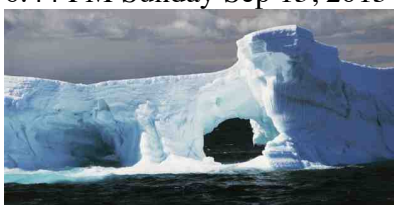
# The Big Read: Climate change and the fate of Antarctica

6:44 PM Sunday Sep 13, 2015



Iceberg, South Shetland Islands, Antarctica. Photo / Getty Images

A world-renowned climate scientist visiting New Zealand will this week present new evidence suggesting a behemoth "sleeping giant" ice sheet is more sensitive to climate change than we ever thought.

To climate scientists, the vast East Antarctic Ice Sheet represents something of the elephant in the room in terms of what it could contribute to global sea level rise.

If all of it melted, the ice sheet, which forms most of Antarctica, would contribute an equivalent of around 50 metres of sea level rise - the vast majority of the total 58 metres that could come from the frozen continent.

The part of the ice sheet that rests on bedrock below sea level is most vulnerable and holds an equivalent of 19 metres of sea level rise.

In the face of climate change, which has brought warmer ocean water to the edges of Antarctica, the vast ice sheet has been long regarded by scientists to be much more stable when compared with the smaller, 25 million square kilometre West Antarctic Ice Sheet, which satellite measurements estimated was losing more than 150 cubic kilometres of ice each year.

But an Australian expedition that managed to reach the typically inaccessible Totten Glacier in East Antarctica in January revealed some of the first direct evidence that warmer waters were having a significant impact there as well.

This means the wider ice sheet's contribution to future sea level rise could be much greater than realised.

CSIRO physical oceanographer and climate scientist Dr Stephen Rintoul, who was onboard the Australian icebreaker research ship Aurora Australis when it managed to reach the remote glacier, said the region that the Totten drains holds enough ice to produce an equivalent 3.9 metres of global sea level rise - about half the amount that could come from the Greenland ice sheet in the Northern Hemisphere.

"There was good evidence from other places in Antarctica that the ocean was responsible for the thinning of glaciers, like the Pine Island glacier in West Antarctica, but we couldn't say why the Totten was thinning because no one had been there before," said Dr Rintoul, who will give a public lecture at Victoria University in Wellington on Tuesday night.

Scientists in Antarctica. Photo / Getty Images

"What we found was, sure enough, there was warm water reaching the glacier - and that really goes counter to what we'd long thought.

"While the ice sheet in West Antarctica has grown and shrunk over time, East Antarctica, we'd always thought, was pretty stable and unlikely to make much of a contribution to sea level rise.

"Our observations, along with new geological evidence that East Antarctica contributed to sea level rise in the past, suggest that we need to reassess that assumption, and realise that East Antarctica may play a bigger role in future sea level rise than we thought."

While the West Antarctic Ice Sheet would respond more quickly to climate change, Dr Rintoul said the new evidence warranted shifting more of the scientific focus to the east.

The first direct evidence that ocean heat was able to erode the ice shelf in the east added to evidence that East Antarctica was more dynamic than we understood.

"For example, if we go back to the last time in Earth's history when atmospheric CO2 was as high as it is today - which was about three million years ago - the sea level during that climate was about 20 metres higher than it is today.

"Twenty metres is an important number because it means even if we melted all of the ice on Greenland at that time, along with all of the ice in West Antarctica, that's still not enough to give 20 metres of sea level rise.

"The only other place that ice could have melted is East Antarctica."

While that climate period, called the Pliocene, was not a perfect analogue for what might happen in the future, it did tell us that East Antarctica wasn't just a big chunk of ice that sat at

the bottom of the globe and didn't change over time.

"It tells us that the East Antarctic Ice Sheet can change, and what will drive those changes is warm ocean waters reaching the ice shelves - and our results are the first to show that that is happening today."

Dr Rintoul's talk will also discuss recent research on the highly vulnerable West Antarctic Ice Sheet.

This showed that some parts of that sheet may already be on the verge of unstoppable collapse and has potential to contribute up to three metres of global sea-level rise over hundreds to thousands of years in the future, even if greenhouse gas emissions were to be stabilised tomorrow.

## Climate change and warmer oceans

Ice floes floating on water in the Ross Sea, Antarctica. Photo / Getty Images

The new findings link in with what is another big part of Dr Rintoul's work - the role of oceans in climate change.

"One of the things that many people don't realise is that, in a sense, global warming is ocean warming - more than 93 per cent of the extra heat that's been stored by the planet over the last 50 years is found in the oceans.

"So that means if we want to understand how the climate is evolving and how the climate is changing, we need to be tracking and understanding what's happening in the oceans."

Of all the carbon dioxide and greenhouse gases that humans emit, around 25 to 30 per cent ends up in the oceans, and this absorption helps to slow the rate of climate change.

