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Avoiding Dangerous Climate Change

Scientific Symposium on Stabilisation of Greenhouse Gases
February 1st to 3rd, 2005
Met Office, Exeter, United Kingdom

Executive Summary of the Conference Report



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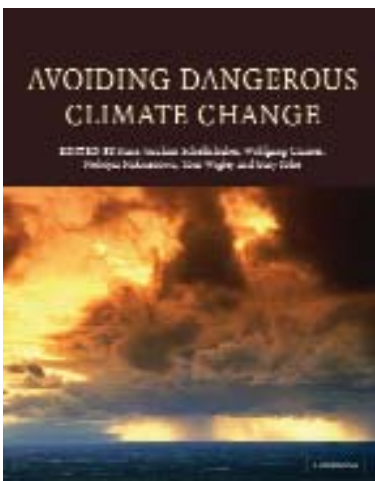
Foreword

The International Symposium on Stabilisation of Greenhouse Gas Concentrations – *Avoiding Dangerous Climate Change* – took place, at the invitation of the British Prime Minister Tony Blair and under the sponsorship of the UK Department of Environment, Food and Rural Affairs (Defra), at the Met Office, Exeter, United Kingdom, on 1-3 February 2005.

The conference discussed the long-term implications of different levels of climate change for different sectors and for the world as a whole. Major themes included key vulnerabilities of the climate system and critical thresholds, socio-economic effects, both globally and regionally, emission pathways to climate stabilisation and technological options available to achieve stabilisation levels.

The conference brought together over 200 participants from some 30 countries, mainly including scientists, and representatives from international organisations and national governments. The conference offered a unique opportunity for scientists to exchange views on the consequences and risks presented to the natural and human systems as a result of changes in the world's climate, and on the pathways and technologies to limit greenhouse gas emissions and their concentrations in the atmosphere.

This Executive Summary was prepared by the International Scientific Steering Committee (February 2005) and summarises the findings presented at the conference. A longer report prepared by the Steering Committee is available on the conference web site at www.stabilisation2005.com. The original papers presented at the conference are also available on the web site.



The scientific findings presented at the Exeter conference have also been published in a book – *Avoiding Dangerous Climate Change*. The book has been prepared by an editorial board led by Hans Joachim Schellnhuber and contains extended and peer-reviewed versions of the papers presented at the conference. As the UK Prime Minister Tony Blair has said, “this book will serve as more than a record of another conference or event. It will provide an invaluable resource for all people wishing to enhance global understanding of the science of climate change and the need for humanity to act to tackle the problem”.

Dennis Tirpak
Paris
January 2006

Executive Summary of the “Avoiding Dangerous Climate Change” Conference Report

The Third Assessment Report (TAR) of the Intergovernmental Panel on Climate Change (IPCC, 2001) reviewed in depth all the scientific, technical and socio-economic aspects of climate change. It concluded that there was strong evidence that climate change due to human emissions of greenhouse gases was already occurring and that future emissions of greenhouse gases were likely to raise global temperatures by between 1.4 and 5.8°C during this century, with a wide range of impacts on the natural world and human society.

Building on the TAR, the conference on *Avoiding Dangerous Climate Change*, considered three scientific questions relating to stabilising greenhouse gas concentrations in the atmosphere at levels which would avoid dangerous anthropogenic climate change. These questions were:

1. For different levels of climate change what are the key impacts, for different regions and sectors and for the world as a whole?
2. What would such levels of climate change imply in terms of greenhouse gas stabilisation concentrations and emission pathways required to achieve such levels?
3. What options are there for achieving stabilisation of greenhouse gases at different stabilisation concentrations in the atmosphere, taking into account costs and uncertainties?

The findings presented at the conference addressed different aspects of these questions.

Assessment of Impacts

Compared with the TAR, there is greater clarity and reduced uncertainty about the impacts of climate change across a wide range of systems, sectors and societies. In many cases the risks are more serious than previously thought. As noted in the TAR, a global temperature increase of up to 1°C may be beneficial for a few regions and sectors, such as high latitude areas and agriculture. A number of new impacts were identified that are potentially disturbing. One example is the recent change that is occurring in the acidity of the ocean. This is likely to reduce the capacity to absorb carbon dioxide (CO₂) from the atmosphere and affect the entire marine food chain.

A number of critical temperature levels and rates of change relative to pre-industrial times were noted. These vary for the globe, specific regions and sensitive ecosystems. For example, a regional increase above present levels of 2.7°C¹ may be a threshold that triggers melting of the Greenland ice-cap, while an increase in global temperatures of about 1°C is likely to lead to extensive coral bleaching. In general, surveys of the literature suggest increasing damage if the globe warms about 1 to 3°C above current levels. Serious risk of large scale, irreversible system disruption, such as reversal of the land carbon sink and possible destabilisation of the Antarctic ice sheets is more likely above 3°C. Such levels are well within the range of climate change

¹ This would be associated with a global temperature rise of about 1.5°C above present or about 2°C above pre-industrial temperature

projections for the century. While a clear temperature threshold has not been identified for shutdown of the Atlantic thermohaline circulation, studies were presented suggesting that a shutdown becomes more likely with increasing temperature. In this context, some felt that it would be useful to agree upon a set of critical thresholds that we should aim not to cross. Others noted it would be difficult to objectively choose such a level.

