# IceSked

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## A Word From our Director

In this issue, we showcase recent drilling successes on the Ross Ice Shelf and from the International Ocean Discovery Project (IODP) expedition to the Ross Sea. We also highlight our people - Nick Golledge, winner of the 2017 McKay Hammer award and freshly appointed IPCC Lead Author, and PhD students Abhijith Ulayottil Venugoapl and Jamey Stutz, who are using ice cores and cosmogenic isotopes to reconstruct past Antarctic climate and ice sheet changes.

*Andrew Mackintosh*

## ARC expertise a major contributor to the IPCC sixth assessment cycle

Two ARC researchers have now been confirmed as Lead Authors in the sixth assessment cycle (AR6) of the Intergovernmental Panel on Climate Change (IPCC) - the world's leading independent assessment of our changing climate. Andrew Mackintosh and Nick Golledge are joined by three other Victoria University academics; Dave Frame and Judy Lawrence (Climate Change Research Institute), and James Renwick (School of Geography, Environment and Earth Sciences). Together, they make up one of the larger groups of Lead Authors from any organisation to be involved in preparing the report.

"It's rare to have five Lead Authors from one institution selected for the same assessment cycle," says Andrew. "Victoria University is very strong in climate science across a wide range of areas relevant to society - including climate physics, global and regional climate change, ice sheets and sea-level rise, and adaptation - which gives us a significant advantage when working on these reports."

The IPCC produces a range of reports that assess scientific, technological and socio-economic information from different areas over the last five years. The reports look at the science of climate change, the impacts of climate change, and mitigation of climate change across the globe.

Nick will be our third ARC Lead Author, joining Tim Naish, who was a Lead Author in the Fifth Assessment Report (AR5), and Andrew, who is a Lead Author in the Special Report on the Oceans and Cryosphere in a Changing Climate (SROCC), which also forms part of AR6 (see previous issue of Icesked).

Nick will work in Chapter 9 'Ocean, cryosphere, and sea level change' of the main assessment report. Andrew says,

"Nick's expertise in ice sheet modelling and projected changes in the Antarctic ice sheet will be critical for considering how sea level will rise in the 21st Century and beyond. This is one of the key areas where things have changed since the publication of AR5 in 2013."

Nick's role in this chapter is also closely aligned with the MBIE funded NZ SeaRise Programme led by Tim Naish, providing a boost to the international connections and stakeholder engagement aspects of this major ARC project.

Andrew is continuing his work as a Lead Author of Chapter 3 'Polar Regions' of SROCC. He is assessing how climate change is influencing polar ice sheets and glaciers, and how these changes are affecting oceans, ecosystems and people. Andrew's role is closely aligned with the anticipated focus of the 'Antarctic Platform' recently supported by the MBIE Strategic Science Investment Fund.

The contribution to be made by Victoria University staff is significant says Nick.

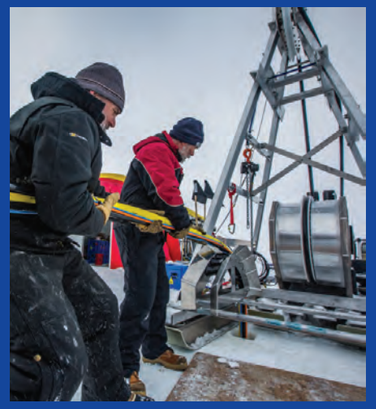
"Our involvement in this report really demonstrates the strength of our international research and recognises the significant scientific contributions we are making."

Victoria's IPCC authors: Dave Frame, Andrew Mackintosh, Judy Lawrence, Nick Golledge, and James Renwick - Photo: VUW Image Services

## Hot water drilling into the world's least known ocean

Over the last two years the ARC, Antarctica New Zealand, and our New Zealand Antarctic Research Institute (NZARI) partners has embarked on an ambitious programme directly accessing the ocean cavity beneath the Ross Ice Shelf. The Ross Ice Shelf is thought to play a key role in 'holding back' or buttressing the ice presently flowing from the East and West Antarctic ice sheets. If this effect was removed the flow of ice from the ice sheets is anticipated to increase dramatically, raising sea level, changing local ecosystems, and most likely changing global ocean and atmospheric circulation. However, direct observations to support and test our conceptual understanding of the ice sheet processes are very sparse.

This 2017/2018 season, the Ross Ice Shelf Project conducted a major traverse, travelling 350 km to the south east of Scott Base with tonnes of drilling and living equipment in tow. Once at the site, two holes were melted through the ~370 m thick ice allowing access to the ocean cavity, and sea floor a further 410 m below the base of the ice. The first hole was used for moorings which will return data over the next ~5 years. NIWA deployed instruments for measuring ocean temperature, salinity and current speed, and a series of seismographs for measuring ice shelf properties were deployed by Auckland and Otago universities. The second hole was used for recovering sediment cores, further oceanography and microbiology. The science team which included Gavin Dunbar and Georgia Grant (ARC), Christian Ohneiser (University of Otago) and Jeff Dunne (Antarctica New Zealand) collected 11 sediment cores. The ARC's Science Drilling Office (SDO) also provided the drilling team consisting of Alex Pyne (team leader), Darcy Mandeno (engineer/driller), Jeff Rawson (mechanic/driller), Hedley Berge (electrician/driller), and Jane Chewings (driller - seconded from SGEES).



