PARLAMENTO EUROPEO EVROPSKÝ PARLAMENT EUROPA-PARLAMENTET
EUROPÄISCHES PARLAMENT EUROOPA PARLAMENT ΕΥΡΩΠΑΪΚΟ ΚΟΙΝΟΒΟΥΛΙΟ EUROPEAN PARLIAMENT
PARLEMENT EUROPÉEN PARLAMENTO EUROPEO EIROPAS PARLAMENTS
EUROPOS PARLAMENTAS EURÓPAI PARLAMENT IL-PARLAMENT EWROPEW EUROPEES PARLEMENT
PARLAMENT EUROPEJSKI PARLAMENTO EUROPEU EURÓPSKY PARLAMENT
EVROPSKI PARLAMENT EUROOPAN PARLAMENTTI EUROPAPARLAMENTET

**TEMPORARY COMMITTEE ON CLIMATE CHANGE**

**Information package for the 1st CLIM public hearing**

**"CLIMATE IMPACT OF DIFFERENT LEVELS OF WARMING"**

# Table of contents

# 1. Introduction by theme leader Mr Vittorio PRODI, MEP

The Temporary Committee on Climate Change is finally entering the heart of the debate that will allow the EP to take political decisions. The perception is that global warming and the ensuing climate change are both very urgent. Concrete measures must be taken to reverse the pattern of climate change in order to protect both current and future generations.

The Committee has set up this thematic session to gather the basic knowledge and form a shared basis for a political action.

Keynote speaker Prof. Schellnhuber and other eminent specialists invited are asked to share with the Members of the committee the latest development of the knowledge together with the uncertainties, in particular regarding the available models and the degree of regional details concerning global warming that can be expected on the basis of the scientific research efforts.

Specific topics and examples of the existing knowledge as applied to particular problems, like the impact on the cultural heritage, will also be covered by the expertise of our guests.

The EP wanted this Temporary Committee as a mean for developing a systemic response: as legislators, our task is to guarantee the best possible legislative framework so that each sector of society (individuals, conurbations, industry) can play its part in moving towards a more sustainable type of existence.

It is not any more only an environmental issue: we must seriously commit ourselves to R&D in order to develop new sources of energy and techniques but also R&D in view of evolving new sustainable environmental techniques.

But EU should not fight alone. We need to display the highest innovation in international relations to find the global consensus needed for an effective action. We have also to be available to change our habits of production and consumption. It means in short being available to create a new civilization.

# 2. Draft Programme

**TEMPORARY COMMITTEE ON CLIMATE CHANGE**

**Thematic Session**

**"CLIMATE IMPACT OF DIFFERENT LEVELS OF WARMING"**

**Monday, 10.09.2007, 15:00-18:30**

**European Parliament, Brussels, room ASP 3E2**

**Chairman: Guido Sacconi MEP**

**15.00 Opening session**

**Mr Guido SACCONI**, MEP, Chairman of the Temporary Committee on Climate Change

**Mr Karl-Heinz FLORENZ**, MEP, Rapporteur for the Temporary Committee on Climate Change

**Mr Vittorio PRODI**, MEP, Theme leader

**Keynote speaker: Prof. Hans Joachim SCHELLNHUBER**, Director of the Potsdam Institute for Climate Impact Research, Germany: *What is dangerous climate change?*

**15.45 Part 1**

**Prof. Jean-Pascal VAN YPERSELE**, Vice-Chair of IPCC Working Group II, Catholic University of Louvain, Belgium: *Which impacts for which warming? - The IPCC latest assessment*

**Mr Michel JARRAUD**, Secretary General of the World Meteorological Organisation, Switzerland: *Climate change and sustainable development – a WMO perspective*

**Dr. Richard LINDZEN**, Massachusetts Institute of Technology, USA: *Global warming: finding the answer or prolonging the issue*

**Prof. Sir Brian HOSKINS**, Dept. of Meteorology at the University of Reading, UK: *Climate change: a status report from a scientific perspective*

**Debate**

**17.00 Part 2**

**Prof. Dr. Robert WATSON**, School of Environmental Sciences, University of East Anglia, United Kingdom: *Climate Change: The need to adapt*

**Prof. Javier MARTIN-VIDE**, Professor of Physical Geography, University of Barcelona, Spain: *A decalogue of climate change*

**Dr. Malte MEINSHAUSEN**, Researcher at the Potsdam Institute for Climate Impact Research (PIK), Germany: *Emission pathways and concentration levels under a 2 ºC climate target*

**Dott.ssa Cristina SABBIONI**, Istituto Scienze dell'Atmosfera e del Clima, Italy: *Global climate change impact on our cultural heritage*

**Debate**

## 18.15 Conclusions

**Mr Vittorio PRODI**, MEP, Theme leader

## 18.20 Closing remarks and closure of the meeting

**Mr Karl-Heinz FLORENZ**, MEP, Rapporteur for the Temporary Committee on Climate Change

**Mr Guido SACCONI**, MEP, Chairman of the Temporary Committee on Climate Change

## 3. Prof. Hans Joachim SCHELLNHUBER: *What is dangerous climate change?*

Climate change is an unintended side-effect of modern social development and at the same time poses the greatest long-term threat to it. This insight was disputed by influential circles until a short time ago, but recent scientific studies have proven the anthropogenic disturbance of the Earth's atmosphere beyond doubt, and have shown the extent of the damage to be expected to the natural environment and civilization if no counteractive measures are undertaken.

The first part of the lecture will illuminate the present climate change and consequences which can already be witnessed: an increasing number of floods, heavy storms, forest fires and other extreme weather events. It also shows the dramatically increasing economic losses caused by climate change.

The second part will present different developments of global warming with respect to varying emission scenarios. It outlines the main risks associated with a business-as-usual practice. In this context regional changes in precipitation, melting glaciers and ice sheets as well as a rising sea level have to be mentioned. These examples will lead to an introduction of the tipping elements of the Earth system.

With respect to the agenda of the committee the main part of the lecture will explain the aim to limit global warming to 2 degrees Celsius above pre-industrial temperatures. It shows that this ambitious goal is not only scientifically justified but also both economically and ethical imperative.

