IceSked

Issue 36: June 2021

Newsletter of Te Puna Pātiotio—Antarctic Research Centre
Te Herenga Waka—Victoria University of Wellington

A word from our Director

In this issue of IceSked, we highlight the contributions our staff have been making to the next generation of model-based projections for ice sheet and mountain glacier melt under future warming scenarios. These models will provide critical contributions to inform the next Intergovernmental Panel on Climate Change assessment report. We also highlight the challenges several of our international students have faced, and more importantly overcome, in light of the current border closures due to COVID-19. Remarkably, this closure did not restrict us in hosting (in person) Professor Emerita Terry Wilson (Ohio State University) who gave an exceptional lecture on measuring the weight of the Antarctic ice sheet for 18th Annual S.T. Lee Lecture in Antarctic Studies.

Rob McKay

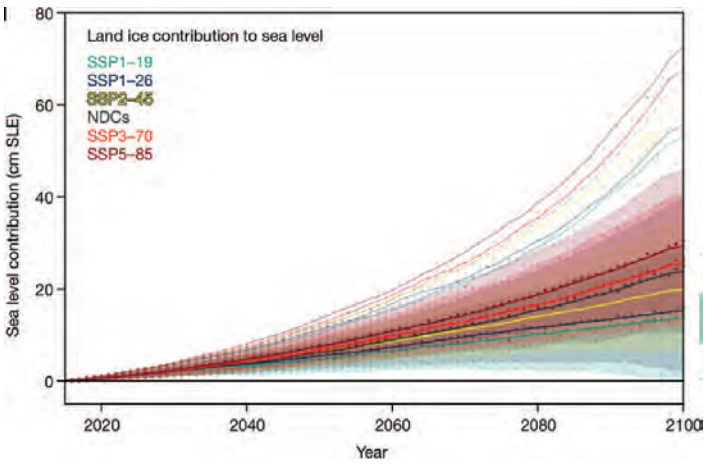
We can limit the future melting of the world's glaciers and ice sheets, as long as we act now

In May, the results of more than five years of ice sheet and glacier modelling by researchers from the Antarctic Research Centre and 80 other scientists from around the world were published in a landmark paper in *Nature*.

The study, led by Dr Tamsin Edwards of King's College London, included ARC's Nick Golledge and Brian Anderson, and ARC alumni and adjunct research fellow, Dan Lowry (also GNS Science). It used outputs from computer simulations to first train a statistical emulator—a tool that identifies relationships in the data and allows them to be reproduced more quickly than from the original models. Then, the emulator was used to investigate socio-economic scenarios or model parameter combinations that weren't part of the original simulations. The flexibility and speed of this approach make it a powerful tool for making predictions, and by running tens of thousands of 'emulated' scenarios, it also allows the uncertainty around future forecasts to be better defined.

The key finding of the research was that if global warming is limited to 1.5°C, rather than the 2.5°C that global governmental emissions pledges currently commit us to, the contribution to sea-level rise from melting ice could be cut from around 25 cm to 13 cm by 2100. This would greatly reduce the costs and impacts of coastal flooding around the world, including in New Zealand. The study underlines the importance of making swift and decisive climate action at all scales, and highlights that we still have a chance to limit the future melting of the world's glaciers and ice sheets, as long as we act now.

The results will inform the United Nations Intergovernmental Panel on Climate Change's (IPCC) Sixth Assessment Report, which will be published later this year, but more immediately, they help underscore the central message of a new global initiative, the '50x30 coalition' (www.50x30.net). This international effort, of which the ARC is a founding member, aims to press governments around the world to take more decisive action on climate change. The coalition is part of a worldwide movement to reduce all greenhouse gas emissions to 50% by 2030, in line with IPCC recommendations for staying within the 1.5°C Paris Agreement limit by the end of the century. This requires net carbon neutrality by 2050. Currently, the NZ government is committed to reducing CO_2 emissions to net zero by 2050, but other greenhouse gases such as methane and nitrous oxide are not yet included in this target.



Projected land ice contribution to sea level by 2100 under a range of greenhouse gas emissions scenarios, from a statistical model trained on process-based ice sheet and glacier simulations. Solid lines show the most likely values, and shaded regions show the associated uncertainties (Edwards *et al.*, 2021, *Nature*)

S.T. Lee Lecture in Antarctic Studies

The 18th Annual S.T. Lee Lecture in Antarctic Studies on 15 April, was presented by Professor Emerita Terry Wilson, The Byrd Polar and Climate Research Center, The Ohio State University, USA.

