precipitation the Sahel region has a high natural potential vulnerability. In addition the region is characterized by a high population growth which boosts processes of land degradation and desertification. Island ecosystems in the semiarid regions of the marginal tropics as Cape Verde are particularly affected by these processes. The Island of Fogo (Cape Verde) is, with the Pico de Fogo (2.829 m) and its small scaled climatic, floristic and geo-ecological differentiation an optimal research space for such an island ecosystem.

Like in other parts of the Sahel region, the archipelago of Cape Verde has an overall decrease in precipitation of 15-30 percent since the 1970's. These effects are joined with the risk of erosion, degradation and finally desertification, which is boosted by the population growth initiated intensification of the agricultural land use and a growing tourism.

By the use of multitemporal and multiscale airborne and satellite data, these above-named processes should be exemplarily analyzed and modelled on the island of Fogo, with the aim to evaluate the ecological vulnerability in relation to the global climatic changes and locally initiated processes of land use changes and land degradation.

Against the background of this situation an land use and land cover classification should be generated, to detect all parts of the heterogeneous land cover segments and degradation phenomena's, which is an important part of the geo-ecological spatial pattern analysis and a planned change detection analysis (over 30 years), which are often linked to degradation processes.

In this context, a Vulnerability Index will be generated for these semiarid island ecosystems, based on a "Top-Down Approach", which includes the geo-ecological spatial pattern - and the change detection analysis, a Geo Ecological Information System (GECIS) of the island Fogo and a ground based analysis of soil, crop, kind and concentration of vegetation, erosion- and degradation appearances.

In a parallel way, socio-economical studies as an important factor of the population development and structure (e.g. the consequences of the high number of emigrants), the rising tourism and the agricultural structures will be operated. These results are a part of the modelled Vulnerability index.

This GIS-based Index should be extrapolated from the test areas to the whole area of Fogo as a "Bottom-Up Approach" and could be a base for sustainable land use planning and the redevelopment of agricultural strategies.

PACTEAU, Chantal

& Sylvie Joussaume

Paris Research Consortium CLIMATE-ENVIRONMENT-SOCIETY,
CNRS, Paris, France

Paris Research Consortium CLIMATE-ENVIRONMENT-SOCIETY

The Paris Research Consortium CLIMATE-ENVIRONMENT-SOCIETY aims to encourage and fund interdisciplinary research into climate change and its impacts on society and environment. It relies on the research expertise of 13 laboratories and a federation in the Paris region working mainly in climatology, hydrology, ecology, health and social sciences and humanities. Its key research areas are:

- Global climate, energy policies and economic development;
- Climate extremes and vulnerable regions;
- Climate change, ecosystems, water resources and land use;
- Climate change impacts on health.

Currently, ten projects are running. Some of them deal with the issues of the present meeting:

-A first one, RENASEC, gives a perspective view from history. Since 1500, have extreme phenomena evolved in amplitude and frequency with present climate change in different French vulnerable regions, as predicted by models ? What have been their ecological, material and socio-economical impacts and what prevention and assistance policies have been triggered a posteriori ? Results will be used to build a cost model of the major extreme events to improve the evaluation of possible damages if their frequency and magnitude increase.

-The aim of the DECLIC project is to contribute to the development of a strategy for building the future climate simulations in the framework of the next IPCC Report (AR5). DECLIC will tackle issues at the heart of this strategy such as : for a given scenario of stabilization of greenhouse gas concentrations in the atmosphere, what will be the compatible levels of these gas emissions in the course of the century, how climate will change, and what mitigation strategies could be planned to reach emission objectives? Emissions will be disaggregated according to IPCC regions and economic sectors, in order to quantify optimal economic trends for stabilizing greenhouse gas.

-Two other projects are dealing with climate extremes and vulnerable regions. REGYNA studies regionalization of precipitation and hydrological and agricultural impacts of climate change on vulnerable regions, whereas MORCE MED coupled regional modelling platform for the study of the regional impacts of climate change.

A further project, RAMONS, is related to the analysis of practice of interdisciplinary science. Its purpose is to give to scientists involved in dynamics of interdisciplinary research on climate change impacts the resources needed to reinforce synergies between distinct scientific fields, and to increase the articulation of their activities of knowledge production with society.

PARFENOVA, Elena

Forest Institute SB RAS, Krasnojarsk, Russian Federation

Bioclimatic modelling of vegetation shifts in the altai-sayan ecoregion under climate warming

The Altai-Sayan ecoregion is a territory with a great variety of landscapes observed at a short distance: from nival and tundra landscapes at highlands, to taiga (dark-neededled and light-neededled) and subtaiga at middle elevations, to steppes at lower elevations.