**CURRICULUM VITÆ**

***of Professor Hans Joachim Schellnhuber CBE***

*Potsdam Institute, Germany, Oxford University, UK, Tyndall Centre, UK*

Born in 1950 in Ortenburg (Germany). Training in physics and mathematics with a scholarship for the exceptionally gifted at the University of Regensburg. Doctorate in Theoretical Physics in 1980. Various periods of research abroad, in particular at several institutions of the University of California system (USA). Habilitation (German qualification for professorial status) in 1985, then Heisenberg Fellowship. 1989 Full Professor at the Interdisciplinary Centre for Marine and Environmental Sciences (ICBM) at the University of Oldenburg, later Director of the ICBM.

1991 Founding Director of the Potsdam Institute for Climate Impact Research (PIK); since 1993 Director of PIK and Professor for Theoretical Physics at the University of Potsdam. 2001-2005 additional engagement as Research Director of the Tyndall Centre for Climate Change Research and Professor at the Environmental Sciences School of the University of East Anglia in Norwich (UK). Distinguished Science Advisor for the Tyndall Centre since 2005.

2002 Royal Society Wolfson Research Merit Award; 2004 CBE (Commander of the Order of the British Empire) awarded by Queen Elizabeth II. Elected Member of the Max Planck Society, the German Academy Leopoldina, the US National Academy of Sciences, the Leibniz-Sozietät, the Geological Society of London, and the International Research Society Sigma Xi. Ambassador for the International Geosphere-Biosphere Programme (IGBP). Visiting Professor in Physics, Honorary Member of the Christ Church College High Table, and Senior James Martin Fellow at Oxford University.

Active service on some dozen national and international panels for scientific strategies and policy advice on environment & development matters. Inter alia, Vice-Chair of the German Advisory Council on Global Change (WBGU), Chair of the Global Change Advisory Group for the 6th Framework Programme of the European Commission and Member of the corresponding panel for FP7, Member of the Scientific Board of the Dahlem Conferences, Member of the Committee on Scientific Planning and Review of the International Council for Science (ICSU), Member of the Board of the Stockholm Environment Institute (SEI).

Chief Government Advisor on Climate & Related Issues for the German G8-EU twin presidency in 2007; Member of the High-Level Expert Group on Energy & Climate Change advising J.M.Barroso, President of the European Commission.

Member of the Editorial Boards of the scientific journals ” “Proceedings of the National Academy of Sciences” Climatic Change”, “Climate Policy”, “Gaia”, “Integrated Assessment”, and “Systems Analysis, Modelling, Simulation”.

About 200 articles and about 40 books in the fields of condensed matter physics, complex systems dynamics, climate change research, Earth System analysis, and sustainability science.

# 4. Prof. Jean-Pascal VAN YPERSELE: *Which impacts for which warming? - The IPCC latest assessment*[1]

KEYWORDS : climatic change, climate impacts, IPCC

Climate change due to human activities is happening now. The massive combustion of fossil fuels since the industrial revolution increased the atmospheric concentration of carbon dioxide, the main anthropogenic greenhouse gas, by 35% between 1750 and 2005. The additional infrared heat trapping due to this change in atmospheric composition will inevitably continue to increase the average global surface air temperature and modify the Earth's climate. In its fourth Assessment Report (AR4, 2007), the Intergovernmental Panel on Climate Change (IPCC) Working Group I reports that in the absence of climate protection policies, continued emissions are likely to increase this global temperature by 1.6 to 6.9°C between the pre-industrial period and 2100, depending on which scenario and model is used. Such rates of global climate change are much more rapid and very unusual in the context of changes over the past two million years. Besides changes in the average climate, the probability of occurrence of heat waves (virtually certain), heavy precipitation events (very likely), intense tropical cyclones (likely), and extreme high sea level (likely) is due to increase in a warming climate.

IPCC Working Group II assessed the impacts that would accompany such warming. For the lowest temperature increase, crop productivity would increase slightly at mid- to high latitudes but decrease at lower latitudes, especially in seasonally dry and tropical regions; hundreds of millions of people would be exposed to increased water stress; up to 30% of living species would be at increasing risk of extinction, coral bleaching would increase; coastal regions would be subjected to increased damage from flood and storms, heat waves, floods, and droughts would induce increased morbidity and mortality. Damage increases in most areas for higher temperature increases. For example, around 2.5°C above the pre-industrial value, most corals would be bleached and terrestrial biosphere would tend towards a net carbon source (hindering hopes to compensate fossil fuel emissions with forest projects…). Above 3.5°C, millions more people could experience coastal flooding each year. If the global average warming was remaining in excess of 1.9°C to 4.6°C, the bulk of the Greenland Ice Sheet would melt and contribute about 7 m to sea level rise over the millennia. In general, the net annual costs of the impacts of climate change are projected to increase over time as global temperatures increase. While developing countries are expected to experience larger percentage losses, global mean losses due to climate change could be 1 to 5% GDP for 4°C of warming. Overall, the "reasons for concern" put forward by the IPCC in 2001 are confirmed and strengthened.

[1] Invited talk at the Thematic Session "Climate impact of different levels of warming", Temporary Committee on Climate Change, Brussels, Belgium, 10 September 2007

The good news from IPCC (Working Group III) is that for the lowest range in concentration stabilization levels assessed, 445 to 535 ppm of CO2-equivalent (which means that global CO2 emissions need to peak before 2015-2020 and leads in the long term to a temperature increase between 2 and 2.8°C above pre-industrial), the reduction of average annual GDP growth rate is less than 0.12 percentage points in 2050.

Knowing that climate change is threatening the livelihood, the water resources, the food security of hundreds of millions of people; knowing that 20-30% of plant and animal species assessed so far are likely to be at increased risk of extinction if increases in global temperature exceed 1.5 to 2.5°C above the 1990 temperature, is that price for mitigation (a reduction of average annual GDP growth rate of less than 0.12 percentage points) too expensive?

It is NOT for the IPCC to answer that question. The IPCC shows what the problems are, what caused them, and options for moving forward. But its reports are now on your table.

