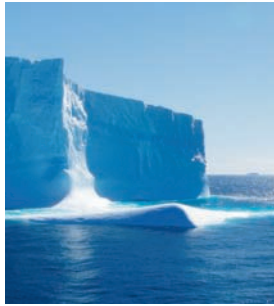


Progress



CSIRO, Atmospheric Research



Jan Will



Jane Norton



Gay Erwood



Jan Will



CSIRO, Sustainable Ecosystems



Paulus Riyanto

A view of dangerous climate change

Earlier this year, prominent international climate advisor, Professor John Schellnhuber, spoke in Canberra on the topic: *Avoiding Dangerous Climate Change*. Steve Davidson was there, and reviews the background to the widening discussion on this scenario.

For many years, interest in climate change centred on whether or not global warming was really happening and, if it were, by how much climates would change in various parts of the world. In scientific circles, all but a minority of sceptics and confirmed contrarians now agree that global warming is a reality and most climate experts have moved on from this debate and begun serious consideration of the severity, the impacts and the prospects for adaptation and mitigation.

Some climate scientists now argue that climate change will be compounded by positive feedback mechanisms that accelerate warming. And, they say, we face the risk that certain global systems could reach dangerous thresholds or 'tipping points' beyond which we lose any prospect of management.

In particular, the prospect of rapid and dangerous climate change has come into focus and the evidence is growing that we will experience some previously unex-

pected impacts. Earlier this year, Professor John Schellnhuber, CBE, Director of the Potsdam Institute, Germany, spoke in Canberra on the topic: *Avoiding Dangerous Climate Change*.

'One school of thought,' Schellnhuber said, 'has been that climate change caused by human activities will be gradual and we will be able to adapt to it. However, I believe the evidence now indicates that once climate change exceeds certain "tipping points" or critical thresholds, the consequences will enter a largely uncontrollable and irreversible domain.'

He says there is a real possibility that we will see a range of major large-scale events that will be beyond our management.

The dangers, says Schellnhuber, include intensification of El Niño and the risk that it could become a permanent feature, weakening of the Gulf Stream, melting of the West Antarctic and Greenland ice sheets, disruption of the Indian monsoon, widespread death of corals due to bleach-

ing, and hurricanes of increased intensity. Without action on our part, these tipping points could occur one by one, some sooner, some later.

Is this scare-mongering or just plain scary? Schellnhuber backs his views with worldwide research on various systems at risk. The new book, *Avoiding Dangerous Climate Change*, with Schellnhuber being the principal editor, brings together the views of many eminent researchers who addressed a UK Government-hosted international conference of the same title held in Exeter in February 2005.¹ So he is not a lone voice.

The Exeter report says that in many cases the risks associated with climate change are more serious than previously thought and it identified a number of new impacts that are potentially disturbing. These include a recent increase in the acidity of the ocean, which is likely to reduce its capacity to absorb carbon dioxide from the atmosphere, not to mention effects on the marine food chain.

Dr Barrie Pittock, a senior climate scientist in CSIRO for over 30 years, now retired, and author of the comprehensive book, *Climate Change: Turning Up the Heat*, has argued for some time that

¹ www.defra.gov.uk/environment/climatechange/international/dangerous-cc.htm



Professor John Schellnhuber was a lead contributor to the UK Government-convened international conference on dangerous climate change, attended by many of the world's leading climate authorities. Photo courtesy IISD/Earth Negotiations Bulletin

climate change may be greater than previously predicted. Speaking in a private capacity, he warns that several positive feedback processes, such as reduced albedo as ice sheets melt, have the unnerving

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effect of speeding up global warming and increasing the severity of impacts.

