IceSked

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Newsletter of the Antarctic Research Centre
Victoria University of Wellington

A Word From the Director

We have celebrated success in the last few months with ARC staff being awarded prestigious research grants and fellowships. It is particularly pleasing seeing our early-career researchers being acknowledged in this way, and in the words of the late Professor Sir Paul Callaghan, "an environment being created where talent wants to live"!

Tim Naish

Rob McKay awarded prestigious Rutherford Discovery Fellowship

Rob McKay, recently promoted to Senior Lecturer in the Antarctic Research Centre, was one of three Victoria University researchers to receive a Rutherford Discovery Fellowship.

Rob is regarded as one of the world's top glacial sedimentologists, and his research into past environmental change in Antarctica won him the 2011 Prime Minister's MacDiarmid Emerging Scientist Prize. He has made numerous trips to Antarctica, gathering marine sedimentary records and glacial deposits to reconstruct episodes of melting and cooling in Antarctica over millions of years.

The Rutherford Discovery Fellowship will enable Rob to conduct an in-depth study into how the Antarctic Ice Sheet and the Southern Ocean has interacted over the past 23 million years, with particular reference to how New Zealand's climate is likely to be affected in the future by greenhouse gas emissions. As Rob points out, the consequences of Antarctic warming are more far-reaching than sea level rise alone: changes in the Southern Ocean sea ice belt around Antarctica would affect the primary plankton productivity in the Southern Ocean.

Just as critical, is that warming of the Antarctic weakens the temperature gradient between the poles and equators, as this changes the location and strength of the westerly winds that pass over the Southern Ocean and New Zealand latitudes. These winds help drive global ocean circulation, and regulate the relative location where Antarctic and tropical-sourced water masses meet. These waters currently meet in the latitude of New Zealand, and as we have a strongly maritime-influenced climate, changes in the Southern Ocean and Antarctica will have a profound impact on our climate.

Rob comments that "there are still numerous first order gaps in our knowledge of how Antarctica and the Southern Ocean have responded during warmer-than-present past climates, so we are not short of ideas for future work. We also have a wealth of archive material from decades of field work in the Antarctic to address these questions, but not enough 'hands on deck' or existing laboratory facilities in New Zealand to get though this work. The Rutherford Fellowship allows us to develop these new lab capabilities, and employ laboratory assistants, so is a fantastic opportunity to say something new about climate history in the Southern Ocean and Antarctica, and how this may have influenced our own climate in New Zealand".

The ten fellowships, administered by the Royal Society of New Zealand, support New Zealand's most talented early- to mid-career researchers by providing financial support of $800,000 over a five-year period to investigate a particular research topic, and help them further their career in New Zealand.

Rob McKay

A Science Story - Victoria scientists contribute to an assessment of the state of the world's climate

Three climate science experts from Victoria University of Wellington played a central role in the latest global report on the state of the world's climate. Professor Tim Naish, Professor David Frame (Climate Change Research Institute), and Associate Professor James Renwick (School of Geography, Environmental and Earth Sciences) are lead authors on Working Group One of the International Panel for Climate Change's (IPCC) Fifth Assessment Report (AR5), released in Sweden at the end of September. We believe that Victoria University may hold the record for the most Lead Authors from a single Institution.

Climate Change 2013: The Physical Science Basis confirms and strengthens many of the findings from the Fourth Assessment Report published in 2007 on observed changes in the global climate, their underlying causes and their future projections. 209 Lead Authors and 50 Review Editors from 39 countries spent 4 years comprehensively assessing the published literature and writing the report, which cites more than 9000 scientific publications and received 60,000 individual review comments on its 4 drafts. The 14,000 word Summary for Policymakers was approved line by line in a Plenary Session in Stockholm between 23-26 September and was signed off by 195 countries.

For Tim Naish who contributed to Chapter 5 - "Information from paleoclimate archives", the experience was challenging and time-consuming, but enormously rewarding and a privilege to be working alongside the world's leading climate scientists. "The challenge is processing such a large volume of information while remaining objective and reaching a consensus amongst your peers. You really have to be very critical about the quality of evidence and the confidence that you can place on it" says Tim.

The latest report documents global temperature increases of the atmosphere and oceans, decreases in the volume and cover of snow and ice, as well as an average rise in sea level of 19 centimetres between 1901 and 2010. It also documents the continued increase in concentration of greenhouse gases in the Earth's atmosphere, caused primarily by the burning of fossil fuels and land use changes, and a related trend towards ocean acidification. The report reiterates that "warming of the climate system is unequivocal" and that the "human influence on the climate system is clear".

Ice core evidence shows that carbon dioxide concentrations are now at levels unprecedented in at least the last 800,000 years, and the report outlines four possible future greenhouse gas concentration scenarios to the end of this century and beyond, ranging from one in which emissions are substantially reduced, to one with continuing high emission rates. Corresponding estimates for global surface temperature increases range from between 0.3 and 1.7ºC, to between 2.6 and 4.8 ºC by the year 2100.