A final note: If the IPCC has acquired the weight it has, I think it is essentially because of three factors: 1) a large number of the best scientists are involved in the writing of its reports, 2) three cycles of reviews take place (by experts and governments) with thousands of comments that are taken into account, and 3), the final approval Plenary for the Summary for Policy Makers (SPM) involves both the main authors of the Report and official delegations of over 120 countries, which means that the consensus at the end reflects not only the scientists viewpoints, but also the policy makers'. Please note that, because of the elaborated review procedure, and because of the efforts by some delegations to dilute the SPM, the IPCC reports are certainly not exaggerating anything. They try to tell the truth, however inconvenient it might be.

(NB: many elements from the presentation will be based on the Fourth assessment report from the Intergovernmental Panel on Climate Change – see www.ipcc.ch or www.climate.be/ipcc ).

**CURRICULUM VITÆ**

***of Professor Jean-Pascal van Ypersele***

*Vice-Chair of IPCC Working Group II, Université catholique de Louvain, Institut d'astronomie et de géophysique G. Lemaître, Chemin du Cyclotron 2, B-1348 Louvain-la-Neuve, Belgium. E-mail : vanypersele@climate.be Web : www.climate.be*

Jean-Pascal van Ypersele (Brussels, 1957) has a Ph. D. in Physics from the Belgian Université catholique de Louvain (UCL, 1986 with highest honours), based on work done at the U.S. National Center for Atmospheric Research (NCAR, Boulder, Colorado) on the effect of global warming on Antarctic sea ice. He has specialized in climate change modelling and the study of the impact of human activities on climate. He does it in an interdisciplinary perspective, and is also interested by the impacts of climate change on human activities and ecosystems. As professor at UCL (www.climate.be), he teaches, e.g., climatology, climate modelling, astronomy, geophysics, mathematical geography and environmental sciences, and directs the interdisciplinary Master programme in environmental sciences and management (www.cgse.ucl.ac.be). He was a lead author for the Third Assessment Report of the IPCC (Intergovernmental Panel on Climate Change, www.ipcc.ch ), and was elected in 2002 Vice-Chair of its Working Group on climate change impacts and adaptation. For the IPCC Fourth assessment, in addition to his responsibilities as member of the IPCC Bureau in charge of structuring and organizing the assessment, he chaired sessions at the Plenaries of the three Working Groups: Paris, Brussels (which he helped organize), and Bangkok.

Jean-Pascal van Ypersele is a member of the Belgian Federal Council for Sustainable Development (www.cfdd.be) since 1993, and he chairs its Working Group on "Energy and Climate". He has also been science advisor in the Belgian delegations to a dozen United Nations conferences including Rio (1992), Berlin (1995), Kyoto (1997), Buenos Aires (1998), Marrakech (2001), Delhi (2002), Milan (2003), Montreal (2005), and Nairobi (2006). The federation of environmental NGOs "Interenvironnement-Wallonie" gave him in 1999 a "Palm for the environment", he was nominated in 2000 by the Université libre de Bruxelles (ULB) for the « Jean Teghem Prize » for scientific vulgarization, and he received in 2006 from the International Polar Foundation the Special Prize "Energy and Environment Award 2006".

## 5. Mr Michel JARRAUD: *Climate change and sustainable development – a WMO perspective*

The Secretary-General of WMO has been invited to participate as an expert in a thematic session related to the Temporary Committee on Climate Change. He will provide a PowerPoint presentation and begin by recalling early international cooperation in meteorology, which started more than 150 years ago.

Within its specific competence area of climate, in 1976 WMO issued the first statement on the accumulation of CO2 in the atmosphere and the potential impacts upon the Earth's climate. WMO organized in 1979 the First World Climate Conference, which led to the establishment of the World Climate Programme. In 1988 WMO and UNEP jointly established the Intergovernmental Panel on Climate Change (IPCC), which has been since then instrumental in providing the most authoritative and unbiased assessments of climate change science, its potential impacts and available policy options.

In 1990, the Second World Climate Conference convened by WMO called for the establishment of a climate convention, which in 1992 resulted in the development of the United Nations Framework Convention on Climate Change (UNFCCC) and widespread recognition that future climate change policies will require the combined consideration of efficient energy, socio economic needs and sustainable development. WMO has recently begun planning a World Climate Conference-3 for 2009.

In the context of the IPCC physical science assessment, it is noted that the concentration of greenhouse gases remained stable for thousands of years and then abruptly increased over past the 200 years, which cannot be accounted for unless human factors are explicitly considered. Reference is also made to the inertia of emissions and warming dependence on projections of economic growth, use of fossil fuels and emission agreements.

In the context of climate change impacts and responses, it is noted that climate change will seriously affect health and welfare, in particular through heat waves, fires, insects, disease and sea level rise, which will affect millions, especially in the developing countries, LDCs and SIDS. Moreover, the effects will be most severe on impoverished countries, on account of their diminished food security and adaptive capacities. Ultimately, a strong combination of both adaptation and mitigation will be essential. Additionally, all relevant decisions will have to be science-based so, as a corollary, global observational networks will have to be maintained and improved, since they will provide continuous performance indicators on future climate change and on the adequacy of any mitigation measures being adopted.

While recognizing the competence, resources and collaborative structures of European meteorological and scientific institutions, it is also stressed that they will have to evolve in proportion to the magnitude of the climate change issue. Since climate change is

fundamentally a global issue, authoritative research will require access to truly global data. In addition, data quality and timeliness will be essential considerations.

However, many developing countries, in particular the LDCs and SIDS, may lack even minimal resources to maintain adequately their basic systems. These countries will therefore require some assistance to make their data widely available. WMO's perspective involves progress through partnerships among all stakeholders, in facing the consequences of climate change, which may be a challenge for the next thousand years. To do so successfully, it is necessary to act now.

**CURRICULUM VITÆ**
***of Mr Michel Jarraud***
*Secretary General of the World Meteorological Organisation*

Mr Michel Jarraud is Secretary-General of the World Meteorological Organization (WMO) since January 1st, 2004. WMO is the United Nations' specialized agency and authoritative voice on weather, climate and water (www.wmo.int). WMO coordinates the activities of the National Meteorological and Hydrological Services of its 187 Members.

Before joining WMO as Deputy Secretary-General in January 1995, Mr Jarraud devoted part of his career to the internationally renowned European Centre for Medium-Range Weather Forecasts (ECMWF). He was appointed Deputy Director of the Centre in 1991 having been Director of the Operational Department since 1990. From September 1978 to December 1985, he was a researcher in numerical weather prediction at the ECMWF. Mr Jarraud started his career with Météo-France, as a researcher (September 1976 - August 1978). He joined the French National Meteorological Service again in January 1986 as Director of the Weather Forecasting Department, until December 1989.