Our goal was to predict vegetation redistribution by 2050 coupling our bioclimatic vegetation model with a Hadley climate change scenario.

Our working window was 80-102° E and 46-56° N covering some parts of Russia, Mongolia, China and Kazakhstan. Our bioclimatic model provides climatic limits of temperature sums, base 5o C (GDD5), temperature sums below 0° C (To), and a moisture index (a ratio of GDD5 to annual precipitation, AMI) for each vegetation elevation belt.

In our bioclimatic model, forest landscapes are separated from steppe landscapes by the value of AMI of 3.3 and dark-neededled forests from light-neededled forests – by the value of 2.25. Other elevation subdivisions are determined by a warmth factor rather than a moisture factor.

Current climatic layers of GDD5, To, and AMI were mapped based on data of 200 weather stations over the region and a digital elevation model (DEM) of 30” resolution (NOAA) using a thin plate spline interpolation procedure. Results were visualized using the Idrisi Andes software. Climatic layers for

2050 were mapped using a Hadley Center climate change scenario A1FI. To model vegetation distribution over the Altai-Sayan ecoregion for now-days and 2050, our vegetation model was coupled with corresponding climatic layers.

In a warming climate, forest redistribution across the Altai-Sayan ecoregion is predicted to shift in favor of most productive and floristically rich forests like dark-needled chern taiga. However, in steppe landscapes, areas of dry and desertificated steppes is predicted to increase. Unfavorable climatic conditions in “inland” steppes may intensify anthropogenic pressure on steppes and may negatively influence agricultural crops and thus regional economics.

PENG, Changhui

Institut des sciences de l'environnement, Université de Québec, Montréal, Canada

Data-Model Fusion Approach in Global Change Research: Recent Development and Future Challenges

It is increasingly recognized that global change research requires methods and strategies for combing process models and data in systematic ways. This is leading to research towards the application of model-data fusion approach. The model-data fusion is a new quantitative approach to model analysis and data assimilation that provides a high level of empirical constraint over model predictions based on observations. Applications of model-data fusion require (a) a model that describes the underlying physical, chemical and biological processes, (b) experimental observations and (c) an optimization tool. The optimization tool is used to find optimal estimates of model parameters or states by minimizing the differences between model predictions and experimental observations. Finding the optimal parameters can help us improve predictions or test alternative hypotheses embedded in the models. Model-data fusion can be used in several different ways: to estimate parameter values or in a sensitivity study that can be used to identify the observations required to estimate model parameters or to test our hypotheses. In this paper, we will review recent applications of model-data fusion in global ecology and paleoecology studies and highlight current progress and issues, potential problems and future challenges.

POPP, Alexander

& Lotze-Campen, Hermann

Potsdam Institute for Climate Impact Research, Potsdam, Germany

Food demand, productivity growth and the spatial distribution of land and water use: a global modeling approach

Nowadays, human society appropriates about one quarter of total net primary production of the terrestrial biosphere. Production of food, energy and materials, and the related use of land and water account for crucial components and interactions in the Earth System. However, rising food, energy and material demand, climate change and ambitious mitigation policies will enhance the competition for land and water.

While the combined impacts of these drivers are still highly uncertain, global land-use patterns will change in the future, reacting to these pressures. Projecting their future development is important to study both, their impacts on the Earth System as well as the limitations of land use since freshwater and fertile land are only available in limited amounts. The challenge of projecting future land-use patterns is to account, within one modeling framework, for the socio-economic determinants of agricultural demand as well as for the spatial heterogeneity of the land's suitability for agricultural production.

In order to simulate these combined effects in a spatially explicit way, we present a Model of Agricultural Production and its Impact on the Environment (MAGPIE). MAGPIE is a mathematical programming model covering the most important food and feed, livestock and bioenergy production types in 10 economic regions worldwide. It takes regional economic conditions as well as spatially explicit data on potential crop yields, land and water constraints from a global process-based vegetation model (LPJmL) that covers also the full hydrological cycle into account and derives specific land-use patterns for each grid cell. Implicit economic values (shadow prices) for binding constraints can be used to value resources for which in many places no markets exist, especially irrigation water and different types of technological change in agricultural production are included.

In this presentation we describe the model structure and validation. We apply the model to possible future scenarios up to 2055 and derive required rates of technological change (i.e. yield increase) in agricultural production in order to meet future food demand.