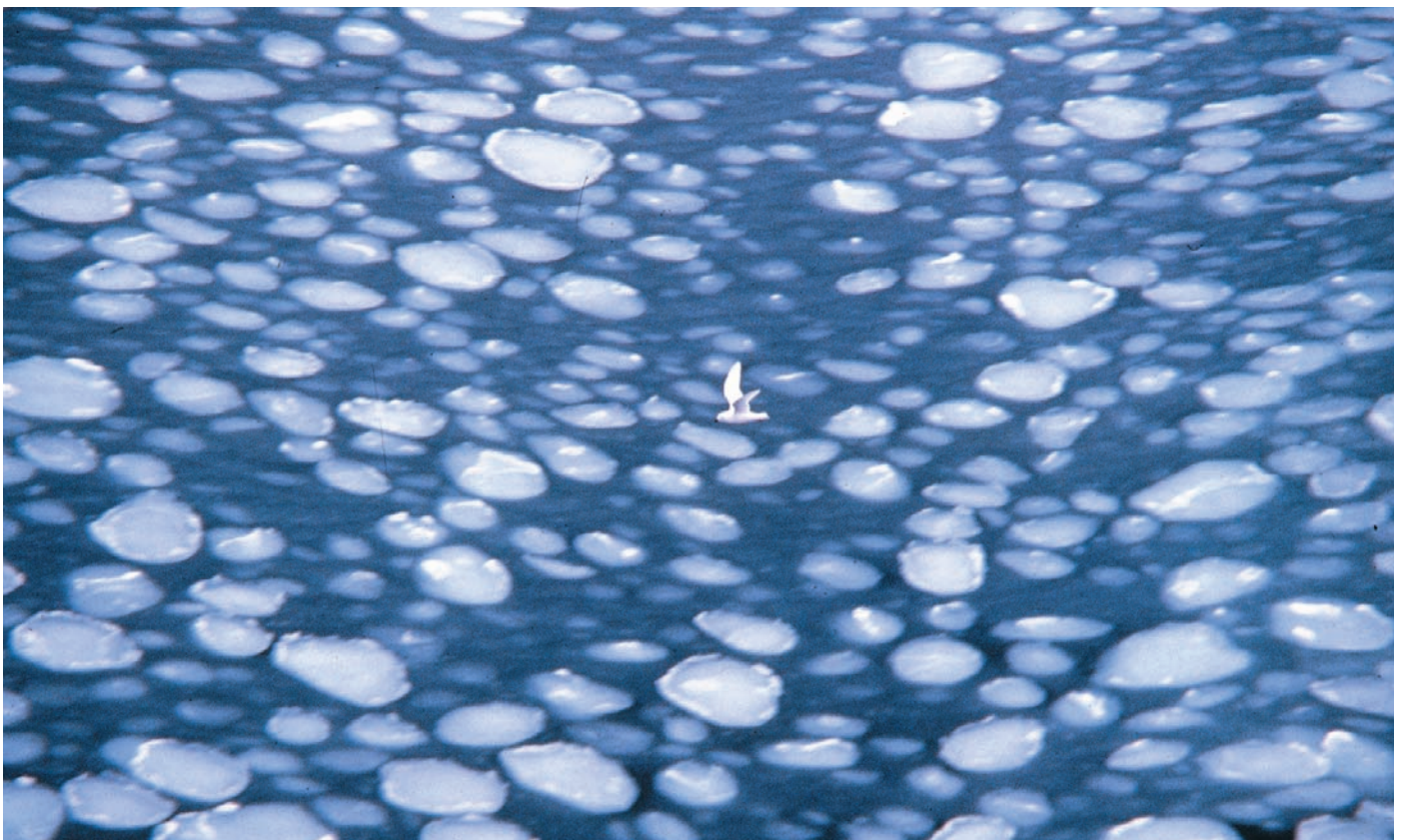
'Climate scientists tend to be conservative when talking about climate change because they don't want to be accused of being irresponsible or alarmist,' says Pittock. 'But when looking at the range of possibilities for climate change, such as the Intergovernmental Panel on Climate

Change (IPCC) 2001 projection of 1.4 to 5.8°C warming by 2100, it is important not to ignore the upper end of the range of uncertainty and the associated risks of disastrous impacts. We shouldn't always play these down.

'The use of a temperature range rather than a single value, incidentally, is due to both choice of different scenarios, for example for future greenhouse gas emissions and controls, and to scientific uncertainty,' says Pittock. 'But, uncertainty shouldn't be used as an excuse for inaction.'

