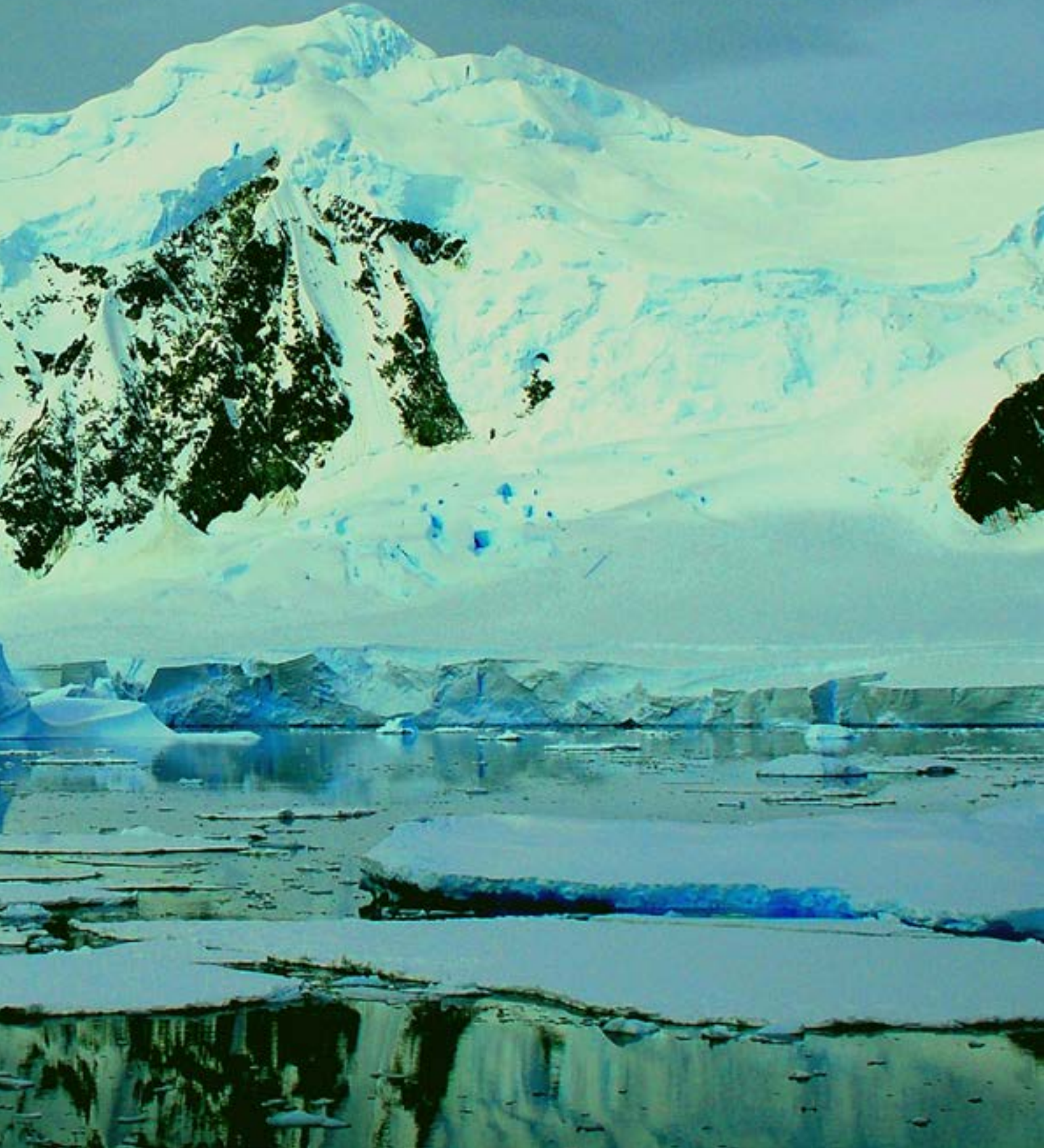




VICTORIA UNIVERSITY OF  
**WELLINGTON**  
TE HERENGA WAKA

# Te Puna Pātio Antarctic Research Centre

## Annual Review 2023





# Improving understanding of Antarctic climate and ice sheet processes, and their impact on New Zealand and the Earth system

*Near Upper Priestley Glacier, Victoria Land  
Photo by Holly Winton*

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Designed and edited by Anna Bowron.

*Cover image:  
Western Antarctic Peninsula, 2008  
Photo by Nick Golledge.*



## Research

### Expeditions

Four Antarctic expeditions during the 2023-24 season involving 18 staff and drillers, and 4 PhD and MSc students (pages 10-23)

### Landslides in Ross Sea

Giant underwater slips displace up to 230 km of sediment and pose potential tsunami hazard (page 12)

### Watering the Dry Valleys

Mountains in the Dry Valleys were last wet 6 million years ago (page 10)

### Ice core records of marine change

New cores collected in the Transantarctic Mountains capture 200 year record of phytoplankton changes in the Ross Sea Marine Protected Area (page 14)



## Funding

### SWAIS2C Drilling

International drilling consortium provided \$5.4m over 2022/23 to support drilling operations by our Science Drilling Office

### External research revenue

A total of \$9.26 million in external research revenue to support high-impact science led by the ARC (page 40)

### Philanthropic donations

A total of \$538,127 donated in 2023 to support ARC development opportunities and the Girls\* on Ice expedition

### Ray Hoare scholarship

Ray Hoare donation provides MSc scholarship to Lottie Stevenson to study past ice sheet change (page 29)



## Awards

### Hutton Medal Royal Society Te Apārangi

Awarded to Prof. Nicholas Golledge for work of outstanding scientific or technological merit in the animal, Earth or plant sciences (page 39)

### S.T. Lee Travel Award

Recipients Yaowen Zheng and Billy van Uitregt travelled to Alaska as part of the S.T. Lee exchange programme (page 33)

### Arnold Heine Award

Recipient Matt Tankersley funded to publish two papers (page 38)

### Endowed Development Fund

Seven ARC PhD candidates were awarded funds to undertake special projects to progress their research (page 38)



## Engagement

### 5 theses

completed by ARC supervised PhD and MSc students (page 37)

### 42 publications

in 2023 with ARC staff and student authorship (pages 42-43)

### 25 talks

given to scientists, politicians, stakeholders, schools and community groups by ARC staff and students (page 44)

### 63 media interviews

given by ARC staff and students on Antarctic and climate related issues (pages 45-47)

# DIRECTOR'S SUMMARY



Professor Rob McKay  
Director, Te Puna Pātiotio - Antarctic Research Centre

This year saw a welcome return to geological drilling for the Antarctic Research Centre, with the deployment of the SWAIS2C drilling team at the southernmost margin of the Ross Ice Shelf. This project has been almost a decade in the making, and is a complex international project made even more challenging by a constantly shifting funding and logistical landscape. Drilling for geological archives of past warm climates to inform on future change is a central pillar of the ARC's scientific legacy and reputation for excellence. For several decades, our Science Drilling Office has been at the international forefront of this field, developing innovative technology to overcome some of the most globally challenging barriers to obtaining these valuable archives of Antarctic climates.

The SWAIS2C project ramps up the challenge a step further, aiming to drill beneath the heart of West Antarctica, remote from any national bases, using a new lightweight technology consisting of a glass-reinforced drill casing. If successful, this technology would have offered

a game changer in our ability to drill deeper beneath Antarctica's vast ice sheets, and in even more remote locations. Unfortunately, we experienced a setback in this new technology that restricted our ability to drill deep, but regardless the season was a huge success. We obtained a unique set of oceanographic data and collected numerous shallow sediment cores longer than any obtained in the past. Most importantly, many other aspects of our new system were tested in the field for the first time and worked seamlessly.

Setbacks are just part of the deal when undertaking ambitious research in the Antarctic, and while we try to avoid them, they are something we remain proud to own. The early termination of the first season of Cape Roberts due to a weather event is a notable example, but preceded two remarkably successful seasons in later years, and really laid the foundations for our success over the next few decades. The SWAIS2C field team were obviously disappointed not to come back with everything planned this year, but they are not

disheartened – in fact they came back quite buoyant, with solutions immediately developed. We are raring to go again, and to get the job done next year!

The ongoing value of obtaining such hard won drill cores is demonstrated by results emerging this year from our previous drilling campaigns in the Friis Hills and the International Ocean Discovery Programme (IODP) Expedition 374 to the Ross Sea. Two flagship papers were published this year on the Friis Hills cores. The first revealed a history of the giant East Antarctic Ice Sheet approximately 14 million years ago and defined the thresholds of warming and atmospheric CO<sup>2</sup> changes required to initiate significant surface melting of that ice mass. The second, published in *Nature Geoscience*, addressed a long-standing question – when were the Dry Valleys last wet? Meanwhile, results from the IODP drilling offshore reported on the unexpected discovery of giant submarine landslides that pose potential hazards for triggering tsunamis.