Terry's lecture, 'Weighing the Antarctic ice sheet: A decade of geophysical imaging', explained a novel approach to understanding the loss of Antarctic ice by measuring the rate and pattern of bedrock deformation as the melting ice sheet 'loses weight', a process called 'glacial isostatic adjustment'. Measuring the solid Earth motions as it deforms using geodesy, and scanning the deep earth underlying the ice using seismology, provides a geophysical 'scale' to monitor weight change in the Antarctic ice sheets. It is now recognised that the changing shape of the deforming bedrock can alter how the ice sheets flow and how much ice is discharged to the surrounding oceans. Under certain conditions, these 'negative feedbacks' can stabilise ice sheet retreat and slow sea-level rise.

Terry was a pioneer in using GPS to measure bedrock motion in Antarctica and has led over 25 field expeditions to Antarctica. She has been influential in training the next generation of polar scientists, mentoring over 40 students in Antarctic research, and organising multiple international training schools on polar science. Terry has held several high-profile leadership positions in polar science and is currently the delegate to SCAR (Scientific Committee on Antarctic Research) for the International Union of Geological Sciences.

The ARC was lucky that Terry was already in New Zealand after getting 'locked down' in Akaroa, Banks Peninsula over a year ago due to COVID-19 boarder closures. Whilst in Wellington, as well as giving the public S.T. Lee Lecture, Terry also presented specialised lectures at GNS Science and to the School of Geography, Environment and Earth Sciences, she spoke with media, and participated in fieldtrips to Matiu/Somes Island and the Whanganui coast as part of a third year course.

Terry Wilson in Coachella Valley, California, USA

Arnold Heine Antarctic Research Award

The 2021 Arnold Heine Antarctic Research Award recipient was recent MSc graduate Emily Moore. Emily will use the funds to write and publish an academic paper based on her MSc thesis.

The thesis, titled 'The glacial history of Rocky Top cirque, southeast Fiordland, New Zealand', studied Rocky Top cirque, a presently non-glaciated site that has evidence of past glaciation in the form of moraine sequences. Moraines are ridges of glacier debris that form at ice margins. As mountain glaciers are sensitive to climate, changes in climate are expressed in glacier length fluctuations recorded by moraine deposits. These moraine records offer the potential to reconstruct past climates in order to extend existing instrumental climate records, which are especially limited in the Southern Hemisphere. The aims of Emily's thesis were (i) to constrain the timing and magnitude of past glacier length changes at Rocky Top cirque, and (ii) to derive a quantitative estimate of paleoclimate. She achieved these aims by utilisation of a combination of geomorphic mapping, cosmogenic ^{10}Be surface exposure dating and modelling of the former glacier surface (equilibrium-line altitude reconstruction).

Emily's research demonstrated that the Rocky Top cirque glacier exhibited periods of re-advance or standstills within an overall pattern of glacier retreat between ~19,000 and 17,000 years ago. These insights are significant for determining the dominant drivers of climate and glacier length changes during the pre-industrial era, providing an important baseline for assessing present-day anthropogenic climate change.

Emily Moore taking measurements, Rocky Top cirque

Studying abroad during COVID-19 boarder closures

Yaowen Zheng during a badminton tournament

In November 2020, I enrolled in my PhD at Victoria University of Wellington. However, border restrictions due to COVID-19 prevented me from actually coming into New Zealand and joining the ARC. Instead, I was in Hobart, Australia waiting for trans-Tasman travel to open. After six months spent visiting the University of New South Wales, the Australian National University, and the University of Melbourne, the trans-Tasman travel bubble finally opened on 19 April 2021, so I boarded a plane, and arrived in Wellington the very next day!

I have a keen interest and background in maths and physics. During my Honours year I found myself also becoming interested in Antarctica, ice cores and paleoclimatology and decided to do a PhD in this area of research and step into an academic career. Through recommendations from my supervisors I was put in touch with the ARC's Nick Golledge and Nancy Bertler and we started a conversation about potential projects that fitted both their fields and my own interests. I've only been here a few weeks, but the ARC is more stimulating than I expected, and the people are very supportive. I am working with Nick, Nancy and ARC postdoctoral fellow, Alexandra Gossart on a project in understanding surface melt in Antarctica and the implications for future ice sheet evolution.