Mr Jarraud is a meteorologist with degrees from the prestigious French Ecole Polytechnique and the Ecole de la Météorologie Nationale. He is a member of the American Meteorological Society (USA), the Société Météorologique de France, the Royal Meteorological Society (United Kingdom), the African Meteorological Society and of Chinese Meteorological Society. He was also awarded a First Class Distinction (highest grade) by the Civil Defence of Venezuela, in recognition of services in relation to natural disasters, which affected the country in 1999.

Mr Jarraud is fluent in French and English and also speaks German. He was born in 1952 in Châtillon-sur-Indre, France. He is married and is the father of two children.

## 6. Dr. Richard LINDZEN:
## *Global warming: finding the answer or prolonging the issue*

The fundamental scientific aspects of the global warming issue have been maintained in fog of ambiguity since at least 1979. This is particularly but not exclusively the case with the crucial matter of climate sensitivity. It has been argued that the persistent appeal to consensus disguises the lack of real arguments. This is not true. Many relatively rigorous alternatives exist to the complete dependence on polling among modelers. It is easy to demonstrate the explicit errors in commonly presented claims and to explain the more rigorous tests. However, the rigorous tests point to low sensitivities which largely obviate most worrisome consequences of anthropogenic climate change.

**CURRICULUM VITÆ**
***of Dr. Richard Lindzen***
*Massachusetts Institute of Technology, USA*

Richard S. Lindzen (b. February 8, 1940 in Webster, Massachusetts) attended the Bronx High School of Science and Rensselaer Polytechnic Institute. He received his A.B. (1960), S.M. (1961) and Ph.D. (1964) degrees from Harvard University. The first degree was in physics; the last two were in applied mathematics. His thesis on the interactions of ozone chemistry, radiative transfer, and dynamics in the middle atmosphere brought him into the atmospheric sciences where he continues to work and teach. He was a postdoctoral fellow at both the Universities of Washington (1964-65) and Oslo (1965-66). He was a research scientist at the National Center for Atmospheric Research (1966-68). He taught at the University of Chicago (1968-1972) before moving to Harvard University where he held the Burden Chair in dynamic meteorology and served as director of the Center for Earth and Planetary Physics. Since 1983, he has been the Alfred P. Sloan Professor of Meteorology at M.I.T. He is a member of the National Academy of Sciences, and the Norwegian Academy of Science and Letters, and a fellow of the American Academy of Arts and Sciences, the American Geophysical Union, the American Association for the Advancement of Science, and the American Meteorological Society. He is a recipient of the Macelwane medal of the American Geophysical Union, and of the Meisinger and Charney Awards of the American Meteorological Society. He was the 1997 A.M.S. Haurwitz Lecturer. In 2006, he received the Leo Prize from the Wallin Foundation in Goteborg, Sweden. He has been a Japanese Society for the Promotion of Science Fellow at Kyushu University, the Vikram Amblal Sarabhai Professor at the Physical Research Laboratory, Ahmedabad, India, a Lady Davis Visiting Professorship at The Hebrew University, a Sackler Visiting Professor at Tel Aviv University, the Landsdowne Lecturer at the University of Victoria and a National University Lecturer at the University of Hokkaido. He is the coauthor (with the late Sidney Chapman) of a monograph, Atmospheric Tides, the author of Dynamics in Atmospheric Physics, a co-editor (with Edward Lorenz and George Platzman) of The Atmosphere - A Challenge: The Scientific Work of Jule Gregory Charney, and the author or co-author of over 200 papers in the scientific literature. He was also a lead author of the IPCC Third Assessment Report, and has served on numerous panels of the National Research Council, the Council of the American Meteorological Society and the Corporation of the Woods Hole Oceanographic Institution.

Professor Lindzen's scientific interests include the dynamics of the earth's climate and its atmosphere's general circulation, the middle atmosphere, and planetary atmospheres. He has contributed to the theory of hydrodynamic instabilities and waves. His work has provided explanations of a variety of atmospheric phenomena including atmospheric tides, the quasi-biennial oscillation of the tropical stratosphere, the super-rotation of the atmosphere of Venus, and the generation of upper atmospheric turbulence by breaking internal gravity waves. His current research is on the climate sensitivity of the earth to radiative forcing, on the factors which determine the equator-to-pole temperature differences, and on the nature and role of atmospheric convection.

# 7. Prof. Sir Brian HOSKINS:
## *Climate change: a status report from a scientific perspective*

The 2007 IPCC provides an authoritative assessment of the status of climate change science, which has taken account of reviews by a very wide range of the community. My views in general are consistent with its conclusions.

There is an impressive range of observational information consistent with the general warming of the climate system in the past century.

Green house gases play a very important role in the radiative balance of the planet. The most important is water vapour. After this come carbon dioxide and other gases whose concentrations are being increased by emissions associated with human activity.

The magnitude of the observed warming is broadly consistent with the results from a range of models of differing complexities when forced with the additional greenhouse gases somewhat compensated by the impact of aerosols, also due to human activity.

Natural variability associated with solar variability is not negligible, but all the current evidence and understanding suggest that it is of lesser importance.

The complex climate system models are based on the laws of physics applied to the air, water and ice. The representation of processes in them is based on detailed observation and modelling. Aspects of climate models are tested routinely in e.g. weather forecasting, seasonal predictions, and simulations of particular climate phenomena and periods.

Current models suggest that the surface temperature will continue to rise to 2030 by about 0.2C/decade with little dependence on the actual course of human activity. After 2030 there is a strong dependence on human activity now and in the future. For example the chances of the globally averaged surface temperature exceeding 2ºC by 2100 range from less than 50:50 for stabilisation at double pre-industrial levels of carbon dioxide equivalent to very likely if emissions continue to grow as they are now. In the latter case current models suggest there is a significant possibility the rise by then could be 5ºC.

Large regional climate changes could be expected to be associated with such global changes but in general there can be little confidence in current predictions of them. However there can be expectations of

- much larger temperature changes over northern continents
- enhancement of tropical contrasts in wet and dry regions
- more heavy precipitation events.

