IceSked

Issue 11: December 2008

Newsletter of the Antarctic Research Centre
Victoria University of Wellington

In this issue we focus on the research and activities undertaken by some of our staff and students, highlighting recent results. We also reflect on the current status of our Endowed Development Fund and present some of the experiences of recent recipients.

A Word From the Director

Since August I have been at-large in the USA experiencing mid-western hospitality hosted by Betty Trummel (ANDRILL ARISE Educator), Dr Ross Powell and Dr Reed Scherer (ANDRILL collaborators) at Northern Illinois University for a 5 month sabbatical. It has provided a much needed opportunity to recharge my intellectual batteries and focus on publishing ANDRILL science. The major effort has been put into two papers presenting new evidence of orbitally-controlled fluctuations in the West Antarctic Ice Sheet (WAIS) based on the AND-1B drill core and a new ice-sheet/ice shelf model. The latter is being led by Dr David Pollard (Penn State University, USA) and Assoc Prof Rob DeConto (University of Massachusetts, USA), with whom I have spent some of my time. A highlight of the trip was an opportunity to attend the annual WAIS Meeting held in Washington, D.C. in October. There were very useful interactions between the paleoclimatology and ice sheet modelling communities, and great to see PhD student, Jeremy Fyke presenting his research on Antarctic ice shelves (see next article).

In my absence the ARC has not missed a beat. Congratulations to Alex Pyne, a most-deserving recipient of a 2008 Royal Society of New Zealand Science and Technology Medal. We are excited about the addition of Post-Doctoral Fellows, Nick Golledge to the glacial modelling team, and Rob McKay who will participate in the Wilkes Land Ocean Drilling Program expedition. The Science Drilling Office is recruiting an engineer to assist Alex Pyne and Tamsin Falconer with technical developments. Finally, ARC researchers are justifiably proud of a new book 'Antarctic Climate Evolution' produced by the SCAR-ACE Project and published by Elsevier this October, in which we have contributed to five of the chapters. I look forward to rejoining the team in January 2009. *Tim Naish*

Modelling Antarctic Ice Sheets in a Warming World

Jeremy Fyke is one of the resident climate modellers, and the main resident Canuck, within the Antarctic Research Centre (ARC). His PhD with Dr Lionel Carter (ARC) and Dr Andrew Weaver (University of Victoria, Canada) relates to large-scale interactions between the Antarctic Ice Sheet (AIS) and the surrounding climate, ocean, atmosphere and land. In particular, the research addresses the question: How will the AIS evolve in response to human greenhouse gas emissions?

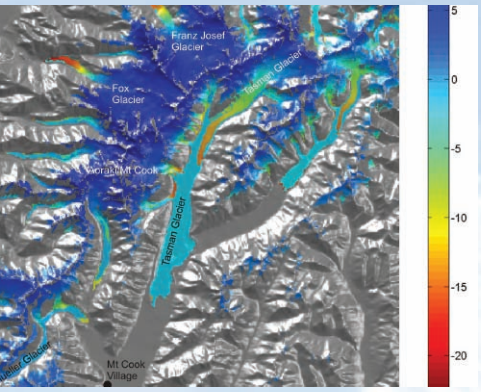
To explore this issue two computer modelling tools are being utilised. The first tool is the University of Victoria Earth System Climate Model. This is an 'intermediate complexity' climate model, which can simulate several millennia of climate change within a reasonable amount of computing time (a 5000 year simulation of climate takes about two weeks on a supercomputer). The second tool is the state-of-the-art ice sheet model of Dr David Pollard (Penn State University, USA), which is able to simulate the grounded ice and ice shelves of the AIS. Both models exist in the form of large libraries of the computer language FORTRAN. This means most of Jeremy's time is spent in front of large computer screens deciphering lines of computer code. Not exactly what most people associate with Antarctic research, but heroic nonetheless (watch the movie 'The Day After Tomorrow' to see what we mean).

The first results of Jeremy's PhD have used the climate model to diagnose ice shelf stability under projected climate warming scenarios. This is done by watching model output for regions that experience extended summer warming. Extended warming causes melt-water to pond over ice shelves, and when the water refreezes, it expands to hydraulically fracture the shelf, causing it to collapse. Preliminary results indicate that the method can 'hindcast' observed shelf collapses such as Larsen A/B, Wilkins, and Ward Hunt. Within the next 200-300 years, the model predicts melt-water ponding over the Ross and Ronne-Filchner shelves and much of the grounded West Antarctic Ice Sheet.

The main component of this research involves the 'coupling' of the ice sheet model to the climate model. This effectively embeds the ice sheet within the simulated climate, allowing the simulated ice, ocean, atmosphere and land surface to evolve in synchrony. This model configuration will allow isolation of the important feedbacks between the AIS and Southern Hemisphere climate. In particular, simulated interactions between the ice and the Southern Ocean will determine the control the ocean exerts on ice sheet evolution.