Yaowen Zheng

I began my journey working with Rob McKay through email correspondence enquiring about a PhD in July of 2020, seeking a shift in my career path, but was aware COVID-19 was going to make international travel hard. At the time, I was teaching physical geography and mathematics for local community colleges but wanted to work on climate change to help me and my future children develop a better world. Despite being unable to travel to New Zealand, I was fully accepted to my PhD programme in October 2020 while still working remotely. There have been a few unique challenges, such as navigating the complex layers of paperwork related to the pandemic, and working on a project in an area I've never studied in depth. This required quite a bit of background work to catch up on - but I've loved learning about all of it. Rob and I have risen to each challenge, navigating an immigration approval as a Critical Worker on a government funded science project—and can now enter into New Zealand in July while borders are still shut to most.

My PhD research involves looking at the sedimentology and stratigraphy collected by International Ocean Discovery Program Expedition 374 in 2018. I will focus on Site U1521, which includes a spectacular record of the Miocene Climate Optimum, thought to represent some of the warmest climates of the past 34 million years—as well as the Miocene Climate Transition, which is a large cooling event that is thought to have led to a permanent shift toward larger ice sheets in Antarctica. I have already gotten to know many in the International IODP Expedition 374 team via various zoom meetings, but I look forward to finally arriving in Wellington. It will be great to have other students and staff to interact with again in person, and bounce ideas off.

Jay Cockrell

Jay Cockrell in Grand Canyon National Park, USA

The Alarmist: Fifty Years Measuring Climate Change

ARC Adjunct Professor, Dave Lowe, has just launched his book *The Alarmist: Fifty Years Measuring Climate Change* which tracks his journey from a high school dropout to Nobel Peace Prize-winning scientist. Dave was recruited at the age of 23 by climate scientist Charles David Keeling, who developed an early gas analyser and set up the world's first record of atmospheric carbon on Mauna Loa, Hawaii. Keeling wanted Dave to start tracking the same process in New Zealand, so he would have a record in both hemispheres. So, from a lighthouse on a rugged, windswept peninsula on Wellington's Baring Head, he's been tracking minute particles in the air for the last 50 years. The gas analyser they developed splits a sample of air into 1 million parts and counts how many of those are CO_2. The first ever CO_2 reading Dave recorded at Baring Head was 323 parts per million (ppm). The most recent reading was 410 ppm—invaluable mathematical proof that human activities were having an irreversible impact on the planet.

But there is hope, says Dave, "We know how to move towards net zero carbon. There's no magic new tech required, it's just the political will that's needed."

The Alarmist: Fifty Years Measuring Climate Change (VUP, $40) is out now

Congratulations and welcome to our students

The ARC would like to congratulate the following students on recently completing their theses:

Florence Isaacs PhD, 'Sea ice and large-scale atmospheric variability in East Antarctica.' Supervised by James Renwick (SGEES) and Ruzica Dadic (ARC).

Wei Ji Leong PhD, 'The subglacial landscape and hydrology of Antarctica mapped from space.' Supervised by Huw Horgan (ARC/SGEES) and Brian Anderson (ARC).

Emily Moore MSc, 'The glacial history of Rocky Top cirque, southeast Fiordland, New Zealand.' Supervised by Shaun Eaves (ARC/SGEES) and Kevin Norton (SGEES).

Marjolaine Verret PhD, 'Reconstructing 15 Myr of environmental change in the McMurdo Dry Valleys through permafrost geochemistry.' Supervised by Warren Dickinson (ARC) and Kevin Norton (SGEES).

We would also like to welcome new students to the ARC

Olya Albot, Patty Anderson, Joanna Borzecki, Jay Cockrell, Kevin Henson, Natasha Lelieveld, Ruby Muir, Ihanshu Rane, Greta Stuthridge, Hayden Young, and Yaowen Zheng.

ARC's 50th anniversary coming in 2022!

The Antarctic Research Centre was formally established in the beginning of 1972, so 2022 marks our 50th anniversary. To celebrate we are planning an ARC reunion for all current and past staff and students. We plan to hold a social event (probably mid-year) as well as create a 'memories' booklet to remember our journey from the early days, when the staff consisted of just Peter Barrett and Alex Pyne, to today with almost 30 staff made up of permanent academics, postdocs, engineers, administrators and adjuncts. We hope 2022 will see New Zealand's boarder reopen so some of you may be able to join us in person, so we'll let you know as soon as we have plans in place. In the meantime, if you have any memories you'd like to share or old photos from your time with us, please email them to: Michelle.Dow@vuw.ac.nz

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