PERGAMON

Global Environmental Change 9 (1999) S1–S2

GLOBAL ENVIRONMENTAL CHANGE

www.elsevier.com/locate/gloenvcha

Viewpoint

The global impact of climate change: a new assessment

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Received 11 June 1999

In Article 2 of The United Nations Framework Convention on Climate Change (UNFCCC) signatories agree to take action to avoid dangerous levels of climate change that would threaten food security, ecosystems and sustainable development. Actions agreed under the Kyoto Protocol represent the first attempt to control the growth of greenhouse gas emissions. But agreement is hampered by, amongst other things, uncertainty about the effects of climate change. In part this has been due to the sheer complexity of the issue and the state of science in impact assessment that is less well developed than in climate change modelling. It also stems, however, from the fact that impact assessments have generally not been well co-ordinated. They have been based on different assessment methods and on a wide variety of climate change scenarios. This results in sets of analysis that are difficult to compare across different sectors (such as water, agriculture, etc) and between different regions.

The set of global impact assessments published here represents an attempt to overcome some of these drawbacks. It brings together five sectors of analysis (ecosystems, water, food, coasts and health) using the same climate change scenarios (the HadCM2 and 3 simulations, see Hulme et al., this issue), and adopting consistent assumptions about population and economic development in the future (although by no means trying to sample the full range of possibilities).

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The 'fast-track' nature of this study is also new. Its outline results were published and tabled at the third Conference of the Parties to the UNFCCC (COP3, Kyoto, 1997 where HadCM2 results were reported) and at COP4 (Buenos Aires, 1998, HadCM3 results). In this way the time-lag between the publication of climate change scenarios and that of the impact assessments that use these scenarios, a gap that previously had averaged about three years, was reduced to six months. This was made possible by the rapid preparation and transfer of climate change data through the UK's Climate Impacts LINK Project (Viner and Hulme, 1997) and by funding from the UK's Department of Environment, Transport and the Regions.

Similar fast-track impact studies should now be possible by impact assessors everywhere by accessing the IPCC's Data Distribution Centre. Established in 1998, this contains and makes available up-to-date quality-controlled climate change and socio-economic data for climate impact assessment (see: http://ipcc-ddc.cru.uea.ac.uk).

The prospective effects of the climate changes reported here are a cause for concern: Net ecosystem productivity may decrease significantly after the 2030s, causing the terrestrial carbon sink to decrease significantly with the possibility of it becoming negative by 2100, thus increasing the release of carbon to the atmosphere (White et al., this issue). By 2025 the number of people living in countries with water stress may increase by 50–100 million (Arnell, this issue). Food prices and the risk of hunger increase under all scenarios of climate change (Parry et al., this issue), as do rates of wetland loss and the number of people at risk of coastal flooding (Nicholls et al., this

PII: S0959-3780(99)00014-X

issue), and the risk to human health due to malaria (Martens et al., this issue).

In addition, these impact assessments confirm the conclusion of previous studies that, generally speaking, the most severe negative effects of climate change occur in less developed countries. This is partly the result of the geographical pattern of expected climate change, and also due to the lower adaptation potential characteristic of such regions.

The impact estimates presented here are comparisons with respect to a future world without climate change. The precise magnitudes and timings of these impacts remain conditional on the specific climate change scenarios used. We have used scenarios based on successive versions of *one* global climate model (GCM), forced with *one* scenario of greenhouse gas emissions growth. Different GCMs and different forcing scenarios would yield different impacts of climate change.

However, we know that such effects (at least the non-ecosystem ones) are extraordinarily sensitive to assumptions about wealth, technology and resource use in the future. A wealthy, well-governed country might well avoid some adverse effects and could probably adapt to many others. Yet barely any assessment of adaptive potential has been made and it remains our next priority. We can reasonably guess, however, that significant adaptation will need to be made in order to avoid major impacts in the future. For example, current agreements to reduce emissions under the Kyoto Protocol, even if fully implemented, are slow to reduce future impacts: in 2050 impacts under the Kyoto reductions are reduced by barely a tenth of the amount expected under an unmitigated change of climate (Parry et al., 1998,1999). In contrast, adaptation such as the more efficient use of water, can reduce substantially the vulnerability of water supplies to climate change (Parry et al., 1998).

Finally, we should note that while the assessments reported here are *compatible and consistent* (they use the same climate change scenarios and other assumptions about the future), they are not *integrated*. We have, for example, not analysed the effect of increased water shortage on food production or human health; or of climate change-driven changes in agriculture on the distribution of natural vegetation. The chapters thus stand as separate though compatible studies. Interactive global assessments are a task ahead.

References

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