Current model predictions are for average sea level rise by the end of the century to probably be in the range 0.2-0.4m, with the dependence on the scenario for human activity in the 21st century having its impact in later centuries. If recent accelerated ice

loss from Greenland is associated with the warming that has occurred, then higher sea level rise would be expected.

The continued reduction of late summer Arctic sea ice is expected to continue and under some scenarios its seasonal disappearance is considered likely.

Our understanding of the climate system is incomplete and our models of it are imperfect. To make progress, sceptical questioning and probing is essential as in all science. However, there is very high confidence that we are perturbing the Earth's climate system in a significant manner. There is no indication of a particular critical level of atmospheric greenhouse gases above which the consequences suddenly become more severe, but they can be considerably diminished by a reduction in emissions consistent with stabilisation at as low a level as possible, e.g. double pre-industrial carbon dioxide equivalent.

Adaptation to climate change that is inevitable requires a much enhanced ability to predict the probabilities of regional climate 10-50 years in the future. This is perhaps the Grand Challenge for science in the first part of this century.

**CURRICULUM VITÆ**

***of Professor Sir Brian Hoskins, CBE, FRS***

*Dept. of Meteorology at the University of Reading, UK*

***Name:*** Brian John HOSKINS

***Place of Birth:*** Bristol, England. ***Date of Birth:*** 17 May 1945.

***Education:***

| | |
|---|---|
| 1966: | BA (First Class Hons.) Mathematics, University of Cambridge. |
| 1967: | Distinction in Part III Mathematics, University of Cambridge. |
| 1970: | PhD in Mathematics, University of Cambridge. |

***Employment:***

| | |
|---|---|
| 1970-71: | Post-doctoral Fellow in the Advanced Study Program at NCAR. |
| 1971-72: | Post-doctoral Fellow in the Atmospheric Modelling Group, University of Reading. |
| 1972-73: | Visiting Scientist, GFDL, Princeton. |
| 1973-92: | Group Leader of the Atmospheric Modelling Group, University of Reading. |
| 1976-81: | Reader in Atmospheric Modelling, University of Reading. |
| 1981-date: | Professor of Meteorology, University of Reading |
| 1990-96: | Head, Department of Meteorology, University of Reading. |
| 1990-date | Holder, Established Chair in Meteorology, University of Reading. |
| 1996 (Sept): | Visiting Professor, Isaac Newton Institute, University of Cambridge. |
| 2001-date | Royal Society Research Professor |

***Awards and Honours:***

| | |
|---|---|
| 1972: | L.F. Richardson Prize (Royal Meteorological Society). |
| 1976: | Buchan Prize (Royal Meteorological Society). |
| 1982: | Symons Memorial Lecture (Royal Meteorological Society). |
| 1985: | Fellow of the American Meteorological Society. |
| 1987: | Charles Chree Silver Medal (Institute of Physics). |
| 1988: | Carl-Gustav Rossby Research Medal (American Met. Society). |
| 1988: | Fellow of the Royal Society. |
| 1990: | Member of Academia Europaea. |
| 1993: | Corresponding Academician, Real Academia de Ciencias y Artes de Barcelona. |
| 1995: | Third Bernard Haurwitz Lecturer (American Met. Society) |
| 1997: | Vilhelm Bjerknes Medal (European Geophysical Society) |
| 1998: | Commander of the British Empire (for services to Meteorology) |
| 1998: | Honorary Professor, Chinese Academy of Sciences |

| | |
|---|---|
| 2001 | Honorary Fellow, Royal Meteorological Society |
| 2002 | Foreign Associate, USA National Academy of Sciences |
| 2002 | Foreign Member, Chinese Academy of Sciences |
| 2007 | Knighted for Services to Environmental Sciences |

***Named Lectures*** include

| | |
|---|---|
| 1982: | Symons Memorial Lecture, Royal Meteorological Society |
| 1989: | Starr Memorial Lecture, MIT |
| 1995: | Bernard Haurwitz Lecture, American Meteorological Society |
| 1997: | Gal-Chen Lecture, University of Oklahoma |
| 1999: | IUGG Plenary Lecture |
| 2002 | George S Benton Lecture, John Hopkins University |

***International Activities*** include

| | |
|---|---|
| 1983-87: | President of Dynamical Commission of IAMAP. |
| 1985-88 and 1998- 2005 | Member of the Scientific Advisory Committee of the European Centre for Medium-Range Weather Forecasts (Chairman, 1987-88). |
| 1986-date: | Member of the Academic Committee of the Laboratory for Numerical Modelling of the Atmospheric Sciences and Geophysical Fluid Dynamics, Academia Sinica. |
| 1991-95: | President of the International Association of Meteorology and Atmospheric Sciences (IAMAS). |
| 1993-2002 | Member of Scientific Advisory Committee for Max-Planck Institute, Hamburg. |
| 1995-2004: | Member of the Joint Scientific Committee of World Climate Research Programme (WMO/ICSU) (Vice-Chair, 2000 –04, Chair of 2005-15 Strategy Group, 2003-5). |
| 2005- date: | Inter-governmental Panel for Climate Change Fourth Assessment Report, Review Editor for Ch.3 and Author for Technical Summary. |

***Previous National Activities*** include

| | |
|---|---|
| 1988-94: | Council Member of the Natural Environment Research Council |
| 1990-92: | Scientific Director of the Universities' Global Atmospheric Modelling Programme |
| 1990: | Special Advisor to the Secretary of State for Transport |
| 1994-96: | Chairman of Inter-Agency for Global Environmental Change Expert Panel that produced the National Strategy in GER. |
| 1998-2000: | President of the Royal Meteorological Society |
| 1999-2001: | Royal Society Council |
| 1998-2005: | Member of the Royal Commission for Environmental Pollution |

***Current National Activities*** include

| | |
|---|---|
| 1995-date: | Chairman of Met Office Scientific Advisory Committee. |
| 2003-date: | Non-Executive Director of the Met Office |
| 1998-2006: | Chair of Royal Society Global Environmental Research Committee |
| 2000-date | Member of the Environmental Advisory Board for Rolls-Royce |

***Academic Activity***

Subject: Dynamical meteorology, weather and climate science
140 papers in referred journals and 3 books edited.