RATHGEBER, Cyrille

Centre INRA de Nancy, Champenoux, France

Influence of environmental factors on seasonal dynamic of tree-ring formation – Monitoring the present for understanding the past and gauging the future

This project aims to analyse the seasonal dynamic of wood formation of three conifer species (silver fir, Norway spruce and Scots pine) in the Vosges Mountains (north-eastern France) in relation to climate. In 2007, data were collected from 4 mature mixed stands distributed over an altitudinal gradient from 300 to 700 m above sea level. Each stand is instrumented in order to record meteorological data and tree stem radius variations hourly. During the growing season, wood microcores were collected weekly on the stem of five trees per species and stands. Cross sections were prepared in order to follow xylem development by counting the number of cells in the cambial zone, radial cell enlargement, secondary wall thickening and the number of mature tracheids. Preliminary results show species specific behaviour concerning wood formation calendars and dynamics. Cambial activity starts earlier for pine (mid-April) than for spruce and fir (beginning of May); and xylem development stops later for pine (end of October) than for spruce and fir (mid-October). Fir and Spruce xylem cell production shows a well-marked S-shape curve while pine being more linear; however, for the three species, maximum growth rates occur at about the same date (mid-June).

REISSELL, Anni

UHEL, Helsinki, Finland

Cross-disciplinary international research on land-atmosphere interactions

The presentation will focus on scientific issues of importance to global change and climate change research: interactions of reactive trace and greenhouse gases between the biosphere and atmosphere in combination with boundary layer processes, importance of land use and land cover for climate studies, and aerosol-cloud-precipitation-climate interactions. These issues are of vital importance and research is carried out under the auspices of the multi- and cross-disciplinary Integrated Land Ecosystem-Atmosphere

Processes Study (iLEAPS), a core project of the International Geosphere-Biosphere Programme (IGBP) in collaboration with other international research organizations.

The interactions between the biosphere and the atmosphere mediated by the production and emission of reactive trace gases are crucial and central components of the study of the Earth system and life science. Their importance to the structure and functioning of terrestrial ecosystems and to chemical weather of Earth is only now beginning to be appreciated, and there is wide acknowledgement that these are areas needing concerted scientific effort on a large scale. The current knowledge of the relation between physical and chemical processes and their impact on the larger spatial and temporal scale distribution of atmospheric compounds requires combination of knowledge of sources and sinks of atmospheric compounds, boundary layer processes: mixing, dispersion and exchange with free troposphere. This requires implementation of surface and boundary layer models in air quality and atmospheric chemistry-transport models. Recent studies suggest that the increased aerosol loading may have changed the energy balance in the atmosphere and at the Earth's surface and altered the global water cycle in ways that make the climate system more prone to precipitation extremes. As yet, we do not fully understand how the aerosol affects the development of precipitation, nor the extent to which it affects the cycles of water and radiant energy in the climate system as a whole. Achieving better understanding on the scientific issues briefly described above is not only a major scientific challenge, but is also important to policy makers and stakeholders for making decisions on adaptation and mitigation strategies.

ROVENSKAYA, Elena

International Institute for Applied Systems Analysis , Laxenburg, Austria

Optimal Economic Growth under Stochastic Environmental Impact: Sensitivity Analysis

We present an approach toward the sensitivity analysis of optimal economic growth to a negative environmental impact driven by random natural hazards that damage the production output. We use a simplified model of the GDP whose growth leads to the increase of GHG in the atmosphere provided

investment in cleaning is insufficient. The hypothesis of the Poisson probability distribution of the natural hazards is used at this stage of the research. We apply the standard utility function — the discounted integral consumption and construct an optimal investment policy in production and cleaning together with optimal GDP trajectories. We calibrate the model in the global scale and analyze the sensitivity of obtained optimal growth scenarios with respect to uncertain parameters of the Poisson distribution.

We found the analytic structure of the optimal investment. It turns out that one should switch an optimal control mode twice. One should start from intense developing production providing zero investment in cleaning. GHG concentration is growing exponentially at that stage. The first switching point opens a period of intense cleaning when the rate of increase of GHG in the atmosphere slows down. However at some time moment the system enters the “unsafe” mode, and catastrophes start to occur. In this period one invests all admissible resources in production.

We calibrated the model based on data available. Since the “unsafe” mode is only assumed to happen in future, we reveal uncertainty in values of the critical level of GHG concentrations in the atmosphere above which catastrophes affect the GDP significantly, of the cleaning efficiency, as well as of distribution parameters of random hazards.

