



The Grandparent

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AN OCEAN OF EVIDENCE ON WARMING IS OUR CUE TO TAKE ACTION – NOW

By John Church. Originally published in the *Sydney Morning Herald* on 14 January 2019

Over 90 per cent of the heat trapped in the climate system by increasing greenhouse gas concentrations from our burning of fossil fuels is stored in the oceans. With much less variability than surface temperatures, ocean warming is one of the most important indicators of the ongoing pace of climate change.

Two new studies published last week confirm the world's oceans are warming. The first, published in the *Proceedings of the National Academy of Science*, shows that ocean warming has accelerated since 1870. The second, a perspective published in the prestigious journal *Science*, reports studies that indicate the rate of ocean warming over recent decades is 10 per cent or more greater than the studies considered in the last Intergovernmental Panel on Climate Change Assessment published in 2013, and that the rate has increased since 1991.

The updated observations are in agreement with the

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results of climate model simulations of the impacts of our continuing release of greenhouse gases. These models show the ocean will continue to warm through the 21st century and beyond.

Greenhouse gases have a long life time in the atmosphere. Even if carbon dioxide emissions were to cease completely, atmospheric concentrations would only decrease slowly over thousands of years unless we discover a way to artificially remove them from the atmosphere. As a direct consequence, surface temperatures would remain elevated. As a result of the oceans' ability to store heat, they will continue to warm for centuries.

Decisions we make now about greenhouse gas emissions have long-term consequences for the world and Australia's climate and sea level, and of course for the natural

environment and our modern society.

Continued greenhouse gas emissions at a business-as-usual rate would result in the ocean warming accelerating through the 21st century, and a contribution to sea-level rise of about 30cm from ocean thermal expansion alone by 2100. The warmer ocean would be accompanied by warmer surface temperatures, increased frequency of climate extremes, and increased intensity of extreme rainfall events and hurricanes, with major disruptions to society.

Paris targets of 'limiting global average temperatures to well below 2C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5C above pre-industrial levels', and thus significantly reduce the impacts of climate change. Current mitigation 'promises' are not sufficient to meet these goals, and planned mitigation is even further away. Every day we delay action makes the Paris targets more difficult to achieve.

The long time scales of the ocean means we will have to



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The ice sheets are even more important for long-term sea-level change. Unabated emissions this century would commit the world to metres of sea-level rise over coming centuries. We would likely cross the threshold, well before 2100, leading to an accelerating melting of the Greenland ice sheet and a sea-level rise of up to about seven metres. An acceleration of the Greenland contribution to sea-level rise has already been observed.

For Antarctica, a warming ocean would lead to the decay of ice shelves and an accelerating flow of ice into the ocean, as revealed by recent observations of the West Antarctic Ice Sheet. The rate of sea-level contribution from Antarctica is more uncertain but could equal or exceed the contribution from thermal expansion by 2100, and could be metres over coming centuries.

Global average temperature is already about 1C above pre-industrial levels and we have already seen an increased frequency of coastal flooding events. Unabated emissions would see permanent inundation and a dramatic increase in the frequency of coastal flooding events, disrupting the lives of tens to hundreds of millions of people.

Urgent, significant and sustained mitigation of our greenhouse gas emissions is required if we are to meet the

adapt to climate and sea-level change resulting from past emissions. However, further sea-level rises and other changes in our climate can be greatly reduced, but not eliminated, by reaching the Paris goals.

We should remember that sea levels were six to nine metres above current levels at a global average temperature about 1C above pre-industrial values.

Current Australian government figures do not indicate Australia is on track to meet our committed greenhouse gas emission mitigation target of 26 to 28 per cent reduction in emissions by 2030 'in a canter'. Meeting this target will require the urgent development of an effective Australian climate policy.

Perhaps more importantly, this target is completely inadequate. To make a proportionate commitment to meeting the Paris targets, Australia needs to ratchet up our targets, as expected by the Paris agreement, and to urgently develop realistic plans to meet these targets.

Actions we take now will affect the lives of our children and grandchildren and that of future generations. We know what is required for significant mitigation and we have the knowledge and technologies to do it. What we require urgently is the will to do it.