



We know the world's climate is changing, but what risks do rising temperatures pose for people around the world? It's time to ask the difficult questions, says **Mike Hulme**

SPARE a thought for climate scientists. On our backs rode the heroes of the 1992 Earth Summit and the 1997 Kyoto Protocol, which set international targets for cutting back greenhouse gas emissions. This month, governments will meet again, this time in The Hague, to finalise details of how the Kyoto Protocol will work. Many of the delegates gathering there will tell you that the climate scientists have completed their tasks. It's time, they'll say, for us to turn off our supercomputers, put away our temperature charts and go back to measuring the weather.

If only it was that simple.

Kyoto left climate scientists wiser to the ways of politics and international diplomacy. But the traffic all seems to have been one way. Politicians didn't come away with a reciprocal awareness of what climate science can still do for them as they turn their attention to setting policies to deal with global warming.

One of the issues high on the agenda at The Hague will be emissions trading. This is the idea that rich countries that emit more than their allowed quota of carbon dioxide or methane can buy the entitlement to do so from countries that emit less. But delegates will discuss this without actually knowing how much carbon or methane in the atmosphere poses real dangers.

Similarly, the US and some other countries would quite like to be allowed to plant forests in place of cutting greenhouse gas emissions. The idea here is that the trees will suck carbon from the atmosphere. But as any climate scientist will tell you, predicting trees' carbon uptake is a very imprecise science.

The Kyoto Protocol is built on the assumption that something, anything, must be done, and done quickly. It is an application of the precautionary principle: we may not have all the evidence to know precisely how climate change is harming the planet, but the risks associated with doing nothing outweigh the risks associated with taking action. But I think we can better than this. In this important area environmental policy, science really can deliver-and here's how.

There are three questions that lie at the heart of how we should respond to our changing climate. First: how can we tell what rate of climate change poses appreciable dangers to human health and to the environment? Second: can we control climate in a way that avoids such dangers? Third: if the answer to the second question is no, then can we shape our future world to accommodate the expected climate change? These are questions that scientists from a range of disciplines, from engineering to economics, can help to answer.

Many researchers believe that we need limit global warming to no more than 2°C, and that it is dangerous for CO₂ concentrations to rise above 550 parts per million by volume, or twice the level before the Industrial Revolution. But not everyone agrees on this target, not least because it doesn't allow for the radically different effects that warming will have on different nations and regions of the world. A certain degree of warming could be catastrophic in some places while barely inconveniencing others.

So what exactly do we mean when we say a particular degree of warming is dangerous? Danger implies unacceptable risk. And to assess risk we need to know both the probabilities of particular outcomes and the consequences of those outcomes. The reality is that at the moment we don't know what these risks are. For example, is the collapse of the West Antarctic Ice Sheet (a low-probability, high-impact event) a greater risk to society than a 1°C warming (a high-probability, low-impact event)? Scientists can help to quantify these risks. Societies then need to arrive at a consensus on which risks they are willing to accept. Evaluating risk requires input from social scientists, as well as from climate scientists, physicists, and biologists engaging with society at large. Only then can we say with any confidence how big a temperature rise is too dangerous to tolerate.

That brings us to the second question: can we control climate sufficiently to prevent warming reaching this "dangerous" level? It is the question that lies at the heart of the debate raging around the emissions targets set at Kyoto. These require the richer countries to reduce their greenhouse gas emissions by about 5 per cent before 2012.

But can this target, or any other, be reached? We don't know. We do know that ordinary people and businesses will have to change the way they live and make money. To find out whether they will do so needs research into the dynamics of technological change and research into the psychology of consumer behaviour. We need to answer questions such as why are Western societies so reluctant to consider nuclear power as an alternative to fossil fuels? And why are we so opposed to taxes on fuel, even when we know that some of the money will be spent on energy efficiency improvements? We need evidence-based policy.

More climate research is also critical for the third question: what happens if we cannot reduce the rate of climate change enough to avoid unacceptable risk? Can we adapt our institutions, our regulations, our behaviour to somehow accommodate more rapid climate change? Such questions have hardly been raised within the UN Climate Convention. Even talking about them is seen as defeatism, or at best as a diversion from the central issue of slowing down climate change.

In fact, identifying what "insurance policies" we may need to manage climate change is an entirely rational response to the problem. Here again, a broad range of scientific expertise can help put the necessary debate on a sound footing.

To shape a global community that can evolve with a changing climate, we need to strengthen links between knowledge producers and the UN Climate Convention. The real challenge for climate change science in the end is not to be able to predict future climate; rather, it is to give society the options to choose its own climate future.

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Inside Isaac

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Rounded thoughts

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