It turns out that depending on the correlation between parameters of random catastrophes, and costs and efficiency of cleaning two extreme cases may hold. The first corresponds to the case of low damages from catastrophes and high cost of cleaning when it is optimal to allocate all admissible resources for developing production. The system approaches the critical level fast, catastrophes start to harm early which is nevertheless compensated by a relatively low damages. In the second case both damages from catastrophes and cleaning efficiency are high. Then it is optimal to postpone the time of starting catastrophes as long as possible.

The presented work is a step toward understanding how random natural hazards impact the technological development. Even under rather significant simplifications and strong assumptions made in this research, it reveals the eventual bifurcation of optimal dealing with economic growth harmed by natural hazards. Further quantitative and qualitative analysis of alternative hypothesis on both economic model and catastrophes regularities, as well as data analysis are needed to specify or refute them.

SALAMI, Taira

Nigerian meteorological agency, Egbe Lagos, Nigeria

Interactions between atmosphere, ecosystem and marine environment in Nigeria .

Over the past decades we have witnessed extra-ordinary natural and anthropogenic ally-driven changes in Ocean Biogeochemical composition. Most of atmospheric and oceanic climatic variability have been related to interaction between Ecosystem, Atmosphere and Marine environment.

Between 2004-2006 we studied the Interconnection and Teleconnection between ecosystem, atmosphere and marine environment. We noted that critical input of nutrients by Riverine and increase in Green house gases caused significant changes in Biogeochemical properties of ocean around Lagos area of Nigeria. In turn, the feedback to local communities has resulted in changes in their economies and diets. More practical issues will be presented.

SAMADI, Seyedeh Zahra

Azad University, Tehran, Islamic Republic of Iran

& G.SAGARESWAR, Geoenvironmental Research Centre, Cardiff University, United Kingdom

Climate Change Impacts on Environmental Resources. Climate Change and Petroleum Development

Today's by developing the industry and increasing the greenhouse's gases, the destiny of earth is dangerously exposed to changes that arise from the warmth of earth. The Increasing of greenhouse density in atmosphere is threat for changes in the earth atmosphere in century 21st. the weather changing has started from century 20th that because of the most of the earth warmth and that is because of the greenhouse's gas increasing. The semi governmental association estimate the weathers changing (IPZZ) that the warmth will increase from 1/4 till 5/8 degree centigrade. By increasing the warmth, the sea level comes up and the unstable of the meteoric, storm, flood and whirlwind will increased. The most of weather changing will inevitable. Increasing of flood, heat degree, the inflate of seas level, decrease of land, increase of illness arise from heat warmth like cholera and....one of the

important reason of weather changing. it feels important to analyze the ways of adaptibility of this phenomena like other country in Iran. One of the most important reason that the environment experts argue for weather changing is: Sea level,1-2 millimeter inflate in year, the length of ice age period of river and lakes decrease for 2 weeks in northern hemisphere,the thick of Atlantic ices is less and the amount of it decrease to 10-15 percent and snow deep decreases 10 percent and the blossom of the plant start early and forecasting the heat degree, evaporation and rainfall in future with declaring various climatic senarioes. The most evidential changes about environmental resources are increasing in flood, storm and whirlwind in some areas and increasing drought, low water in other areas. so regarding all over activity of countries in the ground of climatic changes effect in world it seems obligatory and essential to research about Iran's watersheed. In this paper the increasing process of heat degree and rainfall will be analyzed from past up to now and then declaring the ways of adaptibility of this phenomena.

SAPANOV, Mamay

& M.L.Sizemskaya

Institute of Forest Science, Moscow, Russian Federation

Effect of climate changes on water redistribution in southern regions of the Russian Federation

The problem of fresh water supply to population is a vital issue in the present-day world. It is especially urgent for arid regions of the Russian Federation where atmospheric precipitation is commonly the only renewable source of fresh water. But for all that, the significant part of precipitation which might have been accumulated in the open reservoirs due to the surface runoff falls within the cold season of the year. In arid regions there are no other reasons for formation of flood flows. The purpose this research is to reveal the changes in water redistribution in the Pricaspian lowland area as related to climate changes. The study is based upon the monitoring of the of the climatic conditions dynamics during 50 years.