Jeremy Fyke and Lionel Carter

Jeremy on the Franz Josef Glacier



Energy balance model of the Mt Cook region of the Southern Alps. Blue shows snow accumulation and red indicates melting

Progress in Glacier Modelling

Brian Anderson (ARC), Andrew Mackintosh (ARC/SGEES) and Alun Hubbard (University of Wales) have been developing numerical models of Southern Alps glaciers as part of a Marsden FastStart and a Comer Science and Education Foundation project. We have successfully applied an energy balance model to the Southern Alps, which can simulate measured mass balance on Brewster Glacier, and measured end of summer snowlines (Trevor Chinn's work) over the last thirty years. Modelled ice volume is almost identical to glacier length changes at Franz Josef Glacier during this period, providing an independent validation of the model. Meanwhile, Alun and Andrew have simulated the Southern Alps ice field at the Last Glacial Maximum, discovering that temperatures had to be ~7°C colder than present to match known moraine limits. This compares well to reconstructed sea surface temperatures off eastern New Zealand, but is somewhat larger than indications from terrestrial climate proxy records.

We also have a new FRST subcontract to work with NIWA to link the energy balance model to a regional-scale atmospheric model (at one end) and a hydrological model (at the other). The aim is to improve climate change scenarios for NZ including runoff into hydro lakes in the Mackenzie Basin and Otago region. Key collaborators at NIWA are Dr Brett Mullan, Dr Sam Dean, Dr Jordy Hendrix and Dr Martyn Clarke. Brian Anderson will spend part of his time between 2009 and 2011 working on this project.

The Antarctic Research Centre, with funding from the Alan Eggers donation, has also recently increased its capacity in glacier modelling by appointing Dr Nick Golledge, a recent PhD graduate from Edinburgh University as a Post-Doctoral Fellow for three years. To date, our work has largely focussed on New Zealand glaciology, and we believe it is time to expand our Antarctic research. *Andrew Mackintosh and Brian Anderson*

Graduate students Gretchen Williams and Martin Schiller dig a pit into the Hart Ash surface for sampling ^{10}Be in the Wright Valley

When the Dry Valleys were Last Wet

Prevailing knowledge suggests that climate in the Dry Valleys of Antarctica has not changed much over the last 14 million years. However, because little direct evidence has been left behind in the Dry Valleys, understanding past climate is elusive. Evidence from the ANDRILL core, the presence of fjord sediments in the Wright Valley, and wet-based glacial deposits give small clues that there may also have been warm periods in the Dry Valleys.

For the past 4-5 years, graduate students, colleagues led by Ian Graham (GNS Science) and I have been measuring Beryllium ^{10}Be in Dry Valley soils. Initially we thought ^{10}Be, which falls out of the upper atmosphere like ^{14}C, could be used to date Antarctic soils. But when calibrating the age method with the 3.9 million year old Hart Ash in the Wright Valley, we found the Hart Ash was devoid of ^{10}Be, yet the paleosol below the ash had large amounts of it. Because ^{10}Be does not dissolve in water, we reasoned that it attaches to clay particles that are washed into the paleosol by a common process when soils are exposed to rainfall. This means that sometime before the ash was deposited, there must have been enough water in this part of the Dry Valleys to activate this process, but since then, the climate has been cold and dry. So I believe that most of the ^{10}Be found in other Dry Valley soils, has been washed into them during warmer and wetter periods prior to four million years ago. *Warren Dickinson*

Back to School

During the bitter New Zealand winter I was fortunate enough to be awarded a scholarship with support from the ARC to attend the Urbino Summer School in Paleoclimatology. The three week course was set in the medieval walled city of Urbino, NE Italy and brought together students and academics from all over the world with a shared interest in paleoclimatology, themed around the Cenozoic. The course covered topics on climate modelling, geochemistry and paleobiology/ecology and enhanced development of particular research specialties with lectures, hands-on workshops, labs and field excursions to the Umbria Marche region, including the Cretacious/Tertiary boundary and the Paleocene-Eocene Thermal Maximum. It was a fantastic experience and I was delighted to win the Student Poster award, and it has definitely given me more food for thought for my thesis.

