IceSked

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Victoria University of Wellington

A word from our Director

Postdoctoral fellowships change people's lives, often providing a bridge between PhD studies and a permanent academic job. In this issue we highlight our recent success in attracting an unprecedented three new Rutherford postdoctoral fellows to the ARC. We also report on other successes including a new Marsden grant to Rob McKay, new scholarships and exchanges, and the 16th S.T. Lee Lecture by Dorthe Dahl-Jensen from the University of Copenhagen. We were also delighted to host Rt. Hon Helen Clark and share with her our latest research on the state of glaciers in New Zealand and worldwide.

Andrew Mackintosh

Antarctic research benefits from Rutherford postdoctoral fellowships

Congratulations to Bella Duncan, Holly Winton and Oliver Wigmore who are among ten researchers nationwide awarded Rutherford Foundation New Zealand Postdoctoral Fellowships. All three will be based here in the Antarctic Research Centre (ARC). The two-year fellowships from the Royal Society Te Apārangi are for promising researchers in the early stages of their careers. Four fellowships were awarded to Victoria University.

ARC Director, Andrew Mackintosh says the Centre is delighted to secure three Rutherford postdoctoral fellowships.

"This provides further evidence of our standing as a leading global research centre, attracting the brightest young international scholars to Wellington, and also supporting our home grown talent."

Bella Duncan, who completed her PhD in 2017 with the ARC's Rob McKay and Tim Naish, has been awarded her fellowship for research into the role that atmospheric warming has played in driving ice sheet retreat and Antarctic environmental change in the past. She will use molecular fossils to reconstruct past Antarctic climate, air temperature, and vegetation.

Holly Winton will conduct research using biomarker techniques on Antarctic ice cores to study marine primary production—tiny photosynthetic plants that float in the upper ocean—in the Ross Sea over the past 2000 years. The research aims to answer how primary production changed over this time period and what drove the change.

Bella is currently working at the ARC, and Holly, who completed a Master's degree with the ARC in 2011, has been working for the British Antarctic Survey in Cambridge in the United Kingdom since completing her PhD.

Oliver Wigmore, from the University of Colorado, Boulder, will map changes in the debris-covered tongue of New Zealand's biggest glacier—the Tasman—using drones, satellites and field observations. The data will improve our understanding of how debris-covered glaciers respond to climate change.

The ARC team is very pleased to continue working with Bella and looks forward to welcoming Holly and Oliver in 2019.

ARC's new Rutherford postdoctoral fellows—Bella Duncan, Holly Winton and Oliver Wigmore

Helen Clark's visit sparks discussion on the future of glaciers

The ARC was delighted to host former Prime Minister, Rt. Hon. Helen Clark on 10 July to share details of key research projects seeking to better understand the impact climate change is having in New Zealand.

Helen Clark spent time with staff and students from the Centre before sitting down with ARC Director, Professor Andrew Mackintosh, ARC's Senior Research Fellow Dr Brian Anderson, PhD candidate Lauren Vargo, Chief Scientist for Climate-NIWA, Dr Sam Dean, and Victoria alum, now working at the University of Canterbury, Dr Heather Purdie, who all talked with Helen Clark about their areas of research focus—spanning the breadth of climate modelling to water security and threats to regional economies.

Speaking to the group, Helen Clark said she had accepted the offer because she was seeing the incredible impact climate change is having, including on some of the poorest and most vulnerable communities in the world, and increasing extreme weather and storm events.

"I've found that for the developing countries their focus was very much on adaptation. But of course we know that unless you're addressing the source of the problem you can't adapt your way out of it. In the end you have to mitigate and that involves getting the carbon footprint down."

"These are the issues that I have a passionate interest in, and catching up with the latest scientific research is extremely important, because I will keep commenting on these issues."

A particular focus of the meeting was the changes observed in glaciers because of the impacts of climate change, both in New Zealand and worldwide, and the trickle down effects this would have for communities who lived near them and relied on them for access to clean water, irrigation for farming, and even to support the economy.

Andrew shared research showing that glaciers are retreating significantly throughout the world.

"Glaciers have been retreating since the early 20th Century, but ice loss has accelerated in recent decades. The problematic areas are arid areas—particularly in central Asia and South America. Communities there often rely on water that runs off melting snow and ice. By looking at climate change features and doing some simple calculations, there's estimations that this could impact at least 60 million people. From a water resources perspective, melting glaciers are terribly important."

From there the discussion moved on to a New Zealand context, Lauren shared insights on the NIWA End of Summer Snowline Survey, which has provided an ongoing record of key New Zealand glaciers since 1977. Every year at the end of summer ARC and NIWA scientists take to the air in light aircraft to take photos of 50 New Zealand glaciers.