He points to recent developments suggesting that the 2001 IPCC figures underestimate global warming in this century, even though they already foreshadow two to ten times the 0.6°C warming that occurred last century. Notably, recent papers in *Nature*² make grim predictions of 2.4 to 5.4°C and 2 to 11°C of warming, respectively, by the end of this century, throwing some doubt on the earlier IPCC estimate. The 4th IPCC assessment report is currently in preparation and due out in September 2007.

² Murphy JM et al. (2004) Quantification of modelling uncertainties in a large ensemble of climate change simulations. *Nature* 430, 768-772, and Stainforth DA et al. (2005) Uncertainty in predictions of the climate response to rising levels of greenhouse gases. *Nature* 433, 403-406.



Climate scientists are concerned about the albedo-related 'feedback' mechanism associated with melting ice, where the darker water colour eventually exposed increases the amount of heat absorbed, accelerating ice breakdown. CSIRO Marine Research

Progress

Calamitous changes?

A string of recent research findings points to a high probability of serious consequences of climate change if we remain complacent.

For example, NASA and other scientists have observed rapid recession of Arctic sea ice and several research groups have also documented rapid melting of permafrost in the northern hemisphere. These reduce the albedo, or reflectivity of the surface, as bright snow is replaced by darker vegeta-

tion and soil, and this, in turn, leads to more global warming – an early positive feedback that makes things progressively worse.

The extent of sea ice cover in the Arctic is now at its lowest level in more than a century and a 2005 report (Overpeck et al.) in *EOS*, the Transactions of the American Geophysical Union, says that ‘a summer ice-free Arctic Ocean within a century is a real possibility’ and that ‘there seem to be few, if any, processes or feedbacks within

the Arctic system that are capable of altering the trajectory...’

Observations now indicate that the world’s forests, long regarded as important sinks for CO₂, could be transformed into treacherous sources of greenhouse gases as global warming proceeds – a disturbing turnaround and, again, one that means global warming will feed itself.

Pittock says, ‘a number of scientists have recently observed vegetation and soils acting as sources rather than sinks and this

Sceptics targeting governments ... and students

It is well reported that not everyone is yet convinced by the science behind climate change and the arguments for the greenhouse phenomenon. In Australia the politics behind the debate, perhaps appropriately, continues to be intense.

The Lavoisier Group, comprised of greenhouse sceptics, was formed in May 2000, and recently its Secretary, Ray Evans, put together a document entitled *Nine Lies About Global Warming* that ridicules the ‘inherently implausible’ argument that greenhouse-induced warming will bring about ‘global climate catastrophe’ (www.lavoisier.com.au). The printed version was distributed through some Australian universities during orientation-week this year.

Evans says the Kyoto Protocol ‘is now almost dead’ and that ‘it has been sustained to this point through a web of mendacity, fraud and lies’.

According to the Lavoisier Group, it is a lie that ‘The twentieth century has been the hottest in recorded history and the decade 1990–2000 the hottest ever.’ It is a lie that ‘The scientific consensus is that anthropogenic CO₂ emissions have already caused significant global warming and must be severely curtailed to prevent future climate catastrophe.’ It is a lie, says Evans, that ‘Because of anthropogenic emissions, the polar ice caps are melting and sea levels are rising.’ And so on.

Evans refers to ‘the global warming scam’ and concludes: ‘So many people, and institutions, have been caught up in the web of deceit, masterminded by environmental activists working through the non-government organisations and their manipulation of the IPCC processes, that the integrity of Western science is seriously at risk.’

At about the same time, Dr Clive Hamilton, Chair of the Climate Institute, made a hard-hitting speech to a conference in Adelaide on



Storm clouds gather over the Gippsland Lakes in Victoria. More intense storm activity is predicted with a warming Australian climate. Robert Kerton, CSIRO

The Dirty Politics of Climate Change in which he was highly critical of fossil fuel lobbyists and their secretive modus operandi.¹ The Climate Institute is a non-profit organisation that aims to connect policy makers and scientists around the world. Representing it, Hamilton nominated 12 people who in his opinion ‘have done more than all others over the last decade to prevent any effective action to reduce Australia’s burgeoning greenhouse gas emissions’. He dubbed them the ‘dirty dozen’.