We also built on our legacy of ice coring this year, with Holly Winton collecting 20 m long ice cores from near Priestley Glacier to capture a record of marine sourced aerosols being blown in from the Ross Sea. After numerous postponements of getting into the field over the past few years for Holly, it was an immense pleasure to see the success of this Marsden funded project. It will provide critical data to understand the history of the world's largest marine protected area over the past 200 years.

A final aspect of building on our legacy this year is creating an environment where our students thrive. This year, our Endowed Development Fund supported international engagement and networking opportunities for our students at the SCAR Instant conference in Italy, and visits to other institutes around the world. We also saw two students camping in the deep field for the first time to undertake studies into a glacier's past history using cosmogenic nuclides. It remains the most rewarding part of our jobs to see the life-changing experience such work has on the next generation of Antarctic researchers.

We know our alumni also feel this way. It was a pleasure this year to meet Ray Hoare, one of our earliest expeditioners, who has never forgotten his own life-changing experiences on the icy continent. Ray has generously provided a substantial donation to the ARC endowment to support our students with MSc scholarships. It was a valuable reminder that the ARC's success and scientific excellence is built on this sort of passion from our staff and students, both past and present, and from our supporters.



PhD student Linda Balfourt working on sediment cores collected by the SWAIS2C project.  
Photo by Jae Il Lee.

# RESEARCH OUTCOMES



## OUR RESEARCH APPROACH

### Rationale

We are rapidly heading towards a climate that is 2-4°C warmer than present. Ice sheets and oceans take centuries to millennia to fully adjust to climate forcing, and the fundamental changes that we are observing today may be irreversible on human timescales. In order to provide reliable, policy-relevant projections of future climate and sea level, scientists are increasingly relying on computer models. Our Centre has undergone a numerical revolution over the last few decades, and around half of our staff now routinely carry out physics-based computer simulations of past, present and future climate.

We develop confidence in future climate projections if models show skill at simulating present and past climate. Because direct climate and ice sheet observations span the last century at best, reconstructions of past climate conditions provide the only means to assess climate and ice sheet models on their relevant timescales. Furthermore, past climate observations provide insight into the long term “endgame” (equilibrium response), that we will commit our planet to this century based on current warming scenarios. Past climate records also provide insight into the rates and magnitudes of climate and ice sheet changes that may be possible in the near future,

and allow the fingerprint of human influences to be identified in the context of natural variability in the climate system.

### Outcome-based research

Our research approach is policy-relevant and outcome focused. We aim to improve forecasts of future climate change including their global and New Zealand impacts, for the benefit of humanity. By reducing the uncertainties around future climate and sea-level rise predictions, our cutting-edge research is informing the International Panel on Climate Change (IPCC). Improved understanding of climate change impacts including sea-level rise impacts in the Pacific region provide tangible benefits to all New Zealanders. Our research is leveraged by strong national and international collaborations and partnerships, and world-leading in-house polar drilling technology provided by the Science Drilling Office. We are funded and supported through a range of MBIE, Marsden, and Rutherford programmes, Antarctica New Zealand and private donations.

In summary, our approach involves:

a. Improving our physical understanding and observation of modern climate, ocean, glacier and ice sheet systems.

b. Acquiring past observations of surface temperature, precipitation, atmospheric composition (greenhouse gases and aerosols), ice sheet, glacier, and sea-ice variability, and oceanic conditions from terrestrial, marine, lacustrine and ice core archives.

c. Developing and improving numerical models of climate-ocean-glacier and ice sheet systems, by advancing the physics, and then carrying out sound evaluation of models against modern observations and past climate reconstructions.

d. Using our models to improve future climate simulations, and projections of glacier and ice sheet contribution to sea-level rise, river flows and other changes in the Earth System.

e. We disseminate our research findings through publications in the world’s leading scientific journals, and through education, communication and engagement with the public, practitioners and policymakers.

*Emily Moore, Levan Tielidze and Lisa Dowling working in the Ahuriri River valley, Southern Alps, New Zealand. Photo by Shaun Eaves.*

# Friis Hills reveal climate secrets of the Dry Valleys

Not only are the Friis Hills set in a beautiful region of the Dry Hills, they also contain a unique and spectacular sequence of sediments deposited ~15 million years ago as glaciers advanced and retreated across a landscape that was periodically covered by lakes, rivers, and tundra vegetation. Sediments of this age are incredibly rare in Antarctica and the paleoenvironmental and paleontological information they contain are critical to guide our understanding of Antarctica's past climatic and glacial conditions.

The sediments in the Friis Hills were first discovered by geomorphologists from the United States who were scouring the Dry Valleys and surrounding regions in search of clues to reveal the history of Antarctica's climate and ice. Hard work over five long Antarctic seasons by field teams led by Adam Lewis and Alan Ashworth from North Dakota State University finally revealed a detailed map and stratigraphy for the Friis Hills. Results were presented in a comprehensive paper published in *GSA Bulletin*. But Adam suspected there were more sediments to be discovered and approached the ARC's Richard Levy and Tim Naish with a suggestion the New Zealanders bring their drilling know-how and experience to bear.

A team from the ARC, GNS Science, Otago University, and North Dakota State headed to the Friis Hills during the Antarctic field season of 2014/15 armed with sledgehammers, a metal plate, geophones, and seismic recording equipment. Data collected during the geophysical survey provided the targets for drilling. Alex Pyne and a team from Webster Drilling and Exploration developed a drilling system that used a helicopter-portable wireline rotary coring rig and innovative chilled compressed air system to ensure the permafrost cores remained frozen. An 80 m-thick composite sequence was recovered during the Friis Hills Drilling Project (FHDP) in December 2016. Remarkably, this sequence included two volcanic tephra that constrain the age of the sediments to between ~15 and 14 million years old. Results from a detailed study of the cores led by former ARC PhD student Hannah Chorley was recently published in *GSA Bulletin*. Results support those from other offshore drilling projects and modeling studies indicating that ~400 ppm represents a threshold above which Earth's average climate warms to the point that Antarctica cannot sustain marine-based ice sheets.

But the Friis Hills have more to reveal. Former ARC PhD student Marjolaine Verret subsequently published a study of the beryllium isotopic composition of sediments from the Friis Hills cores and several other locations from the surrounding region in *Nature Geoscience*. Under the supervision of the ARC's Warren Dickinson and SGEES Kevin Norton, Dr Verret has shown that the high elevation regions of the Dry Valleys remained periodically wet up until ~6 million years ago, some 7 million years later than previously thought. These results suggest the region is potentially sensitive to relatively small increases in temperature with significant implications for the future of the unique ecosystems that occupy the Dry Valleys region today.

Contact [Richard.Levy@vuw.ac.nz](mailto:Richard.Levy@vuw.ac.nz)

Further reading for those who are interested:

Lewis, A. R. and A. C. Ashworth (2015). "An early to middle Miocene record of ice-sheet and landscape evolution from the Friis Hills, Antarctica." *Geological Society of America Bulletin*.

Chorley, H., et al. (2022). "East Antarctic Ice Sheet variability during the middle Miocene Climate Transition captured in drill cores from the Friis Hills, Transantarctic Mountains." *GSA Bulletin* 135(5-6): 1503-1529.

Verret, M., et al. (2023). "Late Miocene onset of hyper-aridity in East Antarctica indicated by meteoric beryllium-10 in permafrost." *Nature Geoscience*.



View across the central valley of the Friis Hills looking towards the confluence of the Ferrar and Taylor glaciers and Mount Lister (hidden in the clouds). Friis Hills Drilling Project Co-lead Prof. Tim Naish stands on Ferrar Dolerite boulder (centre). Photo by Richard Levy.

# Underwater landslides and tsunami risks in the Ross Sea

A series of giant landslides on the outer Ross Sea continental shelf were investigated in 2018 as part of the International Ocean Discovery Program (IODP) Expedition 374 - co-led by the ARC's Rob McKay and Laura De Santis from the Italian National Institute of Oceanography and Applied Geophysics.

The landslides were first discovered during a 2017 Italian science expedition, and in 2018 the IODP expedition collected sediment cores extending hundreds of metres beneath the seafloor in the region of continental shelf where the landslides originated.

In 2023, the international team from these two scientific cruises combined to publish results in a *Nature Communications* led by Dr Jenny Gales (University of Plymouth). They discovered the slips on the continental shelf extended >100km, and formed beneath layers of weak, fossilised biologically-rich sediments tens to hundreds of metres beneath the seafloor. These sediments were deposited during past warm climates, in particular during the mid-Pliocene warm period ~3 million years ago, when climates were more than 2°C warmer than present.