In previous studies the reliable warming of the cold season of the year had been established which resulted in the drastic decrease in snow accumulation and in the reduction of frost penetration depth that had changed the mecha-

nism of moisture redistribution within the area. Earlier the recurrent (once every 4-7 years) intensive surface discharge of melted snow water into a hydrographic network was observed due to accelerated spring warming and snow melting when the soil was still frozen. At present such a discharge is absent as the spring snow melting occurs when the soil is not frozen and the snow cover is very thin. The years with complete absence of the snow cover are not uncommon now. This is why the surface water comes to the soil in situ. The positive effect of such mechanism of snowmelt is the improvement of plant supply with available moisture. However, the reduction in flood waters causes the general shallowing of local rivers and artificial ponds in natural hollows occurring everywhere. It should be noted, that settlements in arid regions are usually located just within the areas adjacent to such water reservoirs, and therefore the problem of artificial water supply to these settlements becomes so urgent at present. Thus, for the first time the problem of the deficient water supply to population in arid regions of the Russian Federation due to evident climatic changes has been emphasized. Similar global irreversible changes can take place due to reduction of the spring surface runoff over a greater part of the Eurasian continent affected by steady tendency to the warming of winter months. The elimination of these consequences needs development and application of interrelated political, social and economic methods of management in these territories.

SERRA LLOBET, Anna

& David Sauri

Research Group on Water Territory and Sustainability, Bellaterra, Spain

Turning hazards into resources? Climate change, floods and coastal wetlands in the Costa Brava (North-East Iberian Peninsula)

According to the IPCC Fourth Assessment, one of the most vulnerable areas in Europe are coastal zones. This is due to sea level rise combined with increased risks from storms. Coastal wetlands, in particular, are projected to be negatively affected by sea-level rise especially where they are constrained on their landward side, and lack sediment supply. Approximately 20 percent of existing coastal wetlands may disappear by 2080 because of the expansion of the sea. Mediterranean low-lying sedimentary coasts with highly diverse ecosystems appear to be the most vulnerable areas to this phenomenon.

The 4th IPCC Report also warns about the increasing likelihood of extreme events such as floods. However, for coastal wetlands (as well as for other ecosystems) floods need not to be considered necessarily a hazard. Rather, they could be seen as an important natural process contributing to ground-water recharge, to the provision of sediment loads to the coastal zone, and, more generally, to the equilibrium between fresh and salt water that, among other factors, make this transition areas so ecologically productive.

In this paper we want to present the case study of the “Aiguamolls de l’Empordà” natural park, located in the North of the Costa Brava, to illustrate the possible benefits of larger floods originating from climate change for coastal wetlands. However, for this benefits to materialize it is fundamental to improve adaptation to flooding through a new management philosophy that accepts the axiom of “living with floods” rather than the usual, policy of minimizing or eliminating the hazard though hydraulic control works. Through mechanisms such as land use control, the adaptation of the built environment to flooding and compensatory mechanisms such as insurance, security can be enhances and floods may play a very important role in redressing the effects of sea level rise.

SERVONNAT, Jérôme

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& P. Yiou, (LSCE), Gif sur Yvette, France

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Intra-annual climate variability in the North Atlantic during the last millennium : influence of the solar forcing in the IPSLCM4v2 climate model

This work is part of the ANR ESCARSEL project, whose aim is to reconstruct the climate of the last millennium with both simulations and data. We present here the results of simulations realized with the last version of the IPSL coupled model (IPSLCM4v2), and with the solar forcing provided by Crowley (2004). We investigate the intra annual variability over the North Atlantic domain during different periods through diagnostics on the seasonal cycle, occurrences of extremes such as heat waves, and evolution of atmospheric circulation patterns with the characterization of weather regimes.

SHMILOVICI LEIB, Armin

Information Systems Engineering Department, Ben-Gurion University, Beer-Sheva, Israel

A Web-application for local forecasting of micro-climate and particle flow in air

The local gradient of air-borne particles depends on the source of their origin, local winds and meteorological conditions, and the surface structure. Current weather sensors provide only static measurements of the current particle pollution in the proximity of the sensor. In the case of a momentary massive environmental event (such as following an explosion in a quarry) it can not predict the progress of the cloud of particles in the vicinity of the sensor, based on the temporal meteorological conditions (e.g., wind direction). The availability of small computerized weather stations, together with communication to meteorological sources of data and cheap computer technology makes it possible to make real-time meteorological predictions. The purpose of this research is to construct a prototype of a system which can give real-time local and temporal prediction (range of 1-3 Km) for the gradient of particles in the air (such as in the form of ellipsoids). An internet web-site is constructed which presents the predictions for the gradient in the concentration of particles in the following minutes. A prediction horizon of a just a few minutes may be sufficient to warn local population at risk to take shelter in case a cloud of pollutants is bound to pass over their heads.