## *8.* Prof. Dr. Robert WATSON: *Climate Change: The need to adapt*

The recent literature has amply demonstrated that even small changes in the Earth's climate can have drastic adverse consequences. Unfortunately while all countries will be adversely affected by human-induced climate change, developing countries and poor people in developing countries are the most vulnerable. Given that the adverse impacts increase with warmer temperatures and more extreme weather events (e.g., floods and droughts), minimizing the magnitude of human-induced climate change is critically important if we are to limit the damage to agricultural systems, water resources, human health, coastal infrastructure and ecosystems and biodiversity.

Ecosystems, and their biodiversity, are particularly vulnerable to human-induced climate change, due to the limited number of adaptation strategies. Stabilization of GHG concentrations at 400ppm CO2 equivalent is necessary to preserve a strong likelihood of preserving species and ecosystems, and their critically important services, from significant adverse damage. Projected changes in climate could lead to a mass extinction of species if action is not taken quickly. Destroying our ecosystems would not only be morally indefensible, but would have profound human consequences given the importance of ecosystem services , especially for poor people.

Mitigating climate change is clearly the single most important adaptation strategy. The less we change the Earth's climate the less we will have to adapt. Next, we need to reduce the vulnerability of our agricultural, water and infrastructure sectors to current climate variability. Most sectors, in both developed and developing countries, are maladapted to today's climate variability due to inappropriate use of technologies and practices, and perverse policies, e.g., agricultural subsidies and lack of socially-sensitive water pricing policies.

Finally it is critical to integrate climate considerations into sector and national economic planning, with all sectors working together. The usual compartmentalization of government agencies in national governments is not conducive to developing cost-effective strategies to either mitigate or adapt to climate change, hence cross-agency collaboration will be critical. Unfortunately the international Environmental Conventions are equally a problem as they do not develop joint work programs, which are essential to identify the synergies and trade-offs among the different Convention goals.

The challenges are clear. We need: (i) an improved assessment of how climate change will effect socio-economic sectors, ecological systems and human health; (ii) to adapt to a changing climate; (iii) to resolve who pays for adaptation activities in developing countries; and (iv) a comprehensive long-term equitable global regulatory agreement which will significantly reduce GHG emissions in order to limit changes in the Earth's temperature to about 2 degrees C.

**CURRICULUM VITÆ**

***of Professor Robert T. Watson***

*Chair of Environmental Sciences, University East Anglia and Director for Strategic Development for the Tyndall Centre*

Chair of Environmental Sciences at the University of East Anglia, Director for Strategic Development for the Tyndall Center, and Chief Scientific Advisor to the UK Department of Environment, Food and Rural Affairs. Previous positions include Associate Director for the Environment in the White House and Chief Scientist at the World Bank. I have chaired, co-chaired or directed international scientific, technical and economic assessments of stratospheric ozone depletion, biodiversity/ecosystems (the GBA and MA), climate change (IPCC) and agricultural S&T (IAASTD). My areas of expertise include managing and coordinating national and international environmental programs, research programs and assessments; advising on the policy implications of scientific information and policy options for action; and communicating scientific, technical and economic information to policymakers. I have received numerous national and international awards, including in 2003 - Honorary "Companion of the Order of Saint Michael and Saint George" from the United Kingdom.

# 9. Prof. Javier MARTIN-VIDE: *A decalogue of climate change*

1. Variability is one of the essential characteristics of the climate system (the geographer's approach).

2. Throughout the planet's geological history there have been numerous climate changes of noteworthy magnitude (the geologist's approach).

3. The shortness of the instrumental weather series for the analysis of climatic variations and tendencies requires the use of proxy-data (the historian's approach).

4. The atmosphere's chemical composition has been modified by anthropic activity since the Industrial Revolution (the chemist's approach).

5. Over the last century, the planet's average temperature has risen by 0.74ºC –Fourth IPCC- (the climatologist's approach).

6. Extreme weather anomalies and episodes are not related to climate change, although this will probably cause an increase and intensification therein (the economist's approach).

7. Perception of climate often differs from climatic reality, and the presumed "perceived" climate changes are hardly ever supported by instrumental records (the psychologist's approach).

8. Human-induced climate change is one of the few subjects that affects humankind and should therefore be of global interest (the philosopher's approach).

9. Climate change is of great interest in the media (journalist's approach).

10. The uncertainty involved in nature and the consequences of climate change mean that the latter should be considered as a priority research area (policymaker's approach).

**CURRICULUM VITÆ**
***of Prof. Javier Martin-Vide***
*Professor of Physical Geography, University of Barcelona, Spain*

Javier Martin-Vide, a professor of Physical Geography at Barcelona University, has a degree in mathematical Sciences and a doctorate in Geography and History through the same university, with honours. His research has focussed upon probabilistic analysis of rainfall, climatic hazards, synoptic analysis, urban climate and variability and climate change. He has published 24 books and around three hundred papers and book chapters. The following are some of his works: Interpretación de los mapas del tiempo (Interpretation of Weather Maps) (1984), Fundamentos de Climatología analítica (Fundaments of Analytical Climatology) (1991), Guía de la atmósfera. Previsión del tiempo a partir de la observación de las nubes (Guide to the Atmosphere. Weather Forecasting based on Cloud Observation) (1996), Tiempos y climas mundiales.Climatología a través de mapas del tiempo e imágenes de satélite (World Weathers and Climates. Climatology based on Weather Maps and Satellite Images) (1996), Climas y tiempos de España (Spain's Climates and Weathers) (2001), El tiempo y el clima (Weather and Climate) (2003) ("Serra d'Or" Critical Prize) and Aspectos económicos del cambio climático en España (Economical Aspects of Climate Change in Spain) (2007). He has directed eleven doctoral theses and has actively participated in several European research projects (ADVICE, IMPROVE, COST-733). He was the first Chairman of the Spanish Climatology Association (1998-2004) and is currently Chairman of the Catalonia Meteorology Service Advisory Council, Director of the Climatology Group of Barcelona University, a member of the publishing board of the International Journal of Climatology and of 9 other journals, and a member of the Spanish Committee of the World Climate Research Programme. In 2005 he received the ATLAS-2004 prize for his exemplary professional trajectory.