The JOIDES Resolution drill ship in the calm waters of the Ross Sea during IODP Expedition 374  
Photo by William Crawford, IODP JRSO

During subsequent cold climates/ice ages these slippery layers were then overlain by layers of coarse gravels delivered by glaciers and icebergs, creating layers of sediments with highly contrasting levels of cohesiveness. This makes the area highly susceptible to future failure in the face of earthquakes or other seismic activity. While the Ross Sea is a relatively tectonically inactive region, the research team proposed that at the end of the ice ages that deposited the gravels layers, the removal of a heavy ice sheet on the Earth's crust resulted in the uplift of the sea bed – a process known as isostatic rebound. This acted to tilt these highly layered sediments and resulted in the coarse gravel to slide over the top of the slippery biological layers, and vast quantities of sediment to catastrophically slide off the continental shelf edge as one giant sheet.

Multiple landslides events were discovered, highlighting how susceptible this region is to landslides. Individual events displacing up to 230 km<sup>3</sup> of sediment, which are large enough to generate tsunami waves. Similar scale landslides in the northern hemisphere have generated tsunami waves that killed residents along the Newfoundland coast, impacted the coast of Portugal, and caused significant economic damage by severing trans-Atlantic telecommunications cables.

However, whether such events could occur in the face of the modern climate change is unknown at this stage. What could be said with a lot more certainty was that the types of sediment being deposited by these past climate changes have resulted in a region that is highly susceptible to large submarine landslides. Isostatic rebound was proposed as a logical potential trigger, but this remains unvalidated. The triggers for these slope failure events could also be random failure, or climate-regulated shifts in ocean currents acting to erode sediment at key locations on the continental shelf. It is also unknown what the impacts for a Southern Ocean tsunami source would be for Southern Hemisphere populations, or for infrastructure relating to Antarctic bases in the Ross Sea. However, numerical computer models exist that could provide tools that could inform on these potential risks, and will be a focus of future research from this team.

Contact [Robert.McKay@vuw.ac.nz](mailto:Robert.McKay@vuw.ac.nz)

Gales, J. A., **McKay, R. M.**, De Santis, L., Rebesco, M., Laberg, J. S., Shevenell, A. E., et al. (2023). Climate-controlled submarine landslides on the Antarctic continental margin. *Nature Communications*, 14(1), 2714.

# A new coupled model of the Ross Sea

After one and a half years of coding, debugging and recoding, Alena Malyarenko and Alex Gossart from the ARC-hosted National Modelling Hub finally successfully combined ocean, atmosphere and sea ice models into a single model framework. This 'coupled model' is a huge accomplishment, and culminated in a paper published in *Geoscientific Model Development* in 2023.

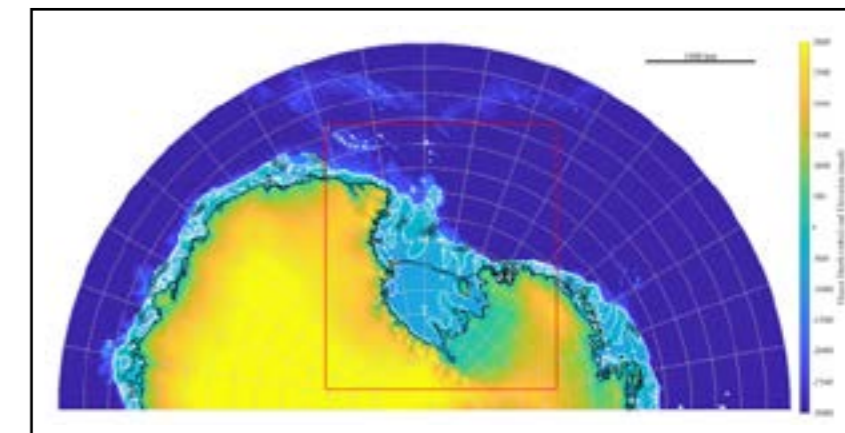
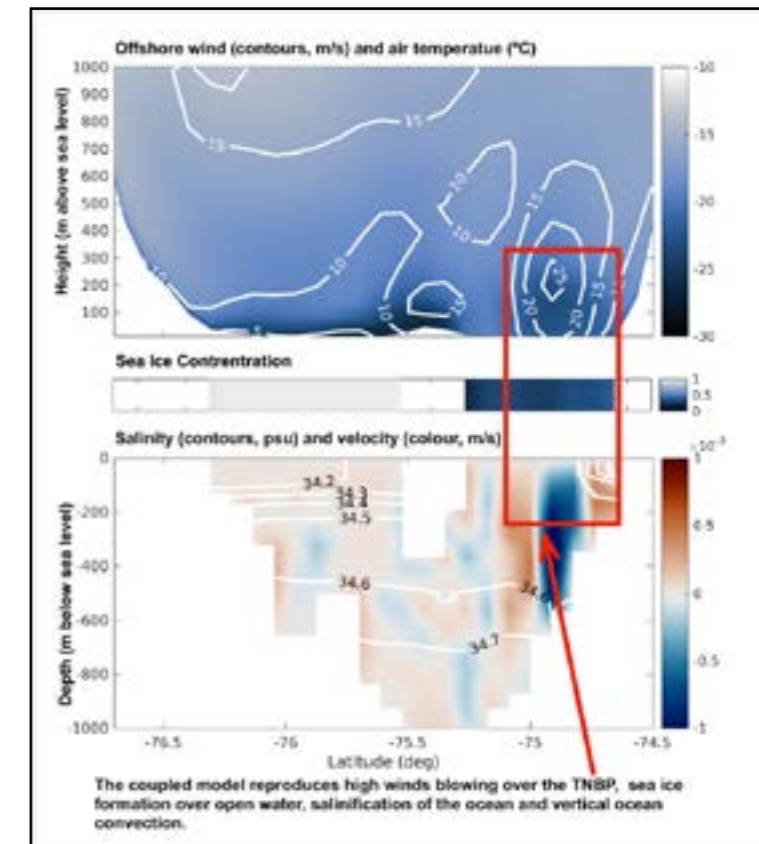
With the new model, Alena (University of Canterbury) and Alex (Victoria University of Wellington) - as well as other researchers around the world - will be better able to forecast what the future holds for the Ross Ice Shelf.

The importance of the Ross Ice Shelf can't be overstated. As temperatures rise, the melting of this ice shelf – which some researchers think could occur later this century – would have dramatic implications for the West Antarctic Ice Sheet. Any loss of grounded ice from there would substantially affect sea-levels across the globe. To understand how the ice sheet and ice shelf will change, the first challenge is to accurately model the complex interplay between the atmosphere, sea ice, and ocean conditions of the surrounding Ross Sea.

Modelling is a tricky business though. The different realms involved (atmosphere, sea ice, ocean) are usually simulated independently in order to make the calculations tractable. To bring them all together, communicating and exchanging flows of heat and moisture in a way that doesn't compromise the values, is a complex task. With the help of other hub members including Mario Krapp, Alena and Alex developed the new P-SKRIPS model so that each system could interact with the others in the same way as they do in real life.

Despite the long road to arrive here, the creation of this model is only the beginning. Alena and Alex are already working to refine these model simulations, and along the way having to overcome new hurdles, the most significant of which isn't the science, but resources. Atmospheric modelling requires enormous computational power because the model calculates how the atmosphere changes based on 20-second intervals. That means that a single simulation can take months to complete. This collaborative effort is now paving the way from technical development to an established capability at a time when climate and Antarctic modelling couldn't be more important.

Contact [Alexandra.Gossart@vuw.ac.nz](mailto:Alexandra.Gossart@vuw.ac.nz)



Antarctic map showing the Ross Sea and surrounding area that the new coupled model represents. (Credit: Malyarenko et al, 2023).

# Ice cores and tohu

Ice core science and maatauranga Maaori combine to provide indicators of environmental change in the Ross Sea Marine Protected Area.

Past, present and future knowledge of the environment is contained in maatauranga Maaori and paleoclimate archives. Environmental calendars, such as the maramataka (Maaori lunar environmental calendar) and Antarctic ice cores, are valuable sources of this knowledge. Holly Winton, Neil Brough and University of Auckland colleague Ayla Hoeta (Waikato Tainui) spent eight weeks over the 2023/24 Antarctic summer working on a research project that brings together western science and kaupapa Maaori perspectives of Te Tiri o te Moana (Antarctica) environment.

The western science component included ice core drilling and atmospheric monitoring. Tiny atmospheric aerosols trapped in ice cores provide valuable insights into climate patterns and environmental changes in Antarctica. The team drilled a 20 m ice core near the Priestley

Glacier in Victoria Land to develop a 200 year history of phytoplankton biomass and composition in the Ross Sea Marine Protected Area using novel biomarkers.