"In that sense, the oceans provide a service by soaking up heat and soaking up carbon dioxide, but that benefit we get from them comes at a cost."

As the oceans soaked up the heat, this caused them to expand, which in turn caused sea levels to rise.

"And as the oceans soak up carbon dioxide, they tend to acidify and the chemistry changes - therefore, if we want to understand the impacts of releasing CO2 into the atmosphere, we need to take ocean acidification into account as well as climate change."

With climate change came global impacts on ocean currents, creating the potential for oceans to change in a way that they fed back on the climate system and caused the change to happen more

rapidly.

"So, for example, if climate change caused the ocean to take up less heat, and less carbon dioxide, that would tend to speed up the rate of climate change."

Presently, data collected from ships and ARGO floats - torpedo-like instruments deployed around the globe - showed that the Southern Ocean was taking up much of the heat, and that its waters were "freshening", or becoming less saline.

"The freshening is important because ocean waters get fresher either because there's more rainfall than evaporation, or if it's from melting ice - in the Southern Ocean, both of those things are happening."

Another focus of Dr Rintoul's lecture were important changes in the very deepest part of the ocean - particularly around Antarctica.

"What we've found there is the waters that sink around the edge of Antarctica and fill the bottom of the ocean are not being formed at the same rate as they used to - those waters are becoming lighter, and the dense layers are contracting.

"If we look in the bottom of the ocean, the layer of dense water that used to be about 1000 metres thick in the mid-1990s is only about half that thick today.

"Those changes in the deepest part of the oceans are reflecting changes in the climate around the edge of Antarctica, and the melt of glaciers is probably contributing to those changes."

The deep-ocean data would be greatly improved after the next generation of ARGO floats, named Deep ARGO, were deployed in 2017.

"In general, all of the evidence we have from the ice, from the atmosphere, and from the top to the bottom of oceans, is that the Southern Ocean is having an impact on Antarctica and an impact on our climate.

"The evidence is just becoming more and more clear that change is underway - and work by my colleagues all around the world is showing these changes are a result of human activity. It's not just a natural cycle we are seeing."

Dr Rintoul has led 12 expeditions to Antarctica and coordinated the major international Southern Ocean climate research programmes conducted over the past 25 years.

He was a coordinating lead author for the Fifth Assessment of the Intergovernmental Panel on Climate Change, better known as the AR5.

His scientific achievements have been recognised by many national and international awards, including the Georg Wüst Prize, the Martha T. Muse Prize, the Australian Antarctic Medal and election as a fellow of the Australian Academy of Science.

## Lecture timely ahead of Paris talks

A turquoise lake forms from melting snow near Cape Folger on the Budd Coast, Antarctica. Photo / Getty Images

Professor Tim Naish, the director of Victoria University's Antarctic Research Centre, said Dr Rintoul's lecture was timely ahead of the United Nations climate change negotiations taking place in Paris later this year.

"The science is very clear on the need to limit global warming to 2C by making a new set of commitments to reduce carbon dioxide emissions," he said.

"If we miss this target then we will face some of the more severe consequences of climate change."

New Zealand is taking to the Paris talks a new target of reducing its greenhouse gas emissions by 30 per cent from 2005 levels and 11 per cent from 1990 levels by 2030.

This commitment has been criticised by some climate scientists and environmental groups, and an Oxfam report published last week described it as falling "well short" of a fair contribution towards limiting the global temperature rise to 2C, let alone the 1.5C limit Pacific Island nations were calling for.

According to present projections, the mean temperature in New Zealand could be 2C higher by the end of the century - and even between 3C and 4C higher if no action is taken to curb the world's carbon emissions.

Within the same period, sea level is expected to rise between 50cm and 100cm, leaving populations to adapt by either abandoning coasts and islands, changing infrastructure and coastal zones, or protecting areas with barriers or dykes.

A recent report on sea level rise by Parliamentary Commissioner for the Environment Dr Jan Wright said the impact of even a small rise in sea level would be significant and very costly for some landowners.

Storms occurring on top of a higher sea level would affect public infrastructure such as roads, railways and stormwater systems, as well as private homes and other buildings.

Climate change was also expected to result in more large storms compounding the effects of sea level rise.

The AR5, found that it was "extremely likely" human activities caused more than half of the observed increase in global mean surface temperature since 1950 and that it was "virtually certain" that natural variability alone cannot account for the observed global warming since 1950.

*Dr Rintoul's lecture will be held at Victoria University's Kelburn Campus, in Level 2 of the Hunter Council Chamber, at 5.30pm, Tuesday, September 15. People wishing to attend should

email shannon.digby@vuw.ac.nz with "Lee lecture" in the subject line or phone (04) 463 6587.

- NZ Herald