Annette in the streets of Urbino, July 2008

My PhD research itself is based around ODP core 1123 (east of NZ), from which I am extracting Mg/Ca ratios from foraminifera to reconstruct sea surface temperatures during Marine Isotope Stage (MIS)-11 (385-430 thousand years ago and MIS-31 (~1.07 million years ago). The foraminifera are analysed in the SGEES geochemistry laboratory using the new laser ablation ICPMS. This research will enable a high resolution record to be reconstructed during these 'analogues' to the future giving much needed data for climate modellers and an insight into future global warming. *Annette Bolton*

Supporting the Antarctic Research Centre

In 2004 the Antarctic Research Centre launched an Endowed Development Fund Appeal to provide funds for students to undertake research on Antarctica, and for emerging research opportunities. The Appeal's goal was to raise a capital sum of NZ$750,000 and we are delighted to report that we are well on the way to that goal, with NZ$450,000 raised from the ARC's alumni and friends.

Since 2006 thirteen students have been awarded grants from the Fund. These grants have helped cover the costs of undertaking field work in Antarctica, conference attendance, and travel for collaborative work at other institutions.

We urge you to consider supporting the Endowed Development Fund, either through a monthly automatic payment, or through a gift in your will, which is a tremendous way to show support while not impacting on your financial needs during your lifetime. For support options please refer to: www.victoria.ac.nz/antarctic/about/Endowments_Donations/development-fund.aspx

All donations are made through the Victoria University Foundation, a registered charity, and are therefore eligible for a charitable gift taxation rebate.

For further information on how you can provide philanthropic support to the Antarctic Research Centre, please contact our Director, Prof Tim Naish, Email: timothy.naish@vuw.ac.nz, or Diana Meads, Fundraising Manager, Victoria University of Wellington Foundation Ph: 0800 VIC GIFT (0800 842 4438), Email: diana.meads@vuw.ac.nz

Reports from Recent Endowed Development Fund Recipients

Andrew enjoys a tea break with the Antarctic locals

With the generous support of the ARC Endowed Development Fund I was able to attend the first joint Scientific Committee on Antarctic Research and International Arctic Science Committee Conference held in Russia in July. Attending this conference provided an excellent opportunity to interact with some of the leading researchers from both polar regions. My presentation '*In situ* response of sea ice microbes to habitat variability: Insight into global warming or just another 'flippin ice core'?' generated a lengthy discussion and it was exciting to showcase the findings of my PhD research with the polar science community.

Andrew Martin (School of Biological Sciences)

In September Alison Glenny and Sylvie Haisman spent three days in Christchurch at the 'Imagining Antarctica' conference, hosted by the University of Canterbury. The conference enabled academics, scientists, visual artists, photographers, writers and historians from diverse disciplines and countries to share their knowledge and enthusiasm for the Antarctic. As their contribution to the conference, Alison and Sylvie read extracts from work as part of their Master of Arts in Creative Writing. Alison read from her folio of short fiction provisionally entitled 'Winter Country' and Sylvie read a number of episodes from her novel, called 'The Albatross Eaters', which tells the true story of nineteenth century passengers to New Zealand who were shipwrecked on a sub-Antarctic Island.

Alison Glenny & Sylvie Haisman (International Institute of Modern Letters)

I have been working to integrate fossil records from sediment cores drilled on the Antarctic continent, such as those from the ANDRILL project, with offshore cores recovered by the Ocean Drilling Program (ODP). Using this powerful composite record, we can reconstruct a precise history of speciation and extinction among the phytoplankton that have populated the surface waters in the region for millions of years, and use it to explore how organisms responded to environmental change in the geologic past.

In August, I presented a paper at the International Geological Congress in Oslo, focusing on certain changes in the fossil record during the Pliocene epoch (~5-2 million years ago), the most recent time in Earth's history when temperatures and carbon dioxide levels were higher than present. Specifically, we have discovered two episodes of rapid, widespread extinction of species and evolution of new ones among marine diatoms, the most important phytoplankton group in Antarctic waters. By comparing our fossil record to the sedimentary record of glacial advance and retreat and offshore paleotemperature evidence, we can show that both "turnover pulses" are associated with periods of heightened environmental variability and possible warming and glacial melting in Antarctica.

Rosie on board the "Nathaniel B. Palmer", Ross Sea, Antarctica, February 2003

Rosie Cody (Antarctic Research Centre)

OTHER ACTIVITIES

A Biologist's Trip to Antarctica

I recently spent a month at Scott Base, traveling on the first WinFly flight (actually called "SpringFly" as we went in early September). With me was Andrew McMinn, a long time colleague from the Institute of Antarctic and Southern Ocean Studies in Hobart. The temperatures in early September were close to -40°C with plenty of wind! Very cold but very pleasant with only 22 people on Base, and it was certainly interesting to see Scott Base at night time!

Ian Whitely (field assistant) and Ken Ryan collecting sea ice algal samples

All plants need sunlight to photosynthesise and grow, but we wondered how they cope when there is none over the three months of the Antarctic winter. In our experiments, we had phytoplankton in culture in darkened bottles at a range of temperatures and we monitored total biomass, lipid, protein, and carbon contents. We expect that the concentration of storage lipids will fall during the dark and that this will be worse in the warmer conditions generated under global warming (metabolism will be greater in warmer water and therefore more energy demanding).