Two weeks of real-time aerosol and meteorological data recorded two marine air mass events transporting a higher loading of coarser particles from the ocean to the site. These aerosols are likely comprised of sea salt and phytoplankton biomarkers that are preserved in the ice core. The Upper Priestley site has emerged as an ideal location for archiving a longer record of past Ross Sea phytoplankton change. The ice core record, combined with the real-time aerosol timeseries, and biogeochemical modelling will help understand the impact of changing sea ice conditions on seasonal phytoplankton blooms in the Ross Sea Marine Protected Area.



Ayla Hoeta and Holly Winton flying the Tino Rangatiratanga flag in the spirit of bringing Maatauranga Maaori to Antarctica and conducting Antarctic fieldwork using kaupapa Maaori frameworks. Photo by Julian Malcolm.



Neil Brough and Holly Winton sampling a 2m snow pit for sea ice and phytoplankton proxies. Photo by Glenn Smith.

Using a kaupapa Maaori approach, the researchers also collected observations of the environment to build knowledge about the Maramataka (Maaori lunar environmental calendar) at Scott Base.

“We looked at tohu (environmental indicators), focusing on the whakapapa of snow and ice and tohu o te rangi (observations in the sky) as a starting point to understand the Maramataka at Scott Base.”

These are the first observations of tohu in Antarctica using the Kaupapa Maaori framework of Hautu Waka and kaitirotiro.

“We hope sharing this mahi will help spark interest in Antarctic science in Te Tiri o te Moana among rangatahi (young people).”

While the team is safely back in Aotearoa New Zealand, tohu observations continue year-round at Scott Base with wintering staff journaling their observations. These tohu observations, supported by time lapse footage of the night sky and western science observations from ice cores, satellites and ground-based instruments combined, are starting to build a picture of environmental change on lunar, seasonal and centennial timescales in the Ross Sea Marine Protected Area. Such baseline data is crucial to monitor and safeguard the world’s largest marine sanctuary.

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## Unusual sea ice formations in Antarctica

A team of four women - Ruzica Dadic, Roberta Pirazzini, Dao Polsiri and Julia Martin - camped on the sea ice near Scott Base during the 2022/23 field season as part of the Marsden-funded project "Can snow change the fate of Antarctic Sea Ice". The team aimed to study the physical properties of the snowpack, to understand the role of snow in the atmosphere-sea-ice-ocean system and the potential impact of the snowpack on the sea ice under future climate change. Julia Martin, ARC PhD candidate, explains the research project.



K046 sea ice camp with Scott Polar tents about 6 km southwest of Scott Base (Ross Island, Antarctica). The neon-yellow tent was a cold storage tent for drones. Life and work life took place in the big yellow rectangular tent. Photo by Julia Martin.

After arriving at Scott Base and reorganizing our cargo, we examined the snow and ice conditions in the McMurdo Sound to mark five distinct measurement areas representing the critical features of sea ice formation in 2022. Typically, the sea ice in the McMurdo Sound forms in March and continues to grow until about December. In 2022, the sea ice formation was disrupted due to repeated southerly storms, and most ice was blown out regularly. The unusual formation resulted in ice with varying thicknesses and snow conditions. The "old ice" (about 2.5 m thick) began to develop in March 2022, and what we called "new ice" (less than 1.5 m thick) did not form until August 2022. The two zones were separated by a transition zone characterized by thick ridges.

After deciding on our survey sites, we moved to our sea ice camp about 6 kilometres southwest of Scott Base. Life on the sea ice was unique - beautiful and harsh at the same time. When weather permitted, we typically made one snow pit per day to capture the temporal evolution of the snowpack during our time on the ice. Since we were particularly interested in the surface properties of the snow, we used drones to map the snow

surface topography on a larger scale (200x200 m) and record the snow surface's temperatures with a thermal camera. Another critical parameter for the energy budget of the surface is the albedo (reflectivity) of the snow, which is the fraction of light that the snow surface reflects. We measured the albedo with a customised drone at different altitudes of up to 70 metres to understand the impact of spatial variability of the snow surface, such as sediment patches in the snow. Working with sensitive electronics like drones in polar regions was challenging, but we achieved our goals and fulfilled our measurement programme. Very happy, we returned to New Zealand in mid-December after a successful campaign.

*Julia Martin is a PhD student at the ARC. Originally from Germany, Julia moved to New Zealand in October 2022. Julia is a snow scientist, and during her doctorate is studying the impact of the snow cover on the Antarctic sea ice using drone imagery, physical measurements and modelling. The K046 project was Julia's first time in Antarctica, and she was fascinated by the beauty and roughness of the continent.*



The all-women team, from left, Julia Martin, Dao Polsiri, Ruzica Dadic and Roberta Pirazzini. Photo by Ruzica Dadic.

# A fresh perspective....two ARC postgraduate students experience Antarctica for the first time

Six bright yellow tents, buckets full of rocks and a team of scientists from across the world overlooking a mountain named after the ancient tuatara – this was an epic deep-field camp in Antarctica! PhD student Aylin de Campo and MSc student Lottie Stevenson report on their experience.

Our team consisted of an Austrian, a Brazilian, two kiwis including Kevin Norton of SGEES, and two Americans including Field Leader Jamey Stutz. For us (Aylin & Lottie), it was our first experience on the ice, and we were joining a mission that had been a few years in the planning: to study the past behaviour of the Byrd Glacier, one of East Antarctica's largest glaciers.

The fast-moving Byrd Glacier drains a huge area of ice - five times the size of New Zealand - through the Transantarctic Mountains into the Ross Ice Shelf. Modelling sea-level rise, and the instability of the Ross Ice Shelf in a warming world, depends upon our knowledge of the speed and timing of glacial thinning. Monitoring the vital signs of this glacier is important in forecasting the future for Antarctica's ice sheets – and understanding the vital signs of the planet.

Before learning about past ice sheet behaviour, we first needed to learn how to survive in Antarctica. It was a shock to step out of the Herc onto a bright, disorienting, white expanse of ice. After a few weeks of field training at Scott Base, and armed with countless warm jackets, we set up our yellow tents on Mt Tadpole, next to Mt Tuatara, right at the Byrd Glacier.

Our intended three-weeks in the field turned into five days due to weather delays, so we were rushed to fill our

buckets with rocks. Fieldwork with our team involves hiking from high to low mountain slopes, collecting pebbles that seem out of place in the landscape, to ultimately produce an elevation transect. We were collecting the traces Byrd Glacier has left behind through its process of thinning. As the glacier shrinks, it melts out pebbles that have been transported a vast distance from upstream, and drops them on adjacent mountain outcrops. In theory, our targets are easily identifiable; they tend to be lightly coloured, rounded, glacially-smoothed rocks perched on the dark, sharply-angled bedrock surface. As Jamey Stutz would say, they had absolutely no business being there! Back in New Zealand, the rocks are analysed using a technique called surface exposure dating, allowing us to reconstruct how the ice surface elevation has changed over time – when, and how fast, the glacier has thinned in the past.

During our fieldwork, we had exhilarating panoramic views from Mt Tadpole. We could see the immense frozen flow of the Byrd Glacier, resembling a Norwegian fjord, and across the other side to distant cloud-topped peaks. It took nearly 20 mins to fly across the immensity of the Byrd Glacier in the Twin Otter. As a comparison, the Byrd Glacier is wider than the Tasman Glacier is long (at 23.5 km)! Looking south, the spiky spine of Mt Tuatara stood centre stage, with the endless polar plateau in the background.

We also had a great opportunity to go helicopter-hopping



From left, In matching hand-knitted beanies: Bia Boucinhas, Kevin Norton, Lottie Stevenson, Jamey Stutz and Aylin de Campo with Mt. Tuatara in the background, before heading back to Scott Base via Twin Otter. Photo by Sébastien Trudel.

on two day-trips. It was on these far-off slopes where we learnt not only how to identify superb samples, but also the burden of carrying heavy rocks in our packs while ascending steep hills... when we could have left them in the helo!

We are hoping these buckets of rocks will make great samples and keep us busy for our thesis work. The trip overall has been an essential learning and fieldwork

experience, and we are beyond lucky to have explored landscapes where few others have set foot.

This exceptional landscape left a profound mark on us and we hope to leave an equally positive mark there too. During fieldwork, our team crossed the unnamed glacier flowing between Mt Tadpole and Mt Tuatara. We will attempt to name this Gecko Glacier, to continue the theme.



Aylin de Campo from Austria is a PhD student in Paleoclimatology and Glaciology at the ARC. Lottie Stevenson is completing an MSc in Physical Geography at the ARC. They travelled to Antarctica in December 2023.

Sunny evening (10:46pm!) panorama from the summit of Mt Tadpole, looking towards Mt Tuatara (centre), with Byrd Glacier in the distance at right. Photo by Lottie Stevenson.