The impacts of climate change are already being observed in a variety of sectors. Ecosystems are already showing the effects of climate change. Changes to polar ice and glaciers and rainfall regimes have already occurred. While consistent with model projections the links to anthropogenic climate change need to be investigated further.

Many climate impacts, particularly the most damaging ones, will be associated with an increased frequency or intensity of extreme events. This is an important area for further work since many studies do not explicitly take into account the effects of extremes, although it is known that such extremes pose significant risks to human well being. The heat-wave that affected Europe in 2003 is a prime example.

Adaptive capacity is highly important to lessening the potential future dangerous effects of climate change. In some sectors and systems this capacity may be sufficient to delay or avoid much potential damage, though in others it is quite limited.

The capacity to adapt is closely related to technological ability, income levels and form of governance in a country. Adaptation and alternative development pathways need to be taken into account in developing strategies to avoid dangerous anthropogenic climate change. This was seen as particularly important if the potential impacts of climate change in Africa are to be avoided.

Climate sensitivity and emission pathways

It is possible to decouple the assessment of different levels of stabilisation from consideration of the question of what is dangerous. The conference thus explored separately the emission pathways associated with different greenhouse gas stabilisation levels and different global temperature limits. It is helpful to take into account uncertainty in the sensitivity of the climate system to greenhouse forcing by presenting pathways in probabilistic terms. There is evidence that the sensitivity is now likely to be higher than quoted in the TAR, however observational data may constrain the range.

There is a range of emission pathways that could be followed theoretically to avoid different temperature levels. Probability analysis provides a quantitative estimate of the risk that a particular temperature level would not be exceeded. For example, limiting warming to 2°C above pre-industrial levels with a relatively high certainty requires the equivalent concentration of CO₂ to stay below 400 ppm. Conversely, if concentrations were to rise to 550ppm CO₂ equivalent, then it is unlikely that the global mean temperature increase would stay below 2°C. Limiting climate change to 2°C above pre-industrial levels implies limiting the atmospheric concentration of all greenhouse gases. Based on new insights into the uncertainty ranges of climate sensitivity, a stabilisation at 450 ppmv CO₂ equivalent would imply a medium likelihood (~50%) of staying

below 2°C warming. In many cases this would mean that concentrations would peak before stabilising, though whether this could be achieved practically was not considered.

Different models suggest that delaying action would require greater action later for the same temperature target and that even a delay of 5 years could be significant. If action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be 3 to 7 times greater to meet the same temperature target. Coupled carbon-cycle GCM simulations showed the importance of considering the future of natural sources and sinks of carbon when determining how to achieve given CO₂ stabilisation levels.

Technological options

The IEA World Energy Outlook 2004 predicts that CO₂ emissions will increase by 63% over 2002 levels by 2030. This is generally consistent with the IPCC emission scenarios, published in 2000. This means that the world will, in the absence of urgent and strenuous mitigation actions in the next 20 years, almost certainly be committed to a temperature rise of between about 0.5°C and 2°C relative to today by 2050.

Technological options for significantly reducing emissions over the long term already exist. Large reductions can be attained, using a portfolio of options whose costs are likely to be smaller than previously considered. Sustainable development strategies can make low-level stabilisation easier. There are no magic bullets; a portfolio of options is needed and excluding any options will increase costs. Multi-gas strategies, emission trading, optimal timing and strong technology development, diffusion and trading are all required to keep costs of low-level stabilisation relatively low. Inclusion of technological learning in models suggests that projected costs of such reductions can be reduced by over half. To make required action more specific and transparent, the challenges could be broken down into discrete wedges, covering for example energy efficiency, nuclear energy, low-emission transport fuels and fossil fuel power plants with CO₂ capture and storage.

Globalisation and market forces will drive the developing countries to follow the same pattern practiced by the developed countries. Demonstrated energy efficiency improvements under the present market system in industrialised countries are not enough to offset increases in demand caused by economic growth in developing countries, although some developing countries have shown much higher improvement rates over certain periods. Efficiency improvements and alternative energy supply such as nuclear and renewables are of priority for developing countries to contribute their share to the effort of stabilisation.

Major investment is needed now in both mitigation and adaptation. The first is essential to minimise future impacts and the latter is essential to cope with impacts which cannot be avoided in the near to medium term.

International Scientific Steering Committee
Exeter, UK
February 2005

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