Recent extensive melting of ice in the Arctic highlighted shortcomings in current climate change models. George Burba

# Shrinking timeframe to prevent dangerous climate change?

**A growing number of scientists are echoing the concern raised in the latest Intergovernmental Panel on Climate Change (IPCC)'s Fourth Assessment Synthesis Report that climate change is happening faster than at rates predicted by earlier IPCC reports.**

A recent paper published in the US Proceedings of the National Academy of Science (PNAS)[1] suggests that the Earth's land and oceans are losing their capacity to absorb the excess carbon dioxide from anthropogenic emissions, accelerating the build-up of greenhouse gases in the atmosphere.

The lead author of the PNAS paper, CSIRO's Dr Pep Canadell – Executive Director of the Global Carbon Project (GCP)[2] – says the acceleration in climate change is due to global economic growth, a more 'carbon-intensive' economy, and a reduced capacity of the land and oceans to absorb carbon from the atmosphere.

'Fifty years ago, for every tonne of $CO_2$ emitted, 600 kg were removed by land and ocean sinks. However, in 2006, only 550 kg were removed per tonne and that amount is falling,' Dr Canadell said.

In another PNAS paper published earlier this year,[3] a team of experts led by Dr Mike Raupach – also from CSIRO – concluded that the growth rate of global $CO_2$ emissions has risen from 1.1 per cent per year in the 1990s to over 3 per cent per year from 2000 onwards.

Dr Raupach said atmospheric carbon from fossil fuel emissions rose by 1.9 billion tonnes of carbon per year in the 11-year period 1995–2006, increasing from 6.5 billion tonnes per year in 1995 to 8.4 billion tonnes per year in 2006. (Additional carbon emissions from changes in land use remained constant over that period at 1.5 billion tonnes per year.)

'No region in the world is decarbonising its energy supply,' he commented.

The GCP team's findings add to the growing body of evidence that carbon dioxide concentrations, global temperatures and sea-level rise are, according to Dr Raupach, 'all near the high end of IPCC projections'.

Dr Raupach points out that while our climate system is complex, some basic interactions are well understood, such as the effects of greenhouse gases in the atmosphere. However, uncertainty levels rise dramatically when feedback loops – for example, carbon sinks losing their capacity to absorb $CO_2$ as global emissions increase – are introduced into climate models. Because many of these feedbacks are absent from current climate models, the IPCC has skewed its estimates towards the conservative.

'Observations from the last 10 years or so show that IPCC predictions are conservative not aggressive,' Dr Raupach says.

'The predictions made using models 10 years ago can now be compared with the reality. This comparison shows that while models are working well, if anything they are too conservative.

'But this should not be used as a reason for inaction. We don't need to worry whether the safe stabilisation level is 550 or 500 ppm of $CO_2$ equivalent in the atmosphere, but we do know it should *not* be 700 ppm.'

The widely reported shrinkage of the Arctic ice sheet during the 2007 northern summer – when the minimum area of sea ice was 22 per cent less than the previous minimum recorded in 2005 – was not predicted by any of the IPCC models.

This led some scientists – including NASA's James Hansen – to pronounce that the Earth may have reached a critical climate change 'tipping point' beyond which the melting of the poles is irreversible.[4]

Dr Raupach says while the extent of ice loss in the Arctic came as a shock to most scientists, 'at least we know now that the assumptions we made about the processes governing the Arctic ice melt are wrong'.

'We were not looking enough at difficult feedbacks: ice-sheet melting is a non-linear process and difficult to model.

'Even though there is uncertainty about how fast climate change will happen, we can be confident that it will happen, at least according to the IPCC predictions,' Dr Raupach reiterated.

'On the research side now, it's a matter of working out probabilities for climate change outlooks, which are bad at best and catastrophic at worst.

'But you don't need to wait for the uncertainties to be quantified to know what to do next – the need for emissions reductions is urgent.'

● **Mary-Lou Considine**

1 Canadell JG *et al.* (2007). Contributions to accelerating atmospheric $CO_2$ growth from economic activity, carbon intensity, and efficiency of natural sinks. PNAS 2007: 0702737104v1-0. Search at www.pnas.org
2 The Global Carbon Project, www.globalcarbonproject.org
3 Raupach MR *et al.* (2007). Global and regional drivers of accelerating $CO_2$ emissions. PNAS 2007 104: 10288–10293. Search at www.pnas.org
4 Spratt D (2007). The big melt: lessons from the Arctic summer of 2007. Report by CarbonEquity, www.carbonequity.info