# Girls\* on Ice Aotearoa New Zealand

2023 saw the inaugural Girls\* on Ice Aotearoa New Zealand expedition, hosted by the ARC, as a branch of Inspiring Girls\* Expeditions. The program offers 11-day tuition-free expeditions that incorporate Earth science, art, and outdoor exploration for 15- and 16-year-old girls\*. We aim to inspire passion, participation, and empowerment for girls\* in professions of science, art, and wilderness exploration.



Mt Ruapehu expedition photos by Rebekah Parsons-King

The inaugural expedition took place in January 2024. Around 230 students applied for the 10 places on the expedition. Participants came from all over New Zealand, from Winton in the south to Auckland in the north. Led by ARC scientists, outdoor specialists and a US-based guest artist, the team explored New Zealand's unique landscape of Mount Ruapehu, the North Island's highest active volcanic peak. Throughout the week on the maunga, they learned about the ever-changing nature of snow and ice, used art to observe the landscape, and engaged in practical fieldwork including mountain safety and guided

science experiments. They worked together to create a positive and educational experience for both leaders and students alike, developing knowledge of the land, and forming life-long friendships.

Following the week on the maunga, the team returned to Te Herenga Waka—Victoria University of Wellington to present research findings and personal experiences to friends and whanau, supporters and sponsors. In an anonymous post-expedition survey, the students responded to questions about their participation:



*"I really enjoyed learning about so many different things in such a vast range of areas and it really confirmed that I want to pursue a career in environmental sciences."*

*"I [now] want to involve myself in as many things as I can. Even if I think it won't be fun, even if I really don't want to, I should just do it. What's stopping me from participating? Who knows what I'll learn..."*

*"The best part of my expedition was probably the long hike up the mountain. I love how everyone encouraged each other and we paced ourselves pretty well throughout the day. I loved the views and having long conversations."*

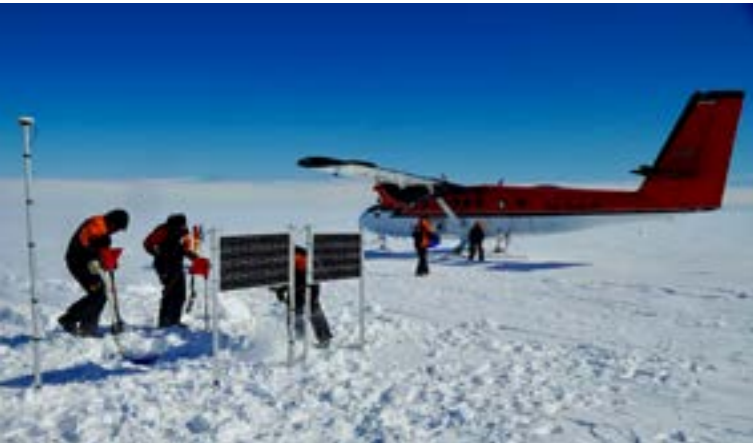
As Girls\* on Ice Aotearoa New Zealand is tuition-free, we are extremely grateful to our major donors Beverley McCombs, Mountain Adventure and the United States Embassy Grants Program. The Grants Program aims to promote stronger connections between the US and New Zealand and address global issues of shared interest, including climate change and the impacts of climate change on snow and glaciers.

Funding from the programme was also provided for an exchange with Girls\* on Ice Alaska which is hosted by the International Arctic Research Center at the University of Alaska Fairbanks. The exchange allowed the Girls\* On Ice Alaska expedition artist, Hannah Mode, to travel to New

Zealand to join the Mount Ruapehu expedition. The Arctic Research Center is already well connected to the ARC through the S.T. Lee researcher exchange programme. The next Girls\* on Ice Aotearoa New Zealand expedition is planned for January 2025, with the online application process opening mid-2024. More details are available on the Girls\* On Ice website, including sign-up for news and supporting this inspiring programme: <https://www.inspiringgirls.org/goi-aotearoa-nz>.

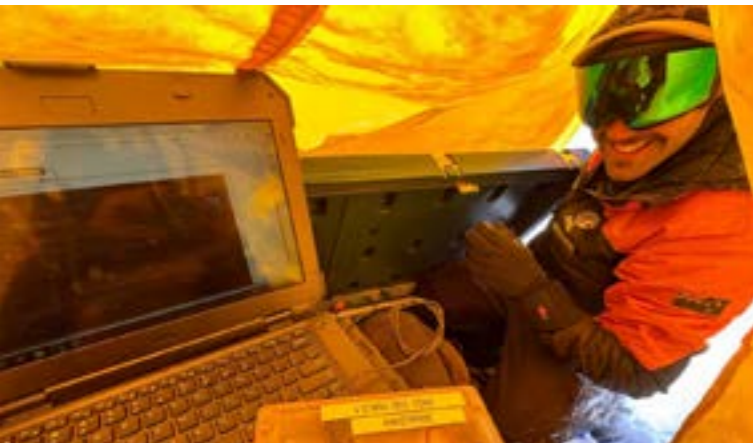
\* We welcome cisgender girls and transgender, agender, nonbinary, intersex, and genderqueer youth.

## Seasonal velocity of the Ross Ice Shelf



Alanna Alevropoulos-Borrill reports on the project's successful season, despite unexpected setbacks.

The 'Seasonal Velocity of The Ross Ice Shelf' project has been running since January 2020. The project aims to capture a multi-year record of seasonal variability in ice flow speed to better understand the present and future behaviour of the Ross Ice Shelf in response to climate variability. The focus for the project this year was to service the existing 6 GNSS (Global Navigation Satellite Systems) sites located over the Western Ross Ice Shelf, with the furthest sites up to 300 km away from Scott Base.



Due to the large spatial coverage of the sites, the fieldwork requires the use of a fixed-wing aircraft to access each of the sites. Unfortunately, this year the aircraft that flies South each season from Canada was held up in Chile for 3 weeks, resulting in big delays for a number of science teams. With only a week's notice the 3-person field team was reduced to one - only Alanna Alevropoulos-Borrill was deployed South to train Scott Base staff to complete the fieldwork at a later date. However, thanks to the unwavering support of the Antarctica New Zealand logistics team, Alanna and the Scott Base staff team managed to fly to four of the six sites during the 3-week field season, and one further site was accessed in January.



At each of the five sites visited, the team dug out all the installed equipment that had been buried by two years of snow accumulation. The equipment included the GNSS receiver located within a large case alongside a number of batteries and solar panels fixed above the snow to keep these charging during summer. Once the equipment was dug out, the positional data was downloaded from the receiver and any required servicing was performed. The equipment was then re-installed to be left to continue extending the record of position data at each of the sites.

Back at the National Modelling Hub based at the Antarctic Research Centre, Alanna is now working on processing the data obtained this season, to be followed up with supporting ice sheet modelling experiments in the coming months.



Project fieldwork in early December.  
Photos: Top three photos by Alanna Alevropoulos-Borrill  
Bottom photo by James Martin

## Aerosol explorations on board the RV Tangaroa

ARC MSc candidate Emma De Jong sailed onboard the RV Tangaroa to the Ross Sea for six weeks in January-February 2023. Emma's aim was to make a series of ocean and atmosphere measurements to better understand the role of biogenic aerosols in the unique Southern Ocean climate.

Southern Ocean biogenic aerosols play an important role in the climate system. Yet observations are incredibly limited.

Increasing the observations of biogenic aerosols provided Emma with the opportunity to head down to the ice for the first time. The goal was to make observations of the chemical and physical composition of aerosols produced from the highly productive Ross Sea to better understand their sources and their ability to seed clouds. The observations also help to validate novel ice core proxies of phytoplankton.

Alongside a team from the University of Canterbury, NIWA, and GNS, Emma monitored a series of real-time aerosol

instruments, collected 176 aerosol samples, and filtered 42 seawater particulate samples. Twelve of the seawater samples were incubation experiment samples, exploring the impact of a 2 °C warmer world on the availability of fatty acids to higher trophic levels. Emma's highlight of the trip was being surrounded by 20 other Antarctic scientists, helping in different areas of science, and doing opportunistic work like the incubation experiments.

Upon seeing Antarctica for the first time Emma described the experience as being "one of the most special feelings I've ever had in my life. I cannot believe how lucky I am to not only be researching something so important but experiencing it in person too. It's an immense privilege, and I will cherish this moment for as long as I can."



Onboard the RV Tangaroa. Photo by Emma De Jong.

# Science Drilling Office

The focus for ARC's Science Drilling Office (SDO) this year has continued to be the SWAIS2C project and implementation of a logistically reduced footprint intermediate depth geological drilling system. The drilling system aims to recover up to 200 metres of sediments from beneath the Ross Ice Shelf near the grounding line of the Kamb Ice Stream utilising hotwater and wireline core drilling technology.

The SDO of the Antarctic Research Centre currently has two full time engineers, Darcy Mandeno and James MacPhail. Alex Pyne continues on a part-time basis as an Antarctic Drilling Advisor.