As far as the cryosphere goes, the report describes observed changes to Greenland and Antarctic ice sheets. It is very likely the Arctic sea ice cover will continue to shrink and thin as the region is expected to warm more rapidly than other areas of the world. In addition, the volume of the polar ice sheets and glaciers globally will continue to decrease, contributing to a likely range of global mean sea-level rise between 26-82 centimetres by the end of the century, depending on the greenhouse gas concentration pathway we end up following. The West Antarctic Ice Sheet still remains a wild card, and the report cautions that only the collapse of marine-based sectors of the Antarctic Ice Sheet, if initiated, could cause sea-level to rise substantially above these 'likely' ranges during the 21st century.

The IPCC AR5 was officially presented in New Zealand on the 11th of October at a stakeholder workshop in Wellington, hosted by the Royal Society of New Zealand. The IPCC Working Group 1 Co-Chair, Professor Thomas Stocker, from Berna, Switzerland, joined the New Zealand authors and New Zealand's IPCC Working Group 1 Bureau Member, Dr David Wratt (NIWA) to present the report and answer questions.

Other Contributing Authors who made a valuable contribution to the AR5 were Dan Zwartz (ARC) and Chris Hollis (GNS Science). The summary and the final draft of the full Working Group One report is available at www.climatechange2013.org. A hard copy will be available in 2014. The remainder of the AR5 report will be released in stages over the coming year.

The Chapter 5 team at the 3rd Lead Author Meeting in Marrakesh, Morocco. Tim Naish is 2nd from right

Fire and Ice: Reconstructing the past behaviour of New Zealand's northernmost glaciers

Shaun Eaves taking a shielding measurement

Minor volcanic activity may have closed the popular Tongariro Crossing in recent months; however, approximately 23,000 yrs ago, trampers would have faced an altogether different (and much colder) obstacle. At this time, Mt. Tongariro, and neighbouring Mt. Ruapehu, were largely submerged beneath ice and the surrounding valleys were filled by outlet glaciers several kilometres long. This is one of the initial findings of my PhD research, supervised by Andrew Mackintosh, Brian Anderson and GNS Science, which aims to find out: (1) how extensive the central North Island glaciers used to be; (2) when this was; and (3) what this means for past climate variability in the southern mid-latitudes.

Thus far, I have undertaken a wide variety of field- and laboratory-based activities. My 2011-12 summer was spent living in backcountry huts, whilst identifying and recording the positions of the abundant glacial landforms on both Mt. Tongariro and Mt. Ruapehu. Supported by the ARC Endowment Fund, this winter I recently travelled to Lamont-Doherty Earth Observatory (LDEO) in New York, to measure cosmogenic 3-Helium (3He) in 60 moraine boulder samples. This rare isotope accumulates at the Earth's surface over time and can be used to date glacial deposits. My nine-week stay in New York was exhausting, as I had so many samples to work on, but was a fantastic experience to work with and learn from many scientists working on cutting-edge climate science. From this work, we now know that glacier advance and retreat in North Island, New Zealand, over the last 60,000yrs, was broadly coincident with cooling and warming respectively, in Antarctica. I am now applying a numerical glacier model to simulate the development of these past glaciers under different climatic conditions, which will help to constrain the magnitude of past climate changes that caused their growth. I am very grateful to the ARC, VUW, GNS Science and Tongariro Natural History Society for financial support.

Shaun Eaves

Heavy Metal Pollutants in an Ice Core from Roosevelt Island, Antarctica

Andrea Tuohy out in the field, Antarctica

About a week after submitting my Masters thesis I was ticking boxes for Antarctic field gear as I embarked on my PhD. I spent the first few months of my project in Antarctica at Roosevelt Island as part of the RICE team in 2011-2012, helping to set up the camp and drill, and begin drilling and processing the first part of the RICE ice core. Spending three months in the same tent in the middle of nowhere on the Ross Ice Shelf was a really good way to get to know my primary adviser Dr Nancy Bertler!

My PhD involves analysing the chemistry of the ice core from Roosevelt Island, and focussing on the concentrations of the heavy metal pollutants contained in the ice. To do this we melt the core using specialised equipment in the Ice Core Facility at the National Isotope Centre in Wellington, and then I run the samples of melted ice in a mass spectrometer to measure the concentrations of metals such as iron, aluminium, lead, and copper. This gives us record of the changing emissions of heavy metal pollutants in the Southern Hemisphere back through time, and will also allow the atmospheric transport pathways to be reconstructed. The high snow accumulation at Roosevelt Island means the record from the ice core has sub-annual to annual resolution, and this will allow me to produce a very high-resolution, detailed record of heavy metals over the past 2000 years.

Andrea Tuohy

S.T. Lee Lecture in Antarctic Studies

On the 15 August, Professor Jane Francis, then Dean of the Faculty of Environment, University of Leeds, and now Director of the British Antarctic Survey in Cambridge, UK, came to Wellington to present this year's S.T. Lee Lecture in Antarctic Studies. Her talk *"When Antarctica was green: Fossil plants reveal Antarctica's climate history"* outlined her research into ancient climates, particularly of the polar regions where she studies fossil plants from the Arctic and Antarctica to decipher greenhouse climates of the past, when forests, not glaciers, covered the high latitudes.