SDO duo Darcy Mandeno and Alex Pyne
Photo: www.neilsilverwood.com

Beginning in the 2019/2020 season the community is preparing for the second phase of the Ross Ice Shelf Project that will access the ocean and sea floor under the Kamb Ice Stream. This site, close to West Antarctica, will further improve our understanding of ice sheet dynamics, which may well indicate the ice shelf's fate.

## A new baseline for understanding modern ice sheet changes

In December 2017, I carried out my PhD fieldwork, along with my supervisor Andrew Mackintosh, fellow PhD student Ross Whitmore, and mountaineer Bia Bouchinhas. The field site was the monstrous David Glacier in Antarctica, which has a drainage area the size of New Zealand and averages over 2000 metres thick! It flows from the high and dry East Antarctic plateau, dissects the Transantarctic Mountains and discharges into Terra Nova Bay in the western Ross Sea. The aim of this project is to understand the long-term thinning history of David Glacier by providing precise chronological ages for glacial erratics left stranded on mountains adjacent to the glacier.

Jamey Stutz and Ross Whitmore sampling along Hughes Bluff with David Glacier in the background

Our field season was an incredible success due to teamwork, amazing weather, and world class logistical support from Antarctica New Zealand, the Italian National Antarctic Programme, Southern Lakes Helicopters, and Kenn Borek Air. In just two weeks, we established 'Camp Yellow', collected more than 100 samples (~350 kg!) from five sites and returned to Scott Base for holiday festivities. Non-scientific highlights of the season include celebrating Ross's birthday, Italian made fresh pizza and bread, and two magical days off as bad weather passed.

I am currently processing my samples in the cosmogenic nuclide chemical laboratory at Victoria, with the assistance of Ross and SGEES supervisor Kevin Norton. Stay tuned as this story develops!

*Jamey Stutz*



## ARC-led research vessel returns from Ross Sea expedition

Led by ARC's newly promoted Associate Professor Rob McKay and Dr Laura De Santis (Istituto Nazionale di Oceanografia e di Geofisica Sperimentale, Italy), the 30-strong research team aboard the *JOIDES Resolution* travelled to Antarctica as part of the International Ocean Discovery Program (IODP).

The research team has brought back rock cores from up to 700 m below the sea floor collected from five different sites on the West Antarctic Ice Sheet. These cores contain substantial new knowledge of past ice sheet behaviour that are critical for predicting the effect of climate change and ocean warming of this vulnerable area of Antarctica.

"We think the modern melting of the West Antarctic Ice Sheet is due to ocean warming, but we are not sure exactly how much warming is required to cause a major loss of the West Antarctic Ice Sheet," says Rob. "Because of this expedition we now have records that will document the magnitude of ocean warming during major ice sheet collapse events in the geological past. It is this direct link between large changes in ice sheet size and the associated change in the oceans directly offshore that is unique to this expedition."

This expedition also broke two drilling records: it achieved the highest-ever recovery rate from a deep drill core, which is typically difficult due to the logistical challenges of working in the Antarctic environment, and retrieved the longest-ever piston core, giving the research team a pristine geological record of oceanographic change over several million years.

This expedition is only the second ship-based deep geological drilling expedition to travel to the Ross Sea. The first expedition on the *GLOMAR Challenger* in 1973 showed that the Antarctic ice sheet is over 25 million years old, which was much older than the two million years researchers had expected. This was followed by an expedition to the Southern Ocean that provided the first ocean temperature history for the last 50 million years through pioneering studies on microfossil geochemistry.

The work completed by the *JOIDES Resolution* and *GLOMAR Challenger* teams is part of a 50 year history of expeditions beginning with the Deep Sea Drilling Project in 1968. Since then, 23 countries have taken part in over 300 expeditions, culminating in the IODP, which will run until 2023.

Laura De Santis and Rob McKay on board the *Joides Resolution*

## From Asian monsoons to Antarctic ice cores

Originally from Kerala State in India, I moved to New Zealand in early 2016 to start my PhD on the Roosevelt Island Climate Evolution (RICE) Project with the project leader, Nancy Bertler. My previous research experiences, including my Master's thesis, was on Asian monsoon using marine proxies. This PhD project on high latitude climate systems involving atmospheric proxies, was both equally challenging and exciting.