SYROESHKIN, Anton

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& Lapshin V.B., Russian Foundation for Basic Research

Influence of the warming of West Arctic on circulation of viruses and bacteria in costal biogeocenoses

Climate change in West Arctic leads to changes in biogeocenoses. The most sensitive ones are costal and marine biogeocenoses. In recent years a sharp raise was discovered in the amount of heterotrophic bacterioplankton in the surface microlayer (SML) of Barents and Karskoye seas. This could have resulted from the abnormal warming in the West Arctic. There is new data

suggesting of a new emerging natural source of infectious diseases of birds and sea mammals that has been formerly unknown. Activation of coastal and marine natural sources of viral diseases and contamination of the water-contact air by the bacterial toxins that can lower immunity, will contribute to increased infection rate in migrating birds. These birds will then spread the diseases along the meridian routes bringing them from Arctic to Europe and Africa. The joint research conducted by State Institute of Oceanography, Peoples' Friendship University and D.I.Ivanovski Virology Institute resulted in finding of a dangerous increase in circulation of Influenza A virus in bird colonies in the resort of Seven Islands and Baidaratskaya Guba. The critical role in these natural sources of infection is now played by an abiotic factor that is concentration of viruses in the surface microlayer followed by further transmission in the air. We have researched the presence and sea-air transfer of influenza A virus in the Northern coast of Kolsky peninsula including the "Seven Islands" resort; Yamal coast of the Baidaratskaya Guba. The kinetic modeling of dependence of circulation of influenza A in coastal arctic zones on temperature let to show the trigger increasing of the virus in SML during global warming. It has been determined that the outbreak of the viral activity in marine coastal ecosystem would be at the temperature of SML near 12 °C for the hydrometeorological conditions of Seven Islands resort .

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A new methodology to estimate climate sensitivity

Uncertainty in climate sensitivity is a fundamental problem for projections of future climate change and poses a difficulty to informing climate change policy. Climate sensitivity is defined as the equilibrium response of global-mean surface air temperature to a doubling of the atmospheric CO₂ concentration from the preindustrial level (280 ppm). In spite of various efforts to estimate its value by using historical observations, climate sensitivity is still not well constrained. Furthermore, how the uncertainty in climate sensitivity changes in the future with the acquisition of new observations is also an important input to current decision-making on climate policy.

This study presents a new methodology to estimate climate sensitivity, which

uses an inverse estimation for the Aggregated Carbon Cycle, Atmospheric Chemistry, and Climate model (ACC2) (Tanaka, 2008). This approach focuses on best estimates of a large number of uncertain parameters, rather than probability density functions for a restricted set of parameters. This feature allows us to consider a large degree of freedom in the uncertainty in radiative forcing and also to perform an inversion for carbon cycle and climate components simultaneously, both of which have been overlooked in previous studies (IPCC, 2007, pp.798-799). Note that the model ACC2 and its inversion are programmed in GAMS and technically feasible for coupling with economy models such as DICE.

Our results suggest that uncertainty in historical radiative forcing has not been sufficiently considered in previous studies – including these uncertainties in the analysis implies that climate sensitivity is much less constrained at the high end than previously thought (Tanaka et al., 2008). How we learn about climate sensitivity over time is significantly influenced by how we account for the uncertainty in radiative forcing (Tanaka and O’Neill, 2008). Including a carbon cycle feedback, which in principle offers an additional constraint on climate sensitivity, does not reduce the uncertainty in climate sensitivity due to the poor knowledge of the global carbon budget before the year 1850 (Tanaka et al., 2008). In the future, better prediction skills of the decadal and multi-decadal variability in temperature are important to estimate climate sensitivity efficiently.

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Pollen-based reconstructions of the Late Quaternary vegetation and climate dynamics in northern Eurasia: advances and problems

Pollen analysis as a technique for reconstructing vegetation by means of the pollen grains it produced was born in 1916, when Swedish geologist Lennart von Post (1884-1951) presented first percentage pollen diagram at the meeting of the Swedish Geological Society held in Kristiania (modern Oslo). Among the pioneers of pollen analysis who made a great contribution to the development of the method and its practical application the names of G. Erdtman, F. Firbas, K. Faegri, G. Iversen and V.P. Grichuk should be also mentioned. In the beginning, the use of technique was limited to the study of arboreal pollen grains preserved in the Holocene peat and bog deposits with

the aim of their stratigraphic correlation. Today, pollen analysis is by far the most important method for the reconstruction of past flora, vegetation and environment through geological history. Objective reconstructions of the past climate and vegetation are among the priority tasks for the scientific community, working in the field of the past global changes and the Earth's system modelling (Joussaume and Taylor, 1995; Prentice and Webb, 1998; PAGES:

<http://www.pages.unibe.ch/>). This research is focused on pollen-based reconstruction of the late Quaternary vegetation and climate in northern Eurasia. Our original task was to design the powerful quantitative methods objectively reconstructing major vegetation types and woody cover at the local to regional scale and producing results, which are suitable for the global scale analysis and inter-regional comparison. To improve our knowledge about the late Quaternary climate and environment at a regional scale is another major task of palaeobotanical research. We aimed to address the key problems of regional vegetation and climate dynamics in several palaeoclimatically sensitive areas of northern Eurasia, contributing to several regional projects, e.g. Pole-Equator- Pole (PEPIII) project (Battarbee et al. 2004), Natural Climate Variations from 10,000 Years to the Present Day – KIHZ (Fischer et al. 2004), a multidisciplinary German–Russian research project “Taymyr” (Melles et al. 1996), Asian Lake Drilling Project (Yasuda 2000), CONTINENT Project focused on the climatic history of Lake Baikal, Siberia (Oberhänsli and Mackay, 2005), and to the DFG “INTERDYNAMIC” Research Program (DFG TA 540/1). The aim of the presentation is to present recent examples of the quantitative pollen-based reconstructions done in the region between the Urals and Japan and to outline the advances and shortages of the reconstructing methods in northern and central Asia.

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Postglacial climate and vegetation changes in the montane area of southwestern Bulgaria; paleobotanical and archaeological record

The postglacial environmental changes in the montane area of southwestern Bulgaria were reconstructed by complex investigation of lake sediments

with the application of pollen analysis, plant macrofossil determination and radiocarbon chronology. The local glaciers retreated ca. 20000-18000 yrs. ago and during the Lateglacial stadials in the conditions of a dry cold climate was distributed mountain-steppe herb vegetation dominated by Artemisia-Chenopodiacea-Poaceae with groups of Pinus and shrubland of Juniperus/Ephedra. This vegetation pattern partly retreated during the Bølling/Allerød climate improvement. At elevation below 1000 m were preserved groups of deciduous and coniferous trees. The Holocene vegetation succession was triggered by the rapid amelioration of the climate. Four chronologically well-delimited vegetation stages were recognized: a) 11500-7900 cal. yrs. BP forests of Betula with Pinus (*P. sylvestris*, *P. peuce*) and below them mixed Quercus forests; b) 7900-5400/5200 cal. yrs. BP shaping of a coniferous belt with Pinus and Abies when the climate changed to more humid with milder winters and cooler summers; c) 5400/5200-3000 cal. yrs. BP final establishment of the last tree immigrants (*Fagus*, *Picea*); d) 3000 cal. yrs. BP till present formation of the modern vegetation vertical zonation and profound destructive changes in the natural forest cover. The favourable climate conditions in the area were the main reason for its early Neolithisation when the farmers from Anatolia migrated with their animals to the Balkans after the 8200 cal. yrs. BP cold event which had caused drought in the Eastern Mediterranean. The increase in the number of settlements in the valleys and foothills of the mountains has intensified the human activities agriculture, cattle-breeding, fires, tree felling. The incidence of the human impact has expanded after 4300 cal. yrs. BP (Late Bronze Age) proved by an increase of the anthropogenic pollen indicators and the charred fragments of wood preserved in the archaeological sites.

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Overview of recent destruction of tufa palustrine systems in Spain. Environmental and anthropogenic causes

Fresh water fluviolacustrine carbonates are of main interest to archaeologists and paleoenvironmental scientist as important environmental archives and for their contribution to landscape and habitat of ancient human settlements Iberian Peninsula, due to its important surface of carbonate rock outcrops

and karstic aquifers, offers an impressive number of tufa fluviolacustrine system remains, similar to the well know examples of Plitvice National Park, Croatia, and Huanglong Scenic District, China. Although some examples of functional nowadays depositing systems are protected by Natural Park figures, there is a widespread evidence of dead fluviolacustrine rivers, which have been destroyed recently, from early Holocene to historical times. Intense human occupation has been claimed to be responsible for such important shift in fluvial behaviour from chemical to detritic sedimentation, meanwhile climatic influence in amount water available from karstic aquifers has received less attention.

