

Piecing together Australia's climate change picture



Rainforest canopy at Bellenden Ker in North Queensland. Robert Kerton

CSIRO researchers have been playing a leading role in tracking the emerging signals of climate change, advancing understanding about how the phenomenon will impact the Asia-Pacific region.

CSIRO Marine and Atmospheric Research scientists contributed to recent studies identifying an acceleration of carbon dioxide emissions beyond current estimates; a weakening of the Southern Ocean's capacity to absorb carbon dioxide; temperature changes in the Indian Ocean affecting ocean currents and mainland rainfall; and the

crucial role played by tropical forests in reducing greenhouse gases.

A team led by Dr Mike Raupach from CSIRO Marine and Atmospheric Research has reported that the average growth rate of carbon dioxide emissions globally has accelerated at a greater rate than previously thought, increasing from 1.1 per cent per year in the 1990s to a 3 per cent annual increase in the 2000s.

Dr Raupach's team of carbon-cycle experts, emissions experts and economists was brought together through the Global Carbon Project – an

international framework for climate change research.

The team reported recently that, over the last 25 years, the average growth rate of Australian emissions was roughly twice the growth rate for the world, twice the growth rate for the USA and Japan, and five times the growth rate for Europe.

Dr Raupach also found that Australia's carbon intensity of energy (amount of carbon burned as fossil fuel per unit of energy) is 20 per cent higher than the world average, and 25–30 per cent higher than the USA, Europe and Japan.

'In the last few years, the global usage of fossil fuels has actually become less efficient,' says Dr Raupach.

'Our results add to previous findings that carbon dioxide concentrations, global temperatures and sea-level rise are all near the high end of IPCC (Intergovernmental Panel on Climate Change) projections.'

CSIRO participated in an international research team that has presented evidence of a progressive weakening of the Southern Ocean's capacity to act as a carbon dioxide sink.

According to Dr Paul Fraser from CSIRO Marine and Atmospheric Research, the work has shown that the Southern Ocean is becoming less efficient at absorbing carbon dioxide due to an increase in wind strength over the ocean.

Winds have strengthened due to higher levels of greenhouse gases in the atmosphere plus long-term ozone depletion in the stratosphere, which has been shown to intensify storms over the Southern Ocean.

The stronger winds influence mixing and upwelling in the ocean, in turn causing more carbon dioxide to be released into the atmosphere, reducing the net absorption of carbon dioxide into the ocean.

Dr Fraser points out that, because the Southern Ocean takes up 15 per cent of global carbon dioxide emissions, a reduction in its efficiency will have 'serious implications for atmospheric carbon dioxide concentrations over coming decades'.

Meanwhile, a CSIRO team led by oceanographer Dr Gael Alory has detected the 'signature' of climate change in the changing temperatures of the Indian Ocean, which affect rainfall in southern Australia.

'These oceanic changes are almost certainly linked to changes in the heat structure of the atmosphere and have led to a rise in water temperatures in the sub-tropical Indian Ocean of around 2°C,' says Dr Alory.

'At the same time, we are seeing changes in ocean circulation in tropical regions as a result of a long-term weakening of the Pacific Ocean trade winds. This affects sea surface temperature in regions relevant to the source and distribution of rainfall across southern Australia.'

Dr Alory says that increasing production of aerosols and greenhouse gases, as well as ozone depletion, have all played a role in this climatic shift.

Another Global Carbon Project study has confirmed that conserving tropical forests can play a key role in reducing future greenhouse gas concentrations.

'Deforestation in the tropics accounts for nearly 20 per cent of carbon emissions due to human activities,' says CSIRO's Dr Pep Canadell, who participated in the international research effort.

'Maintaining forests as carbon sinks will make a significant contribution to stabilising atmospheric greenhouse gas concentrations.'

● **Mary-Lou Considine**

More information:
CSIRO Marine and Atmospheric Research: www.cmar.csiro.au