Abhijith Ulayottil Venugoapl at the Ice Core Facility, GNS Science

My PhD project using the RICE ice cores, aims to reconstruct environmental conditions and atmospheric circulation patterns in the Ross Sea region during the millennial scale warm events of the last glacial period known as the Antarctic Isotope Maxima (AIM). These events have been the subject of great research interest mainly because of their out of phase temperature relationship with their Greenland counterparts (Dansgaard – Oeschger events) known as the 'bipolar seesaw' and also because of the pivotal role played by meridional overturning circulation in these events.

Recently I was grateful to have been awarded a travel grant from the New Zealand Antarctic Research Institute (NZARI) to present our work in the joint Scientific Committee on Antarctic Research (SCAR) and the International Arctic Science Committee (IASC) POLAR 2018 Conference, to be held in Davos, Switzerland this month. I will be presenting highly-resolved RICE chemistry data for the AIM events between 26 and 82 thousand years before present. I believe this conference will be a perfect platform to showcase our results and to receive expert opinions that will significantly contribute to my research.

*Abhijith Ulayottil Venugoapl*

# ARC researcher wins the McKay Hammer award

Nick Golledge with his McKay Hammer

The 2017 Alexander McKay Hammer – the premier award of Geosciences New Zealand – went to the ARC's Nick Golledge. The McKay Hammer is given to a researcher for the most meritorious contribution to geology published in the previous three calendar years. During the nomination period of 2014-2016, Nick published 24 papers dealing primarily with modelling of the Antarctic ice sheet, all in quality science journals including *Nature, Nature Climate Change,* and *Nature Communications*. The papers' co-authorships reveal a high level of collaboration that involves local and international scientists.

Nick joined the ARC in 2009, initially on a 3-year Research Fellowship supported from the Alan Eggers donation to expand the Centre's Antarctic ice sheet modelling capability. Nick's science helps fill an important gap in New Zealand's geoscience. As a nation, we have an excellent record in the international paleo-environmental community. However, we have lacked in applying past environmental reconstructions to improve future projections of change via numerical models. This is where Nick steps in. He provides realistic simulations that employ the paleo–record to help determine future outcomes of prolonged change under natural and anthropogenic forcings. Nick is also a world leader with only a handful of other groups undertaking this type of paleo-calibrated ice sheet modelling world-wide.

As well as being remarkably productive Nick also received both a Rutherford Fellowship and was an AI on a successful RSNZ Marsden Fund in 2015, and is one of the science leaders in the NZ SeaRise Programme in 2017.

# Lessons from the Arctic exhibition

In February, Victoria University's ARC and School of Architecture in association with the New Zealand Antarctic Society and the Norwegian Honorary Consulate General arranged the Wellington showing of the Fram Museum Exhibition "Lessons from the Arctic—How Roald Amundsen won the race to the South Pole", sponsored by the Royal Norwegian Embassy, Canberra.

In December 1911, Roald Amundsen planted the Norwegian flag at the South Pole, just weeks ahead of British polar explorer Robert Falcon Scott, who was approaching by another route. How did Amundsen succeed? The panel exhibition of images and personal accounts explained in detail how Amundsen spent his youth preparing for a life in the Polar Regions, including his three years spent learning from the Inuit in the Arctic. It gave an insight into why he used Greenland dogs, why he tore out the old steam engine in his ship, the *Fram* and replaced it with a diesel engine, and why Lindstrøm cooked American Hotcakes for breakfast every morning. The rare images displayed were taken by the expedition crew and hand-coloured by Amundsen himself.

The month long exhibition included a ceremony on the 7 February opened by the Ambassador of Norway, Her Excellency Ms Unni Kløvstad, along with public events including the screening of the Amundsen episode from 'Ten Who Dared', a 1977 series narrated by Anthony Quinn and three public talks. Ursula Rack's (Gateway Antarctica, University of Canterbury) talk "Race to the South Pole: A historian's view" covered some of the circumstances of the race itself noting it was an event of enormous effort in an extreme environment, driven by science, politics and proving themselves in the context of their time. James Renwick's (SGEES) and Tim Naish's (ARC) combined talk "A race to save the pole: A scientist's

The Amundsen Exhibition panels
Photo: VUW Image Services

view" explained how the Antarctic ice sheet is now changing in response to global warming, and the increasing risk that it could be too late to save the South Pole as we know it. And finally, Pip Cheshire (Cheshire Architects, Auckland) "The nature of building on the Antarctic continent: An architect's view" talked about this experience working on the conservation of three iconic huts on the continent—Scott's Hut at Cape Evans and Hut Point; Shackleton's Hut at Cape Royd's; and Hillary's Hut at Pram Point on Scott Base.

Antarctic Research Centre, Victoria University of Wellington, PO Box 600, Wellington 6140, New Zealand
www.victoria.ac.nz/antarctic | +64-4-463 6587 | Antarctic-Research@vuw.ac.nz