

Dangerous Climate Change - Are we there yet?

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The Australian Academy of Science's annual *Science at the Shine Dome* symposium this year (9 May 2008) tackled the serious and timely topic of *Dangerous Climate Change: Is it inevitable?* The symposium featured some of the latest expert thinking on major aspects of climate change, and discussed what *is* dangerous climate change and what are the tipping points and related factors. Presentations included an update on:

- Arctic ice-melt and the likely fate of Arctic marine systems, including fisheries that support Europe and the USA, and the endangered apex species - the polar bear;
- Accelerating uptake of carbon dioxide in the atmosphere and weakening of the oceanic 'sink';
- Likely fate of the Great Barrier Reef and important 'tipping points';
- Complexities of drought in Australia and links to climate change;
- Factors contributing to Sea Level Rise, including new information since the IPCC's 4th Assessment Report of 2007;
- How humans are now a geological force of nature, leading to the 'Anthropocene' era and the acceleration of the human imprint on Earth since 1950;
- How international treaties are NOT getting us outcomes, and the need to convert scientific findings into political action; and
- How current adaptation and mitigation strategies need further support, integration and engagement of the broader community and industry.

Importantly, there were widely held views amongst the speakers and participants that the Intergovernmental Panel on Climate Change (IPCC) 4th Assessment Report (4AR) has tended to underestimate the seriousness and rapidity of climate change, and therefore the urgency of taking action. Currently major climate change drivers, such as atmospheric CO₂ concentration, air and sea-surface temperature, rising sea levels, frequency and intensity of extreme climate events, etc., are tracking at the higher end-scale or above of the worst-case scenario predictions reported by IPCC 4AR. The rate of change is unprecedented in geological history and we are already committed to significant change for hundreds of years to come, despite any positive actions for global greenhouse gas mitigation.

The symposium heard that the Arctic is the global sentinel of change and represents a magnification of what is happening elsewhere in the world. Some consider that the changes to the Arctic cryosphere may seriously destabilise the global climate system in the future. It seems that the Arctic way of life is being seriously threatened for its people and ecosystems, as demonstrated by recent statistics:

- temperatures are rising at double the rate of the rest of the world and are already 2 °C above the 20th Century average; in winter, temperatures are already four times warmer than average global warming;
- the Bering Sea is now classed as sub-Arctic rather than Arctic; the nature of its food chains have shifted from benthic to pelagic dominated; and some of its commercially important fish stocks have moved 800 km south;

- snow melts are occurring earlier and faster and snow cover has declined by 10% since 1970;
- there is unprecedented melt of glaciers, with some receding by as much as 5 to 7 km in one year;
- close to 40% of the sea ice has been lost during summer over the past 40 years and is thinning dramatically; no 'old' (>5 years) sea ice is left; predictions are for no summer sea ice by 2013;
- for every week earlier that the sea ice breaks, female polar bears lose up to 30 kg weight;
- Arctic river flows are rising and are now 25% above average - which is freshening the Arctic ocean and affecting circulation;
- a globally significant store of carbon (and methane), the Arctic permafrost, may be significantly lost in the next 20 years - threatening to release masses of greenhouse gases into the atmosphere and potentially accelerating climate change further; and
- changes to the Arctic from climate change affect the rest of the world and could potentially, seriously destabilise the global climate system.

Other Key points and issues to arise from the symposium included:

- Atmospheric carbon dioxide concentrations have shifted from historically stable levels of around 280 ppm to 380 ppm in the past 100 years, mainly due to use of fossil fuels (80%) and deforestation (20%).
- Some 45% of anthropogenic CO₂ ends up in the atmosphere, with about 25% absorbed by the world's oceans and the remainder taken up by land systems.
- The ocean 'sink' is taking up a progressively smaller fraction of greenhouse gas emissions and is becoming more acidic.
- There has been an increase in the airborne fraction of CO₂ at the rate of about 2.4% per year; at the same time there has been a 3.3% acceleration of greenhouse gas emissions since 2000.
- Population growth is an important part of the equation, as is affluence.
- The combination of increasing sea surface temperatures and ocean acidity is creating 'dangerous' climate change for coral reefs; the tipping point for the Great Barrier Reef is probably around 450 ppm CO₂ and 2 °C.
- Drought is dangerous, leading to more fires and increased suicide rates; future implications of the drought-climate change link remain uncertain.
- Global sea level rise from thermal expansion of the oceans and melting of non-polar glaciers are relatively well known, but ice mass loss in the Arctic and Antarctic remains complex and uncertain, with indications that levels may be higher and occur faster than previously thought.
- Increases in numbers of environmental refugees into the future is likely.
- Australia needs a more aggressive R&D agenda for climate change - we need to be a 'global leader' rather than a 'fast follower'.
- Many experts consider the technology is available and affordable to deal with elevated atmospheric greenhouse gas concentrations.
- There needs to be more focus on achieving a 'safe' climate.

'Committed' climate change may result in large scale biodiversity loss, including of coral reefs; loss of a significant part of the Greenland ice sheet; feedbacks that push atmospheric CO₂ higher; and threats to the sustainability of modern

civilization. Several experts present at the symposium suggested the window of opportunity to avoid dangerous and irreversible climate change is shrinking and may be as little as a few years - particularly with respect to irreversible Arctic ice melt. Many European experts consider that 450 ppm atmospheric CO₂ and 2°C are the trigger points for dangerous climate change (although this would vary according to system and location). Many Australian experts similarly believe Australia is extremely vulnerable to a 2 °C increase in temperature, and we need to pre-emptively adopt a 'risk management' approach. In one presentation a leading climate expert indicated that Australia needs to do four things to address climate change:

- monitor the climate for change - at a regional scale;
- improve scientific understanding of climate drivers;
- improve Australia's modelling capacity for predicting climate; and
- adapt [and reduce vulnerability - build resilience].

It was sobering for symposium participants to learn that successive governments have reduced Australia's leading agency for climate, the Bureau of Meteorology, by 45% over recent decades - at a time when it is most needed. It was also apparent that while the scientific community may more clearly understand the implications and urgency of the climate change story - this is not necessarily the case for others in the community. Therefore scientists have a responsibility to 'get the message out' and scientific findings need to be translated into political and community action. The need for a collaborative, multi-disciplinary and multi-sectoral approach was highlighted. The symposium ended on a serious but optimistic note - that while the IPCC 4AR seems to have understated the urgency of the extremely challenging problem global climate change, there is still a *small* window of opportunity to do something about it before it reaches the 'dangerous' zone.

[Note: presentations and discussions from the symposium are available on the Australian Academy of Science website at:
<http://www.sciencearchive.org.au/events/sats/sats2008/symposium.html>].