

The lasting legacy of climate change

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New research confirms the likelihood of a substantial rise in global sea-level in the future if greenhouse gas emissions continue, and highlights the moral significance of decisions made now about mitigating climate change.

An international team led by Dr Nicholas Golledge, who holds a joint position at Victoria University's Antarctic Research Centre and GNS Science, has published a paper in the respected scientific magazine *Nature* titled 'The multi-millennial Antarctic commitment to future sea-level rise'. The study predicts how the Antarctic ice-sheet will respond to

future atmospheric warming.

Using state-of-the-art computer modelling, Dr Golledge and his colleagues simulated the ice-sheet's response to a warming climate under a range of greenhouse gas emission scenarios. They found that all but one of the scenarios (that of significantly reduced emissions beyond 2020) would lead to the loss of large parts of the Antarctic ice-sheet, which in turn would result in a substantial rise in global sea-level.

"The long reaction time of the Antarctic ice-sheet—which can take thousands of years to fully manifest its response to changes in environmental conditions—coupled with the fact that CO₂ lingers in the atmosphere for a very long time means that the warming we generate now will affect the ice-sheet in ways that will be incredibly hard to undo," says Dr Golledge.

In its 2013 Assessment Report the Intergovernmental Panel on Climate Change (IPCC) predicted that the Antarctic ice sheet would contribute only 5 centimetres to global sea-level rise by the end of this century even for its warmest ('business as usual') emissions scenario.

But Professor Tim Naish, who worked with Golledge on this latest study and who was also a lead author of the IPCC report, cautioned that at the time that report was written there was insufficient scientific knowledge on how the Antarctic ice sheet might respond to future warming, meaning the IPCC sea-level projections could have been too modest.

"Our new models include processes that take place when ice sheets come into contact with the ocean. Around 93 percent of the heat from anthropogenic global warming has gone into the ocean, and these warming ocean waters are now coming into contact with the floating margins of the Antarctic ice sheet, known as [ice shelves](#). If we lose these ice shelves, the Antarctic contribution to sea-level rise by 2100 will be

nearer 40 centimetres," says Dr Golledge.

To avoid the loss of the Antarctic ice shelves, and an associated commitment to many meters of sea-level rise, the study shows atmospheric warming needs to be kept below 2°C above present levels.

"Missing the 2°C target will result in an Antarctic contribution to sea-level rise that could be up to 10 metres above present day," says Dr Golledge. "The stakes are obviously very high—10 percent of the world's population lives within 10 metres of present sea level."

The new findings therefore raise an ethical decision for us all, according to Dr Golledge. "Without significant reduction in greenhouse gas emissions over the next couple of decades, we will commit the Antarctic ice sheet to ongoing and widespread melting for the next few thousand years. Is that something for which we really want to be responsible?"

"In order to restrict global [warming](#) to 2°C, and prevent the more dangerous consequences of climate change, the United Nations [climate change](#) meeting in Paris later this year must agree to reduce global CO₂ emissions to zero before the end of the century," adds Professor Naish. "To be on track this will require a global commitment to 30 percent reduction, below year 1990 levels, by the year 2030."

Dr Golledge says the time has come for some serious questions to be answered. "It becomes an issue of whether we choose to mitigate now for the benefit of future generations or adapt to a world in which shorelines are significantly re-drawn. In all likelihood we're going to have to do both, because we are already committed to 25 centimetres by 2050, and at least 50 centimetres of [sea-level rise](#) by 2100."

Dr Golledge says the last time CO₂ concentrations in the atmosphere were similar to present levels was about 3 million years ago. "At that

time average global temperatures were two or three degrees warmer, large parts of the Antarctic [ice-sheet](#) had melted, and sea-levels were a staggering 20 metres higher than they are now. We're currently on track for a global temperature rise of a couple of degrees which will take us into that ballpark, so there may well be a few scary surprises in store for us, possibly within just a few hundred years."

More information: N. R. Golledge et al. The multi-millennial Antarctic commitment to future sea-level rise, *Nature* (2015). [DOI: 10.1038/nature15706](#)

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