Evaluation of sedimentary tufa remains dated in occasions by relative archaeological evidences and by historical maps is presented in this work to give an overview map of Spanish disappeared fluviolacustrine systems throughout its geography.

Main human actions attributed to be of principal causes of degradation and destruction of tufa depositing rivers during last millennia are summarized, and evaluation of current active barrages and its future attending to climatic and human pressure scenarios are presented

Contrasting palaeoclimatological and historical climatic data with geomorphologic and historic evidence of degradation of tufa systems allows to conclude the human factor as principal factor disestablishing ecological equilibrium needed to maintain such fragile wetlands.

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Rapid climate change: an overview for economists

The possibility of future rapid climatic changes is a pressing concern amongst climate scientists. For example, an abrupt collapse of the ocean's thermohaline circulation would rapidly cool the northern hemisphere and reduce the net global primary productivity of vegetation, according to computer models. It is unclear how to incorporate such low-probability, high-impact events into the development of economics policies. This paper reviews the salient aspects of rapid climate change relevant to economists and policy-makers. The main scientific certainties and uncertainties are

clearly delineated, with the aim of guiding economics goals and ensuring that they retain fidelity to their scientific underpinnings.

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Setting cumulative emissions targets to reduce the risk of ‘dangerous’ climate change

The ultimate objective of climate change mitigation is to reduce the amount of anthropogenic greenhouse gas (GHG) emissions in order to achieve “stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system” (UNFCCC, Article 2). This statement raises a number of questions regarding (i) what “dangerous interference” means, (ii) what GHG concentration level may be considered “safe”, and (iii) what emissions pathway should be taken towards stabilization. Here we present a novel approach to coupled climate-carbon cycle modelling which allows one to estimate the probability that any given level of greenhouse gas emissions will exceed specified global mean temperature thresholds for “dangerous anthropogenic interference”, taking into consideration uncertainties in climate sensitivity and the carbon cycle response to climate change. Results obtained within this framework can serve as a basis for selecting a greenhouse gas emissions level given a global mean temperature target and an overshoot probability that society is willing to accept. For instance, we show that in order to stabilize global mean temperature at 2°C above pre-industrial levels with a probability of at least 0.66, cumulative CO₂-equivalent emissions after 2000 must not exceed a best estimate of about 640 PgC, independent of the path taken to stabilization.

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Present-day geomorphological changes in polar regions

The landscape uniqueness of polar zone manifests itself in morphological traces of older glaciations and marine transgressions, areas of present-day glaciations, multi-year permafrost, multi-year snow covers, deglaciation processes variable in time and space and resulting in an expansion of ice-free

areas, multi-directional geosuccession, and finally in the various responses of the Arctic peoples to landscape changes and the growing human impact. The abrupt landscape changes taking place over a period shorter than the life span of a single generation can be due to a wide variety of natural causes, whether endogenous or exogenous, or to the increasing, multi-directed human activity. At present, however, their principal cause is believed to be climate change at a variety of spatial scales. The paper presents examples of contemporary changes of morphologic surfaces from all the territory of the Arctic and Antarctica. Among the most significant environmental changes noted in the polar regions, can be list the following:

- air temperatures frequently exceeding the hitherto absolute maxima,
- an increase in annual precipitation totals, first of all in the form of rain, also during the cold period,
- cold periods becoming milder and shorter,
- transitional periods becoming longer: spring coming earlier and autumn ending later,
- a decrease in the thickness, persistence and area of the sea-ice cover,
- an increase in the number of icebergs from intensively calving glaciers,
- an increase in the temperature and a decrease in the salinity and density of ocean waters; changes in the thermohaline circulation,
- an increase in the level of the world ocean,
- intense ablation and rapid recession of the majority of polar glaciers,
- a decrease in the area of nival covers,
- intensive thawing of multi-year permafrost, mainly in continental parts,
- changes in the water cycle manifested by an increase in the surface runoff in streams and a shortening of the period of freezing of streams and lakes,
- an increase in the area of some wetlands and a decrease in others,
- a northward shift of geoecological, including vegetation, zones,
- changes in the carbon cycle in the geoeosystems manifesting themselves in an increase in biogenic carbon dioxide and methane, and
- an increase in the frequency and magnitude of forest fires.

All those symptoms of climate change affect the terrestrial geoeosystems of polar regions to a greater or lesser degree. The ever-growing role of rock geoeosystems, crucially dependent on glacier and nival geoeosystems, results from intensive glacier recession and the melting of permafrost and snow covers. The polar research to date and scenarios of development of polar regions indicate that the polar landscapes have been undergoing rapid changes recently.