Following the previous season's hiatus and another hectic year, the SDO ended 2023 in the field, with the first implementation and operation of the Antarctic Intermediate Depth Drill (AIDD). AIDD is the Multipower MP1000 exploration wireline core rig at the Kamb Ice Stream (KIS) supporting the Sensitivity of the West Antarctic Ice Sheet to 2 degrees Celsius project, SWAIS2C. The recently acquired GNS Science and VUW-owned AIDD was integrated with the existing British Antarctic Survey style Hotwater Drill (HWD1000m) that has continued to prove its utility in gaining access to sub ice shelf locations.

For the most part, 2023 tasks continued on from the 2022 work program preparing critical elements required for the operation of the integrated AIDD and HWD1000m for the following season.

Team selection for the Antarctic season started earlier than most years due to the additional staffing requirements of six HWD1000m drillers and four AIDD drillers to run two drill systems on a 24 hour cycles. AIDD drill system operation was supported by industry partner Webster Drilling and Exploration, led by previous Antarcticians Tony Kingan and Adam Rutten, along with Antarctic first-timers Martin Loughney and Oliver Chappell. The HWD1000m team saw the return of Jane Chewings from Victoria University, Hedley Berge, Tim McPhee, Sean Heaphy and for his first Antarctic operation, James MacPhail of the ARC SDO.

The team deployed over two cohorts during November, arriving at the Kamb Ice Stream site to start site preparation from early- to mid-December. They got straight to work with drilling system installation, many of the drilling system parts having never before been assembled together. Largely without issues, drilling operations started around Christmas. The HWD team was the first to start, drilling through the ice shelf, before starting with the installation of the Glass Reinforced Epoxy pipe (GRE). This innovative solution has better thermal properties than industry standard steel tubulars, reducing heat loss in the ice shelf and improving the AIDD capacity with a product that has more buoyancy in water than a steel equivalent.

It was during this initial installation of the seariser and Bottom Hole Assembly (BHA) that a significant issue arose. The AIDD chuck was unable to hold onto the GRE satisfactorily. Two significant slips were unable to be remediated or prevented with the equipment available on site, forcing the decision to abandon AIDD drilling operations for the season and recover the seariser and BHA.

Despite this, access to the ocean cavity with the HWD1000m was maintained, enabling the successful completion of other scientific objectives for close to a week. The shallower gravity and hammer cores obtained during this period will provide significant insight for sub seafloor drilling operations to be undertaken in the 2024/2025 season (see pages 26-27).

For the near future AIDD drilling will return to more conventional steel drilling pipe, already delivered to Scott Base at the end of the 2023/2024 season in anticipation of the 2024/2025 Antarctic season.

Contact [Darcy.Mandeno@vuw.ac.nz](mailto:Darcy.Mandeno@vuw.ac.nz)

Right: Gavin Dunbar with the drilling team.  
Photo by Linda Balfourt

Left: The Kamb Ice Stream drilling site and team.  
Photo by Ant Powell



## SWAIS2C update: First season at KIS-3

The first Sensitivity of the West Antarctic Ice Sheet to 2 degrees Celsius (SWAIS2C) field season at the Kamb Ice Stream (KIS) KIS-3 drill site on the Ross Ice Shelf was completed between November 2023 and January 2024, delivering a mix of scientific and logistical success, drilling challenges, and much learning. Richard Levy (ARC/GNS Science), Tina van de Flierdt (Imperial College London) and Darcy Mandeno (ARC) report on the project's progress.

Our goal to drill through the ~580 m-thick Ross Ice Shelf and deep into sediments beneath the sea floor near the grounding zone of the West Antarctic Ice Sheet at a location 800 km away from Scott Base is no easy task. And this season once again proved that large-scale complex scientific endeavours in Antarctica don't always go exactly to plan.

Our international team of 27 scientists, drillers, mechanics, logisticians, and camp staff achieved much this season. We traversed gear ~1200 km from Scott Base to the KIS-3 site, set up a large camp, built a stunning skiway, melted a hole through ~580 m of ice shelf, collected many short sediment cores, obtained oceanographic data, and

deployed a GPS system and ice surface radar. We were unable to obtain the long sediment record that we need to address many of our key scientific questions due to an equipment failure, but our team returned home in January pleased to have gained significant knowledge from our field-based 'shakedown' - insight that will ultimately help us achieve our goal to drill deep below the seafloor in this poorly understood region of Antarctica.

We were thrilled when we retrieved an almost two-metre-long sediment core using a hammer coring system - a record for the region. This material provides an extended record of recent ice sheet and ice shelf retreat, a climate and environmental record that will be studied in detail

over the coming months. We also have lots of sediment samples that will be studied for their microbiological content so that we can reveal more about the communities living in the extreme environment below the cold and dark ice shelf cavity.

And finally, we now know that the sediments below the seafloor at KIS-3 are relatively soft and that we can use our hydraulic piston corer with confidence - a big step forward as we sort important details for our drilling campaign. As the calendar crosses from 2023 to 2024, our team is already preparing to return to KIS-3 in November to complete our sediment drilling objectives. We can address the technical issue encountered with

the AIDD system this season. Our drillers, engineers, and scientists have gained significant hands-on field-experience with both the hot water drill and the AIDD system, and how they 'connect'.

We can't wait to return for the 2024/25 season!

*The SWAIS2C Project is a multinational initiative to recover and study sedimentary drill cores from beneath the Ross Sea margin of the West Antarctic Ice Sheet (WAIS). The lead operational parties are a partnership between the Antarctic Research Centre (Drilling Services Provider), GNS Science (Project Manager) and Antarctica NZ (Antarctic Project Operator).*

*Rob Teasdale's runway grooming with camp in distance, KIS-3 Drill site. Photos by Ant Powell.*



# SIGNIFICANT EVENTS



Holly Winton (left) and Neil Brough testing the core at Windless Bight.

## Ray Hoare donation

The ARC is very thankful to Ray Hoare, who made a generous donation to the ARC Endowed Development Fund this year.

Ray is a former Te Herenga Waka—Victoria University of Wellington student who visited the Dry Valleys McMurdo region in the early 1960s on VUW Antarctic Expeditions (VUWAE) 8 and 9. On these expeditions he employed his physics skills to explain the existence of warm water in the lakes in this ice-free area of Antarctica. Lake Hoare is named after Ray.

His contributions were published in four journal articles shortly after these expeditions, including a 1964 article in *Nature*. In that paper, Ray and his colleagues showed that a quantitative solar heating model of density stratified Lake Bonney could explain the warm water, peaking at a temperature of 7°C, 13 m below the surface.

In the last three years he has reviewed his archives and finally published material from two minor lakes from almost 60 years ago, in the *NZ Journal of Hydrology*!

In October, the ARC hosted Ray and his partner Patricia. We were captivated by his stories of the University's early Antarctic history and how our Geology, Chemistry, and Physics departments all worked together to investigate this frontier of Antarctic scientific exploration.

Like most of our VUWAE alumni, Ray described his Antarctic field work as being a pivotal turning point in his life, and felt a strong desire to provide the next generation of students with a similar life-changing opportunity. Accordingly, Ray's Gold Level support of the ARC Endowed Development Fund will provide an enduring legacy for our emerging scientists. This substantial gift to the Fund is being recognised by the ARC via matched funding to establish a Master's Scholarship named after Ray.

We are truly grateful for Ray's support of our students.

ARC student Lottie Stevenson received funds from the Ray Hoare donation to continue her MSc studies in 2024.

"I feel extremely fortunate to be the recipient of the Ray Hoare Master's Scholarship in Antarctic Research. Ray and I conducted scientific fieldwork in Antarctica 60 years apart but had the same aims, I'm sure: to understand and appreciate the icy continent. Just as the remarkable Dry Valleys lakes left an impression on the members of those VUWAE expeditions, motivating them to dedicate names to the newly studied lakes, my team and I were humbled by the landscape near Byrd Glacier and hope to name the unnamed glacier we traversed.

There are many more shared links between myself and Ray Hoare, including our connections to the VUW tramping club and multi-disciplinary interests combining chemistry and geology. Antarctic research is essential as we face future changes and this support enables me to conduct meaningful science, share these experiences and results with society, and to see a future for myself in polar research. Ngā mihi nui ki a koe, Ray Hoare."

Ray Hoare hauling equipment across a Dry Valleys' frozen lake.





Winter School 2023 participants. Photo by Anna Bowron



## National Modelling Hub Winter School

In late September, 20 participants from across New Zealand universities and CRIs came together to develop their skills in numerical climate modelling research, as part of a three-day workshop run by the Antarctic Science Platform's National Modelling Hub.