# 10. Dr. Malte MEINSHAUSEN: *Emission pathways and concentration levels under a 2 ºC climate target*

## Context

This presentation highlights the implications for atmospheric greenhouse gas concentrations and global emissions levels, if global mean temperatures shall be kept below 2°C relative to pre-industrial levels. As the EU Environmental Council recognizes "2°C would already imply significant impacts on ecosystems and water resources"[2].

## Part I: Concentrations

### *What is the probability of staying below 2°C at various concentration levels?*

Recent scientific literature and the Fourth IPCC Assessment Report considering the uncertainty in 'climate sensitivity' confirm that stabilizing concentrations around 550ppm $CO_2$ equivalence would only imply an "unlikely" or "very unlikely" chance of staying below 2°C in equilibrium. For a stabilization at 450ppm $CO_2$eq, there is roughly a "medium likelihood" of staying below 2°C (50% or less). Only for a long-term stabilization at around 400ppm $CO_2$ equivalence or below, the achievement of the <2°C target is "likely" or "very likely".

### *How do these "medium likelihood" 450ppm concentration levels compare to current forcing?*

The best estimate of the current anthropogenic forcing is around 375ppm $CO_2$ equivalence (+1.6 $Wm^{-2}$)[3]. The single most important human influence on the climate is via the emission of carbon dioxide $CO_2$. Other human induced warming and cooling influences approximately cancel at the global mean[4]. Considering uncertainties in both, the net anthropogenic (+0.6 to +2.4 $Wm^{-2}$) and solar irradiance forcing (-0.06 to +0.18 $Wm^{-2}$), the anthropogenic forcing is likely to be at least five times greater. Net anthropogenic forcing is relatively quickly approaching levels of 400ppm and 450ppm $CO_2$ equivalence concentrations. Thus, reaching such stabilization levels will require a

[2] See e.g. 2610th Environment Council Meeting, Luxembourg, 14 October 2004

[3] See Intergovernmental Panel on Climate Change (IPCC), Fourth Assessment Report (AR4), Working Group I (WG1) report, Chapter 2, Table 2.12.

[4] Note, that there is significant spatial heterogeneity and uncertainty in the cooling effects due to aerosols, in particular the indirect effects, rendering the net anthropogenic forcing estimate uncertain (0.6 to 2.4 $Wm^2$) – see Table 2.12 of IPCC AR4 WG1. Thus, even if warming and cooling effects would cancel at the global mean in terms of temperatures, they do neither on a regional scale nor in regard to precipitation patterns.

peaking of concentrations around the mid of this century with a sufficiently fast return to lower levels so that the full equilibrium warming will not materialize.

# Part II: Emissions

## *If we halved global emissions by 2050, are we going to stay below 2°C?*

There is approximately a 50% chance staying below 2°C, if global emissions were halved by 2050. Such a halving of emissions by 2050 is comparable to the medium-range emission pathway ("Stern 500") presented by the Stern Review[5]. As well, an emission pathway presented by the EU Commission[6] based on research at the Joint Research Centre, does roughly fall into the category of "50% probability of staying below 2°C" pathways. Achieving a higher likelihood for staying below 2°C would require a peaking of concentrations below 500ppm $CO_2$ equivalence, e.g. 475ppm. This would require stronger global emission reductions of approximately 60% below 1990 levels by 2050. Both a 60% and a 50% global reduction is in line with the G8 Heiligendamm summit declaration that states "we will consider seriously the decisions made by the European Union, Canada and Japan which include at least a halving of global emissions by 2050."[7]

## *Conclusion*

Much sooner than 2050, there is a near-term benchmark of whether global emissions can be reduced sufficiently to avoid a 2°C warming (with at least a medium likelihood): Peaking of global emissions within the next ten years. If global emissions continue to rise until 2020 and beyond, the emission target of "at least halved emissions by 2050" will be increasingly difficult to achieve. Thus, if reductions are delayed, the required global emission reduction rates in excess of 3%/year might stretch the ability of societies to reduce emissions sufficiently quickly.

[5] See Figure 8.4, page 206, of Stern Review „The Economics of Climate Change"

[6] See Figure 11 in COMMISSION STAFF WORKING DOCUMENT, accompanying document to the COMMUNICATION FROM THE COMMISSION TO THE COUNCIL, THE EUROPEAN PARLIAMENT, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE AND THE COMMITTEE OF THE REGIONS (2007) "Limiting Global Climate Change to 2 degrees Celsius; The way ahead for 2020 and beyond", Impact Assessment ({COM(2007) 2 final}{SEC(2007) 7}, available at http://ec.europa.eu/environment/climat/pdf/ia_sec_8.pdf

[7] See G8 document "Growth and responsibility in the world economy", available at: http://www.g-8.de/Webs/G8/DE/G8Gipfel/GipfelDokumente/gipfel-dokumente.html

**CURRICULUM VITÆ**
***of Dr. Malte Meinshausen***
*Researcher at the Potsdam Institute for Climate Impact Research (PIK), Germany*

Malte Meinshausen received his PhD on climate science at the Swiss Federal Institute of Technology, Zürich, Switzerland, and has since been Post-Doc at the National Centre of Atmospheric Research in Boulder, Colorado USA. Currently, he works as a Post-Doc at the Potsdam Institute for Climate Impact Research, Potsdam, Germany. He has been contributing author to various chapters in IPCC's Fourth Assessment Report. As consultant to the German Ministry of Environment, he focuses on the scientific and technical issues in relation to the further development of the international climate regime.

His publications include:

Meinshausen, M. (2006). What does a 2°C target mean for greenhouse gas concentrations? - A brief analysis based on multi-gas emission pathways and several climate sensitivity uncertainty estimates. Avoiding Dangerous Climate Change. J. S. Schellnhuber, W. Cramer, N. Nakicenovic, T. M. L. Wigley and G. Yohe. Cambridge, Cambridge University Press.

Meinshausen, M., B. Hare, T. M. L. Wigley, D. van Vuuren, M. G. J. den Elzen and R. Swart (2006). "Multi-gas emission pathways to meet climate targets." Climatic Change 75(1): 151-194.

den Elzen, M. G. J. and M. Meinshausen (2006). Multi-Gas Emission Pathways for Meeting the EU 2°C Climate Target. Avoiding Dangerous Climate Change. J. S. Schellnhuber, W. Cramer, N. Nakicenovic, T. M. L. Wigley and G. Yohe. Cambridge, Cambridge University Press.