Ken Ryan (School of Biological Sciences)

Ken Ryan has recently been appointed as a Senior Lecturer in Antarctic Biology. To the best of our knowledge, this is the first lecturing position in Antarctic Science in any of the New Zealand universities.

New Zealand Science and Technology Medal

Alex Pyne, the Antarctic Research Centre's Projects Manager, has been awarded one of four 2008 Royal Society of New Zealand Science and Technology Medals for his leadership in the field of polar drilling technology, enabling recovery of continuous records of past environments in the most challenging places - Antarctica. As noted by Pro Vice-Chancellor David Bibby, this medal is well deserved recognition for the inventiveness and creativity Alex has brought to the development of scientific drilling in the Antarctic.

Alex Pyne

Sixteen Days in the Arctic

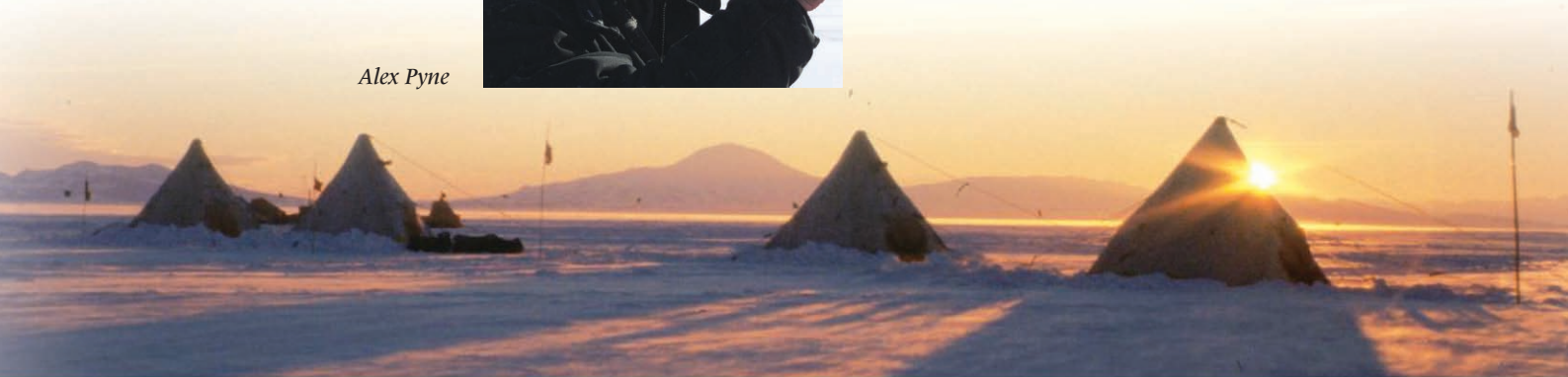
Keleigh examining an ice core, May 2008

Being awarded the 2008 S.T. Lee Young Researcher Travel Award gave me the extraordinary opportunity of being able to travel to the Arctic in May. At Barrow Arctic Science Consortium, Alaska (515 km above the Arctic-Circle) I carried out measurements for my PhD research, looking at producing 3D models of the resistivity structure of sea-ice. During my time I also participated in an interdisciplinary sea-ice research field techniques course. It involved students and leading sea-ice researchers from all over the world and covered a diverse range of topics from ice optical properties to ring seal monitoring to Iñupiaq sea-ice knowledge.

Keleigh Jones (School of Chemical & Physical Sciences)

Geosciences Conference 2008

This year's combined New Zealand Geological, Geophysical, and Geochemical and Mineralogical Societies Conference was held at Te Papa, Wellington from the 23rd-26th November. It featured an Antarctic - Southern Ocean - New Zealand Climate Linkages Symposium honouring Prof Peter Barrett, in recognition of his contribution to Antarctic science during his term as Director of the Antarctic Research Centre from 1971 to 2007. Over the last 35 years the role of Antarctica and the Southern Ocean in the global climate system has become clearer, although many questions remain, including their influence on New Zealand's climate. Addressing such questions has been at the forefront of Peter's research. Other speakers during this symposium included Prof John Chappell, Australian National University; Dr Bruce Hayward, Geomarine Research, and Plenary speaker Dr Will Howard, Antarctic Climate & Ecosystems Cooperative Research Centre, along with ARC staff and students.



Antarctic Research Centre, Victoria University of Wellington, PO Box 600, Wellington 6140, New Zealand
Ph +64-4-463 6587 • Fax +64-4-463 5186 • Antarctic-Research@vuw.ac.nz • www.victoria.ac.nz/antarctic