"We're taking hundreds of photos of each, and by geotagging them and using modelling software we can now generate 3D models of glaciers, which visually show the changes in glacier size over the past 40 years," says Lauren.

Brian discussed the effects this changing glacial landscape might have.

"There are more than 3,000 glaciers in New Zealand, and when they melt, they impact different parts of New Zealand in very different ways, even in quite a small geographic area—along the West Coast, an increase in meltwater can lead to flood events, while at the same time, the loss of glaciers in Canterbury will impact on irrigation and hydropower, and in Southland, the timing of the melt will impact on lowland water quality."

A tangible example that Brian gave was the changes observed on the Franz Josef Glacier which, he pointed out, had retreated 1.5 km since 2012.

"If we don't start to take action to mitigate climate change then it's a nightmare scenario for glaciers," said Brian. "All we'll have are some glaciers on the highest peaks—well known glaciers like Fox and Franz Josef will be almost gone."

"If we follow the Paris agreement and start reducing greenhouse gas emissions quickly and start taking it out of the atmosphere after 2050, then we'll have smaller but still spectacular glaciers. It's really up to us."

Helen Clark talking with Lauren Vargo, Andrew Mackintosh, Brian Anderson and Heather Purdie (back to camera)

Greenland ice cores tell tales of past sea-level contributions from Antarctica

On 1 November, Professor Dorthe Dahl-Jensen, an internationally respected and award-winning ice scientist at the Niels Bohr Institute, University of Copenhagen, presented the 16th annual S.T. Lee Lecture in Antarctic Studies.

Dorthe's lecture focussed on how the Greenland ice sheet is reacting to climate change—progressively losing more mass every year. One future challenge is adapting to rising sea level so by looking into how ice sheets react to changing climate in the past, we can improve future predictions of sea-level rise.

During the last interglacial, 130,000-115,000 years before present, climate was 5°C warmer over Greenland, and global sea level was 6-9 metres higher than present. All ice cores from Greenland show that the ice sheet survived, making only a modest contribution to global sea-level rise of approximately 2 metres. These findings imply that Antarctica was a major contributor to sea-level rise during this past warm period, and may respond similarly in the future.

ARC Director, Andrew Mackintosh says it is challenging to work out exactly where Antarctica's sea-level rise contribution of 4-5 metres may have come from. A sea level contribution of this size requires total loss of marine-based parts of the West Antarctic Ice Sheet, but also ice loss from coastal sections of East Antarctica.

Dorthe and Andrew agree that there are a lot of unknowns in trying to tease out what happened to the great ice sheets in the past, how they might react to different amounts of future warming and what the resulting rise in sea level might be.

"One of the biggest uncertainties is our behaviour in the future," says Dorthe. "Because how strong the temperature change is going to be depends on how we react and how much greenhouse gases we put in the atmosphere."

Professor Dorthe Dahl-Jensen in Greenland

PhD student receives exciting scholarships

PhD student Florence Isaacs was one of three candidates to receive a 2018 Antarctica New Zealand scholarship for research on Antarctica and the Southern Ocean. Florence, who is undertaking her studies with James Renwick (SGEES) and Andrew Mackintosh (ARC), says the scholarship will give her opportunities to go to Antarctic conferences and science summer schools, as well as travel to Antarctica.

Florence Isaacs on traverse to McMurdo Sound, Antarctica

"I hope this is the beginning of a long relationship with Antarctic research," Florence says. "It's incredibly exciting to be given the opportunity to achieve one of my lifelong dreams."

In November, Florence travelled to Antarctica with NIWA scientist Natalie Robinson to study how sea ice in McMurdo Sound interacts with the upper ocean.

Florence was also a recipient of an ARC Endowed Development Fund, to attend the highly competitive Karthaus Summer School on Ice and Climate, run by the Institute of Marine and Atmospheric Research, Utrecht. The school provides a basic introduction to the dynamics of glaciers and ice sheets, for around 40 early-stage PhD students from around the world.

"Before starting this research I had very little background in glaciology, so the Karthaus Summer School really helped to bridge a gap in my knowledge, and expand the possibilities of my research. I hope to incorporate many of the tools and skills that I gained into my final thesis," says Florence.

A new direction for the S.T. Lee exchange

The S.T. Lee Young Scientist Exchange has a 15-year legacy supporting students of glaciology and climatology. It was therefore surprising when my application's outcome read "you'll be the first volcanologist supported by this exchange". So what can volcanoes tell us about climate?