The Hub runs the annual Winter School to guide interested students and researchers through the scientific basis of numerical climate modelling, offering lectures and interactive training. This year's event, Introduction to Climate Modelling and Data Analysis, was run in partnership with NeSI, the New Zealand eScience Infrastructure. It offered participants the opportunity to learn how to use the command line and how to work with NeSI's high-performance computers.

Students took part in interactive sessions and lectures about satellite and climate re-analysis data. Using Jupyter notebooks, students were able to create interactive documents containing live code, equations, visualizations, media, and other computational outputs. Running their

own climate model simulations of Cyclone Gabrielle and having the chance to submit them to NeSI's Mahuika cluster was a particular highlight of the Winter School activities. While fascinating, it wasn't all about wrangling data – the three days offered networking opportunities over tea and coffee, icebreaker drinks, and a social dinner at the Thistle Inn. Everyone enjoyed an excellent view of the Beehive and Wellington Harbour from the 12th floor of Rutherford House, despite the three full days of rain.

With a great turnout, lots of time for discussions and positive feedback throughout, the event was deemed a great success. It serves as an example of how to provide advanced, high-quality training opportunities for Aotearoa's growing numerical climate modelling research community.

Contact [Alexandra.Gossart@vuw.ac.nz](mailto:Alexandra.Gossart@vuw.ac.nz)

## VUWAE 15 (1970-71) returns

In June, the Antarctic Research Centre hosted a reunion for members of the 15th Victoria University of Wellington Antarctic Expedition (VUWAE). Former ARC Director Peter Barrett looks back at the 1970 expedition.

VUWAE 15 was the first VUW expedition led by a foreigner – myself, originally from Auckland but with five years at Ohio State University in Columbus, Ohio. Fortunately, the expedition had been well planned before I arrived. Barry Kohn, a geochemistry PhD student, had had a season two years previously with Barrie McKelvey and Peter Webb in mountains surrounding the Skelton Neve. Their mission had been to extend knowledge of the Beacon Sandstone in that area, and they discovered beds of remarkable Devonian (420-360 million years ago) aged fish skeletons.

As a consequence, VUWAE 15 was planned for a more detailed work in logging the ~1000 m of Beacon strata in the area, with Barry and two prospective PhD students, and fossil fish collecting by experts from the Australian Museum in Sydney. The party also included petrologist,

Rodney Grapes, and a prospective MSc student, to study the spectacular 1000-m-thick dolerite sill in the nearby Warren Range.

I arrived in January 1970 on my first appointment for a two year trial with a new PhD after two seasons in the central Transantarctic Mountains. Prof. Bob Clark's Geology Department, where staff debated among themselves and engaged with the students on the big issues of the day, was an enjoyable challenge.

The expedition left for the ice in early November, 1970, and returned in early February, 1971, after great success with 5000 m of strata measured, 1 ½ tons of fish fossils collected, and a few years later two PhDs awarded, along with a number of reports and papers. There were mishaps involving both the leader and deputy leader, and a number of toboggan failures were overcome.

Despite this, the expedition was a very positive experience for its members, and ensured the continuation of similar expeditions for years.

VUWAE 15 Returns was an event involving four of the original party, with comments from a fifth, on June 8, 2023, at Victoria University of Wellington. A series of five talks and two videos reflected on their experiences at the time, and thoughts since. Videos of the event are available as a playlist on: [www.youtube.com/@newzealandantarcticsociety4100](https://www.youtube.com/@newzealandantarcticsociety4100).

Sadly, Alex Ritchie (1935-2023), paleontologist on this 1970-71 expedition, passed away in November. Alex's extraordinary achievements are summarised in an extended obituary published online by the Sydney Morning Herald (5 December 2023).





# S.T. Lee Lecture in Antarctic Studies

The 20th Annual S.T. Lee Lecture was presented by the long-time ARC collaborator Tina van de Flierdt, a Professor of Isotope Geochemistry and Head of the Department of Earth Science and Engineering at Imperial College London.

Tina's lecture was entitled *Drilling for our future in Antarctica's past* and took us on a personal journey of asking questions, finding answers, and uncovering more questions.

Her academic journey so far has been incredibly diverse and spans a variety of fields, from understanding chemical cycles of trace elements and pollutants in the ocean, to reconstruction of ocean circulation and its relationship to climate, and understanding the history of the polar ice sheets and their vulnerability to future climate change. In all these fields, she is a true world leader, but her talk primarily focused on her pioneering work in using trace element tracers to identify the geochemical "fingerprints" of past ice sheet collapse events, as recently as the last interglacial period 120,000 years ago – and how these results have been fundamental to improving models to project future change.

Tina also highlighted the important role of the Ross Ice Shelf in protecting the West Antarctic Ice Sheet from warmer oceanic temperatures, and the implications of its stability for future sea-level rise around the world. She noted that the scale of this future response remains in our hands, and that she is a stubborn optimist who believes we still have time to overcome many of the challenges that climate change will bring for our ice sheets.



Tina's schedule of events was deliberately short compared to most S.T. Lee Lecturers, as she deployed to Antarctica in the following week for two months. There she was Co-chief Scientist, alongside Richard Levy (ARC and GNS Science), on the international SWAIS2C project, which seeks to understand in more detail the history of the Ross Ice Shelf and West Antarctic Ice Sheet. We eagerly await to see how the next phase of her personal scientific journey plays out in this project.

Tina van de Flierdt with Richard Levy (left) and Rob McKay (right).  
Copyright: Victoria University of Wellington, photo by Colin McDiarmid, VUW Image Services.



# S.T. Lee Travel Award 2023

With funding from S.T. Lee, the ARC and the International Arctic Research Center of the University of Alaska Fairbanks (IARC) began a graduate student exchange programme in 2004 for the purpose of promoting polar research. Because travel has not been possible in the past few years, the 2023 S.T. Lee Travel Award Young Scientist Exchange was awarded to both Yaowen Zheng, ARC PhD candidate, and Billy van Uitregt, Senior Lecturer in the VUW School of Geography, Environment and Earth Sciences (SGEES).

## Yaowen Zheng - ARC PhD candidate

I was thrilled to have had the chance to visit Prof. Andy Aschwanden at the University of Alaska Fairbanks (UAF) with the support of the S.T. Lee Award and the Antarctic Research Centre (ARC). The Geophysical Institute at the UAF has a very stimulating environment, and I thoroughly enjoyed my time there.

My visit at the UAF has inspired the development of my distributed Positive-degree Day model, which aligns with the publication in *The Cryosphere* (Zheng et al 2023) and my PhD thesis. Conversations with PhD students at the UAF also influenced my thesis writing. Besides the science, I fortunately had the chance to play badminton and see the Northern Lights (Aurora).

Overall, this wonderful experience in Alaska has become an asset for me, and I am deeply grateful for the support provided by the S.T. Lee Award and the ARC.



Aurora borealis, Alaska. Photo by Yaowen Zheng

## Billy van Uitregt - SGEES Senior Lecturer

Cecelia Kumeroa (IHI Design, UCOL Whanganui) and Billy van Uitregt (SGEES VUW) travelled to the International Arctic Research Center (IARC) and the Museum of the North, both at the University of Alaska Fairbanks, for two weeks to take their collaborative research project *Poungawai: A Digital River* on a roadshow. The project was specifically about using environmental data from the Whanganui River to animate Whanganui design and create engaging artworks that incorporate interactivity.

The project engaged environmental data broadly to animate Māori design and provoke dialogue around the constraining dichotomies entrenched in discourse around Indigenous knowledges and science, and art and science. The aim of the trip was to use the Poungawai roadshow to establish relationships with indigenous researchers and communities of Alaska

and seek to build global Indigenous research networks that focus on the connections between our distant river systems mediated by migratory bird species, specifically the Kūaka (Māori) or Cugerpak (Yup'ik).

Cecelia and Billy were able to network with many of the researchers from across the IARC, including the Indigenous researchers and community liaison staff. A critical connection was made through the visit with the Yup'ik Paimiut Village Tribal Council who subsequently visited Aotearoa and Whanganui in March 2024 to begin the work of building a Global network of Indigenous peoples connected by migratory species.



Professor Hajo Eicken (far left), Director of the International Arctic Research Centre, opened his home to host a dinner for us to be able to meet and mingle with many of the Native and Indigenous researchers and staff at the University and local representatives of the Native American Fish and Wildlife Society.

# SCAR INSTANT Conference

## Trieste, Italy

### September 2023



Professor Tim Naish reports on the first Scientific Committee on Antarctic Research INSTANT (Instabilities and Thresholds in Antarctica) Strategic Research Programme international conference held in Trieste, Italy.

