Living with environmental change

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THE INTERGOVERNMENTAL PANEL on Climate Change issued its Summary for Policymakers of the Fourth Scientific Assessment of the physical science of climate change on 2 February 2007. This will shortly be followed by the assessments of climate change impacts and mitigation and adaptation options.

The assessment's key conclusion was the increasing scientific certainty that human activities have caused the recent observed warming. The media largely concluded that 'the science is now settled'. I disagree. While we can agree the causes of the warming, exactly what will happen in the future is still uncertain. Examples are the impacts on biodiversity, air quality, regional rainfall patterns and sea level rise. But we are putting mechanisms in place for the scientific community to reduce this uncertainty in the next few years.

Sceptics use the scientific community's continued reference to uncertainty to claim that we should leave adaptation to a richer future generation to cope with. At the least this is a very risky strategy. These uncertainties do not detract from the much greater certainty in the cause of global warming or the likely future for global average temperatures. These statements are not contradictory – we can have more knowledge about average properties of a system than of its component parts. An example is the kinetic theory of gases that allows the average properties of a large number of molecules in a sample of gas to be accurately predicted even though we don't know the details of the behaviour of each molecule; for 'sample of gas' read climate and for 'molecule' read individual weather system or ocean eddy. It is the local and regional impacts of environmental change that will drive societal response rather than the generality of the global average.

So I would conclude that not all the science is settled but that some critical properties of the overall climate system are now becoming well understood. This is why NERC's new strategy has a major priority on the climate system and on the impacts, expressed at a local scale, of global warming on wider aspects of the environment. As put into sharp relief by the Stern Review, predicting the probabilities of particularly the low-risk, high-impact events remains crucial and is at the forefront of where the science and economics need to go now.

While the cause of the observed warming is established some people still query the ability of climate models to forecast accurately the next 20, 30, 50, 100 years. Scepticism about climate models was revealed in NERC's recent Climate Change web challenge. The problem, I suspect, is in the meaning of the words model and prediction. Comprehensive climate models encode mathematically, in a computer program (so that they can be solved), the basic laws of physics, chemistry and biology that pertain to the climate system. They are not, as some contributors to the debate accused, full of fudge factors that we twiddle to get the 'right' answer. They are as right or wrong as our basic understanding of the underlying laws and principles. They also incorporate measurements of the system – so much so that it is a false dichotomy to regard models of this kind as separate from observations, or indeed theory and understanding.

One encouraging development in the Fourth Scientific Assessment is the inclusion of aspects of environmental change other than the traditional fields of meteorology and oceanography. For example the assessment refers to ocean acidification. The impacts of climate change on other aspects of the environment and on society are traditionally dealt with in a separate panel report. This divide is increasingly unhelpful, and it is only by viewing the whole system as a single interacting entity that the essential new science and policies will emerge. This is why NERC is leading an initiative called 'Living With Environmental Change' in partnership with other research councils, government departments and many more agencies. The initiative is described in the draft of NERC's new science strategy *Next Generation Science for Planet Earth* that is now open for consultation.

Consultation on NERC's new strategy closes on 16 April. See website for more details.

A summary of the NERC Climate Change Challenge debate is available at www.nerc.ac.uk

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