Hare, B. and M. Meinshausen (2006). "How much warming are we committed to and how much can be avoided?" Climatic Change 75(1): 111-149.

# 11. Dott.ssa Cristina SABBIONI: *Global climate change impact on our cultural heritage*

Climate change is currently attracting interest both at research and policy levels, but the focus tends to be on sectors such as agriculture, water, environment, industry, energy, transport and health.

On the other hand climate change has never been considered as a threat to cultural heritage, which is a non-renewable resource to be transmitted to future generations.

The Noah's Ark Project funded by European Commission within 6th Framework Programme for Research demonstrates a novel synergy between climate change and cultural heritage scientific research. The project consortium consists of 10 partners of 7 EU MS, including two universities, six public research organisations, one insurance company and one SME. This project begins to fill the gap that exists in studies on the effects of future climate variations on cultural heritage, addressing for the first time the problems arising from the impact of climate changes on Europe's built heritage and cultural landscapes.

The most relevant climate parameters affecting cultural heritage have been identified. Temperature, water, wind and pollution derived parameters have been considered of paramount importance. Using the General Hadley Model (HadCM3) data out put based on IPCC SRES scenario A2, 30-year mean maps have been produced relative to 1961-1990, 2010-2039 and 2070-2099, to provide three different scenarios of the above mentioned parameters in the 1961-2099 period in the European area. The project has also generated difference maps contrasting the 2010-2039 map with the 1961-1990 map and between 2070-2099 map and 1961-1990 map, in order to quantify the changes that will occur in future respect to 1961-1990 benchmark (taken as a reference). In addition, the 30-year mean maps relative to 2070-2099 have been produced using the Regional Model HadRM3. These data have been utilized to produce hierarchical maps aimed at presenting broad regional future threats.

At the simplest level climate change has been mapped for traditional climate parameters relevant to cultural heritage (e.g. frost, amount of annual precipitation, precipitation days > 20mm, consecutive precipitation > 5 days, wind driven rain, intense wind > 15m/s). Climate parameters have also been uniquely combined to produce specific heritage climatologies, e.g. wet-frost that occurs due to rain followed by intense freezing and salt crystallization events per year that occur due to relative humidity cycles through 75.5%. The combination of yearly mean precipitation and temperature also allowed the forecast of the amount of biomass accumulation on monuments and the richness of lichen species. Suitable damage functions based on climate parameters available from the Hadley model have also been proposed and utilized to quantify the damage occurring on building materials in future scenarios (e.g. surface recession of carbonate stone, metal corrosion and glass leaching).

Finally predictive hygrothermal modeling tools have been developed linking current condition of cultural heritage to future conditions under different climate scenarios particularly to understand the effectiveness of different drying strategies after flooding events. The effect of climate change on historic buildings was investigated using novel computer models that predict the transfer of heat and moisture through porous materials, specifically wood, brick and Baumberger sandstone.

One of the main outputs of the Project is the Vulnerability Atlas and Guidelines.

The Vulnerability Atlas aids policy makers and managers to assess the threats of climate change, in order to visualise the built heritage and cultural landscape under future climate scenarios.

The Guidelines offer adaptation strategies for cultural heritage managers in the face of climate change. These adaptation strategies should enable heritage stakeholders, owners and curators of historic buildings and collections, public policy-makers and national heritage organizations to make decisions on how to cope with future climate change pressures. End-users can use the Guidelines to plan their conservation efforts by taking into account the risk factors that threaten their area.

The project has received unprecedented media coverage, from the USA, Asia to Australia, with more than 200 articles and interviews in the press and media.

From this first and unique European project it is evident that gaps still exist at policy and research levels, which need urgent responses. At policy level, future needs include:

- Inclusion of cultural heritage among the priorities in existing and forthcoming legislation and policies.

- Inclusion in future IPCC Reports and other international reports (e.g. UNFCCC).

- International cooperation particularly with developing countries (eg. China and India), neighbouring (e.g. candidate countries, Mediterranean area) and industrialized countries (e.g. USA and Japan).

- Disseminate knowledge and raise awareness of national, regional, local authorities, private sector (e.g. insurance) and citizens.

At the research level, reducing uncertainty by expanding the knowledge base including in the research agenda in the following areas:

- Scenarios on local scales in European cities and other places characterized by concentrations of significant cultural heritage assets.

- Assign probabilities of damage by utilizing probabilistic climate models applied to specific case studies.

- Identify indicators of threats and damage to cultural heritage in outdoor and indoor environments.

- Impact of rising sea levels on cultural heritage protection.

- Development of adaptation strategies that prioritise early and cost-effective action.

Links:

The Noah’s Ark Project: http://noahsark.isac.cnr.it/

**CURRICULUM VITÆ**
***of dott.ssa Cristina Sabbioni***
*Research Director at the Institute of Atmospheric Sciences and Climate (ISAC), CNR, Bologna, Italy*

Cristina Sabbioni (Doctor in Physics). She is currently Research Director at the Institute of Atmospheric Sciences and Climate (ISAC) within the Italian National Research Council (CNR).

She has worked for the European Commission in the organisation of the EC Conferences on Science and Technology applied to Cultural Heritage (Bologna 1989, Rome 1991, Rome 1997, Aachen 1998, Santiago 1999, Strasbourg 2000, Crakow 2002 and London 2004).

Her main scientific interest is damage to Cultural Heritage due to atmospheric interaction, and the research results obtained have been presented at international conferences and published in international scientific reviews (180 papers).

She has been project leader in national CNR projects and EU projects on damage to Cultural Heritage since 1984.

She has been Chairperson of the Expert Advisory Group (EAG) of the Key Action 'The City of Tomorrow and Cultural Heritage' within the 5th EU FP.

She is member of the editorial board of Atmospheric Environment and Aerobiologia.

She is Professor of 'Environmental Physics' and 'Climate and Cultural Heritage' at the University of Bologna.

Contact details:

Cristina Sabbioni
Istituto ISAC - CNR
Via Gobetti 101 - 40129 Bologna, Italy
Tel. +0039-051-6399572, e-mail c.sabbioni@isac.cnr.it