Barrie Pittock’s book (see main story) has a section on greenhouse scepticism (pages 77–82) in which he argues that genuine scepticism in science is good. However, he writes that if we have 10 sets of observations pointing to global warming (land temperatures, ocean temperatures, sea ice, glaciers, melting

permafrost, etc) and one (some satellite data) that does not, do we simply conclude that the ten sets are wrong or do we look critically at the reliability of all the evidence and decide which is more likely?

On criticism of climate modelling, Pittock points to the routine use of predictive models in such applications as weather forecasting, predicting tides, and predicting motions of the planets. He says climatologists are well aware of and open about the uncertainties.

Pittock says while natural climate change has happened in the past, this does not rule out the simultaneous occurrence of human-induced climate change and warns that some contrarians are deeply suspicious of the motives and integrity of climate scientists and suspect the IPCC of bias and censorship despite the fact that its reports have to be approved by a whole range of governments with different views and interests.

¹ www.tai.org.au/WhatsNew_Files/WhatsNew/CC%20in%20Adelaide%20Final.pdf

could mean an earlier-than-expected positive, that is undesirable, feedback in the terrestrial carbon cycle.'

Heatwaves (and other extreme events) are predicted to become more frequent with climate change, and last year *Nature* reported³ that a team of European scientists had found that the stifling 2003 heat wave in Europe caused the continent's grasslands and forests to release massive amounts of carbon dioxide into the atmosphere. The carbon dioxide released as a result of the heatwave was equivalent to the amount of carbon stored in plants over the previous four years of normal growth.

This was unprecedented and the authors say it shows there is a danger in assuming that climate change will be gradual.

On the other hand, Dr Penny Whetton, Leader of the Climate Impact and Risk Stream, CSIRO Marine and Atmospheric Research, is more circumspect. She is not convinced there has been a significant change in the general perspective of scientists working on climate change.

'It is not clear that our understanding of some of the above-mentioned points is that different to where it was a few years ago, for example, in relation to rates of future global warming,' Whetton told *Ecos*.

Taking action

Can we avoid the various tipping points, beyond which serious and probably irreversible system disruption occurs? If so, how?

Schellnhuber says, 'In the end, to avoid dangerous climate change, we have to change human behaviour and economic systems – in particular transform our energy systems – a huge challenge. It is a global problem and Australia certainly needs to join in.'

He argues that geosequestration has a 'promising and necessary' part to play and says we also need to reinvent our cities to use less energy.

'It is probably true that we could leave it to market forces to avoid dangerous climate change, but these would work a century or more too late! We need policies, legislation and incentives in place – then let market forces play their part,' says Schellnhuber.

Pittock urges application of the 'polluter pays' principle in policy so that competing technologies can compete on a level playing field. 'Then low-emission technol-



Could dangerous-scale climate change involve major large-scale environmental events that are beyond our capacity to manage? Gianluca Camporesi

ogy can win in the marketplace,' he told *Ecos*.

Overwhelmingly, climate researchers push for much more urgency.

The Exeter report says: 'Different models suggest that delaying action would require greater action later, for the same temperature target, and that even a delay of five years could be significant. If action to reduce emissions is delayed by 20 years, rates of emission reduction may need to be three to seven times greater to meet the same temperature target.'

High-profile US climate scientist, James E Hansen, earlier this year⁴, said: 'Action must be prompt, otherwise CO₂-producing infrastructure that may be built within a decade will make it impractical to keep further global warming under 1°C. I refer especially to the large number of coal-fired power plants that China, the United States and India are planning to build without CO₂ sequestration.'

The picture looks depressing, but there is some good news. According to the Exeter report: '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 devel-

opment can make low-level stabilisation easier.'

The report suggests that to make 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.

Above all, though, it is time for action according to many scientists. 'Major investment is needed now in both mitigation and adaptation,' concludes the Exeter report. '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.'

● Steve Davidson

More information:

Pittock BA (2005) *Climate Change: Turning Up the Heat*. CSIRO Publishing, Melbourne.
Schellnhuber HJ, Cramer W, Nakicenovic N, Wigley T and Yohe G (Eds) (2006) *Avoiding Dangerous Climate Change*. Cambridge University Press, Cambridge.

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3 www.nature.com/news/2005/050919/full/050919-5.html

4 www.columbia.edu/~jeh1/newschool_text_and_slides.pdf