Since the 1950s, a small number of volcanologists have recognised that lava flows can be buttressed by ice, which often produces spectacular landforms covered with fine-scale cooling joints. Incidentally, such landforms are also paleoclimatic records of ice thicknesses. This concept has been applied with large success in the Tongariro National Park, New Zealand which is a focus of my PhD research. Thanks to Dr Lee, IARC Director, Hajo Eicken and ARC Director, Andrew Mackintosh, I was able to share the results of my glaciovolcanic studies with scientists at the University of Alaska-Fairbanks, the Alaska Division of Geological and Geophysical Surveys (Fairbanks) and the USGS Alaska Volcano Observatory (Anchorage).

My visit to Fairbanks spurred a collaboration with researcher Pavel Izbekov to examine the relative outputs of magma and gas at selected (well-monitored) circum-Pacific stratovolcanoes. Because many of these volcanoes have experienced glaciation, we need to understand how ice has affected the preserved volume of material on each volcanic edifice. Without considering glaciovolcanic processes, it would be impossible to accurately quantify variations in magma output through time.

Leo Pure

Leo Pure in Denali National Park, Alaska

What do climate change science and soft tissue robotics have in common?

On the face of it nothing at all! However, in July ARC adjunct, Dr Dave Lowe, was invited to give a keynote lecture on aspects of climate change science to an engineering summer school run by German and International experts within the field of robotics at the University of Stuttgart.

Mitigation and adaptation to climate change will require huge developments in technology many of which are underpinned by the rapidly developing field of robotics, including soft tissue robotics. Dave's keynote, deliberately aimed to be provocative, led to a lively discussion in several key areas where new technology could reduce carbon emissions. In agriculture, soft tissue robotics harvesting of fruit and other crops is a common theme and there were experimental proposals to replace sugar beet fields with large photo voltaic arrays. The overall efficiency of the process measured by land use and other parameters might be 15% which compares with less than 1% for conventional sugar beet farming. Sounds great but, like many other ideas to mitigate CO_2 emissions, behavioural change remains a huge problem.

However there was a willingness of scientists and engineers to accept climate change as a serious threat and examine ways in which they might be able to help with mitigation and adaptation. *Dave Lowe*

More success for ARC researcher

Rob McKay has recently been awarded a Marsden Fund grant, administered by the Royal Society Te Apārangi, for his research on "Antarctic ice sheet interactions with the ocean during past warm climates". He is Among 22 Victoria University-led projects and will receive $960,000 over three-years.

Rob's research is looking into the marine-based West Antarctic Ice Sheet which is currently experiencing accelerated, and potentially irreversible retreat. This reflects shifts in wind-driven oceanic currents that are transporting warm waters towards the ice margin. While sea-level rise is the obvious impact of ice sheet melt, one of the largest unknowns is the role that ocean-ice sheet interactions may play in either dampening or amplifying future climate change.

"Our aim is to improve knowledge of the magnitude of ice sheet-ocean interactions during large (>2^{0}C) global climate changes in the geological past, when the Antarctic ice sheet partially retreated" says Rob.

Rob McKay on board the *Joides Resolution*

Polar2018 conference

The XXXV SCAR Open Science Conference was a joint meeting between the Scientific Committee on Antarctic Research (SCAR) and the International Arctic Science Committee (IASC). The meeting, held in Davos, Switzerland from the 15-26 June, was collectively called POLAR2018 – "Where the Poles come together". It brought together the world's leading Antarctic and Arctic researchers for the first time since the International Polar Year of 2007-2008.

ARC were well represented at the conference with 13 participants out of a 72-strong New Zealand contingent. Nancy Bertler and Tim Naish chaired SCAR strategic research programmes (SRPs) workshops: 'Antarctic Climate in the 21st Century' (AntClim21) and 'Past Antarctic Ice Sheet Dynamics' (PAIS), respectively.
https://www.scar.org/science/srp/

Three new programmes were also approved, one led by Tim provisionally entitled 'Antarctic Ice Sheet Dynamics and Global Sea Level' (AISSL) aims to quantify the Antarctic ice sheet contribution to past and future global sea-level change, from improved understanding of climate, ocean and solid Earth interactions and feedbacks with the ice, so that decision-makers can better anticipate and assess the risk in order to manage and adapt to sea-level rise and evaluate mitigation pathways.

Peter Barrett, Laura DeSantis (OGS, Italy) and US educator Kimberly Kenny, hosted an evening event showcasing 50 years of scientific ocean drilling and discovery around Antarctica from the pioneering expeditions in the early 1970s to the most recent drilling leg in the Ross Sea led by Laura and ARC's Rob McKay. Tim also chaired a lively panel presentation and Q and A on 'Polar Change and the Future of Society', sponsored by the journals *Nature* and *Nature Communications* to celebrate 60 years of SCAR and the production of a special *Nature Insight* issue.

The research presented by ARC continues to be of the highest quality and attracts a lot of interest whether it be ice sheet modelling, past ice sheet reconstructions from geological and ice core data or geomorphic reconstructions using cosmogenic isotopes.

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