Millions of years ago at a time when Antarctica had moved to its current geographical position, the presence of many plant fossils show that life was very different near the South Pole: Antarctica was green. Fossil remains of leaves, wood, pollen, seeds and flowers show that the continent was covered in lush green forests that flourished in warm humid climates, despite the extreme polar light regime of continuous summer sunlight and long dark winters. Many of the fossil plants have been identified as ancestors of vegetation that grows in South America and Australasia today, with some additional tropical types that migrated far south during periods of extreme global warmth. As the polar climate cooled and ice sheets developed, small dwarf shrubs of southern beech (Nothofagus) heroically survived close to the pole before the expanding ice sheets wiped all forests from Antarctica.

Jane's presentation was highlighted by her collaborations with artists to produce illustrations showing environmental reconstructions of what Antarctica's forests looked like during different time periods as the fossil record changed. We were left with the question, "Will Antarctica become green again as the climate warms?"

Jane Francis delivering her lecture in the Hunter Council Chamber, Victoria University

OTHER ACTIVITIES

Marsden Success for ARC

Antarctic Research Centre has scooped three prestigious Marsden Grants this year. GNS Science has secured another which will be co-led by one of our ARC researchers. The Marsden Fund supports research excellence, allowing New Zealand's best researchers to explore ideas at the forefront of their disciplines.

The successful researchers will be investigating the following projects, which have been funded over a three-year period:

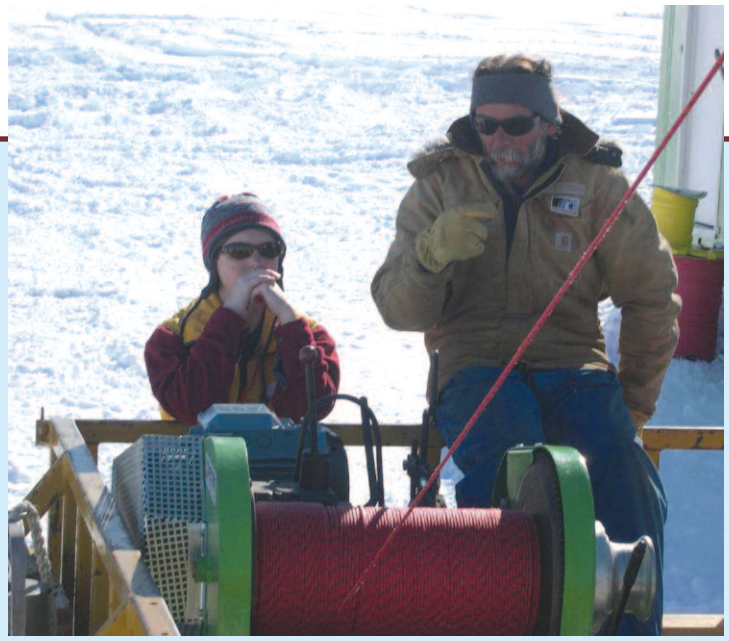
- Professor Tim Naish: *Drilling back to the Pliocene in search of Earth's future high-tide.*
- Dr Huw Horgan: *Can ice sheets help themselves? Investigating self-stabilisation and instability in Antarctica.*
- Dr Ruzica Dadic: *Improving ice core records-understanding the link between rapid changes of greenhouse gases and temperature.*
- Dr Richard Levy from GNS, and Dr Gavin Dunbar (ARC): *New Zealand's Stormy Past: Resolving changes in South Island precipitation under varying influence of tropical and polar forcing over the past 17,000 years.*

"Thin Ice" best popular science film at Baikal

"Thin Ice" (see Ice Sked issue 20) recently won the Best Popular Science Film award at the 12th Baikal International Film Festival. On December 9 it screens by invitation at the American Geophysical Union's Fall Meeting in San Francisco. Geoffrey Haines-Stiles, producer of Richard Alley's "Earth: An Operator's Manual", chairs the panel discussion. For more on "Thin Ice" see www.thiniceclimate.org.

News in Brief

- Congratulations to Nancy Bertler, who has been promoted to Associate Professor, and Rob McKay now Senior Lecturer.
- Visiting Associate Professor Lev Tarasov (Memorial University of Newfoundland, Canada) and Professor Regine Hock (University of Alaska Anchorage) have been sharing their expertise with Antarctic Research Centre while exploring joint research opportunities.
- Each year the Wellington Branch of the Geoscience Society holds an evening for students to present the results of their thesis or related research. Shaun Eaves and Rory Hart were jointly awarded the "Best Talk" at the Geoscience Society Beanland-Thornley Prize Night in October this year.



Looking Back: Photos from the Archives

Alex Pyne, November 2002, taken at the Windless Bight campsite and ice hole. Alex is instructing MSc student Natalie Robinson on the art of operating a winch with an oceanographic sensor for taking readings through the 850m-deep water column beneath the 85 m thick McMurdo Ice Shelf. Alex has had a major role over the years as mentor to many students in both the practical and theoretical side of scientific work in Antarctica.

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