280 participants from 35 countries including 60% early- to mid-career researchers enjoyed four days of interdisciplinary presentations and discussions on Antarctic Ice Sheet changes and their contribution to global sea-level rise as well as the related coastal impacts and challenges for adaptation. The conference was held in a single room with talks in the morning followed by posters and more focussed workshops in the afternoon. Each day had a theme: 1) Climate-ice sheet interactions; 2) Solid Earth - ice sheet interactions; 3) Improving ice sheet mass loss and sea-level rise projections; and 4) Implications for coastal hazard and risk management and the communication of risk and uncertainty.

It was great to see data and observational communities interacting with modellers working across and connecting the ice sheets, sea-ice, solid earth, ocean and atmospheric systems and talking with social scientists about why ice sheet loss and sea-level rise matter to the two billion people living on the world's coastline, and the information and services they need. On Day 4 in the "Melting Ice Rising Seas Symposium" we heard from invited speakers representing Intergovernmental Panel on Climate Change, World Climate Research Programme, UNFCCC COP, NGOs, coastal planners, practitioners and policy decision-makers, journal editors (e.g. *Nature*), indigenous communities, story-tellers and writers. The rich discussions focussed

on how all these stakeholder groups can work to more effectively link science enterprise with policy and solutions needed by communities.

It was great to catch up with many old friends and colleagues and to make new connections and collaborations. Likewise, it was awesome to see so many younger researchers making connections face to face after many years disrupted by COVID. Our community is alive and well, with many exciting opportunities developing to solve the Antarctic ice sheet sea-level rise problem. New Zealand and ARC researchers were well represented at the conference and sponsorship and support by GNS Science, Victoria University of Wellington and SCAR enabled most ECMRs to receive travel support.

Aimee Kaio from Awarua Runaka and the Antarctic Science Platform presented a Te Ao Māori perspective on Antarctica and climate change impacts. Rebecca Priestley from the School of Science in Society gave a great talk on history and challenges of communicating climate change and sea-level science. Some important priorities were identified which will help shape the strategic direction of future research including improved collaboration between ice sheet modelling and sea-level projection communities, guided by the needs of the user community.



## The student experience at SCAR INSTANT

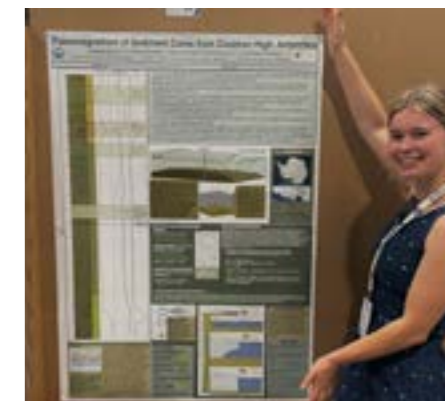
Four ARC PhD students attended the September 2023 INSTANT conference in Trieste, Italy - for most of them it was their first international meeting. Julianne Burns, Hana Ishii, Frank Mackenzie and Huiling Zou report on their experiences.

We left winter in Wellington and arrived for summer in Italy, which was a very welcome environment for such an exciting conference. We had the privilege to attend talks from leading and emerging scientists in our fields, as well as gain exposure to research outside of our specializations. We each presented posters of our research and made a number of connections through the poster session and networking events.

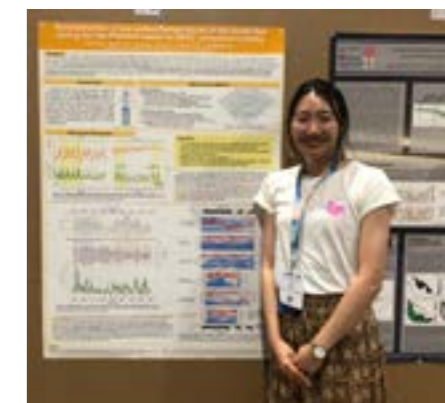
The conference workshops were very engaging, fostering passionate discussion about future collaborations between universities and disciplines. Prior to the conference, Frank and Huiling attended the MARICE workshop, discussing the integration of marine sediment and ice core records and setting a path for ongoing interdisciplinary research. Hana and Julianne participated in the post-conference workshops on Antarctic IODP expedition 374, which involved all of the leading scientists from the expedition discussing what they have discovered from the recovered sediment cores and exploring future collaborations. Hana and Julianne are both using sediment cores from this expedition for their PhDs and they found it invaluable to see the scope of research that has come from this expedition.

A highlight for all was the ECR lunchtime sessions, where a panel of leading scientists and professionals shared knowledge and answered our questions relating both to their specializations and to navigating the career paths ahead of us.

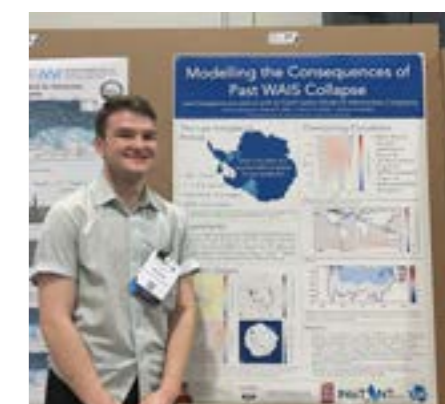
We are very grateful to ARC's Endowed Development Fund for sponsoring our travel, accommodation and attendance at INSTANT. The experience, connections, and friendships cultivated during the conference will undoubtedly stay with us throughout our careers.



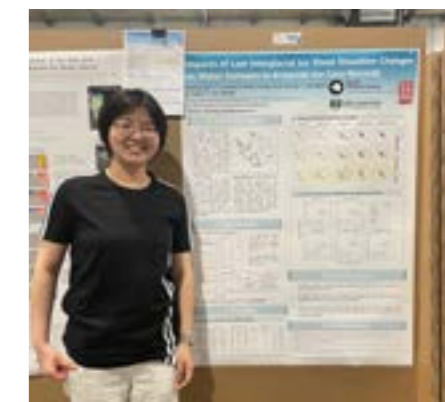
Julianne Burns



Hana Ishii



Frank Mackenzie



Huiling Zou

ARC PhD candidates Julianne Burns, Hana Ishii, Frank Mackenzie and Huiling Zou with their research posters at SCAR INSTANT September 2023.

# TEACHING AND SUPERVISION



Our staff support a wide range of courses taught within the School of Geography, Environment and Earth Sciences, as well as provide postgraduate student supervision. In 2023, our staff supervised 20 PhD and 3 MSc candidates.

## ARC staff contributed to the following courses

ESCI111	The Earth System: An Introduction to Physical Geography and Earth Sciences
ESCI132	Antarctica: Unfreezing the Continent
ESCI201	Climate Change and New Zealand's Future
ESCI204	Petrology and Microscopy
ENSC301	Topics in Environmental Science
GEOG321	Ice and Climate
ESCI301	Global Change: Earth Processes and History
ENSC402	Perspectives in Environmental Science in Aotearoa New Zealand
PHYG414	Climate Change: Lessons from the past
ESCI412	Paleoclimatology
ESCI452	Earth History

## Graduate completions

**Matthew Tankersley** (PhD)  
“Airborne Geophysical Investigation beneath Antarctica’s Ross Ice Shelf.”  
Supervised by Huw Horgan (SGEES) and Fabio Caratori Tontini (GNS).

**Yaowen Zheng** (PhD)  
“Understanding surface melt in Antarctica and implications for future ice sheet evolution.”  
Supervised by Nick Gолledge (ARC) and Alex Gossart (ARC).

**Linda Balfourt** (MSc)  
“Sedimentology and biomarker geochemistry of a Kamb Ice Stream subglacial channel, West Antarctica.”  
Supervised by Gavin Dunbar (ARC) and Sebastian Naeher (GNS).

**Emma De Jong** (MSc)  
“Lipid biomarkers in modern marine sediments and surface snow: Towards a multi-archive reconstruction of phytoplankton conditions in the southwestern Ross Sea region, Antarctica.”  
Supervised by Holly Winton (ARC) and Bella Duncan (ARC).

**Aileen Gordon** (MSc)  
“Development Towards a Chemotaxonomic Classification for New Zealand Plants - Implications for Using Biomarkers to Reconstruct Our Bioheritage.”  
Supervised by Holly Winton (ARC) and Andrew Rees (SGEES).

*Left: ARC PhD student Aylin de Campo collects GPS data and records a description for a glacial erratic on Mt Tadpole, East Antarctica, during the K861 field campaign. Photo by Lottie Stevenson.*

## ARC postgraduate students

### PhD Candidates

Olya Albot	Coastal modelling
Julianne Burns	Antarctic Paleoclimatology
Aylin de Campo	Paleoclimatology and Glaciology
Vincent Charnay	Climate Modelling
Béatrice Désy	Information Systems
Nikhil Hale	Geophysics
Zoe Heine	Sea-level rise
Hana Ishii	Antarctic Paleoclimatology
Daemon Kennett	Atmospheric Modelling
Karsten Lorentz	Geochronology and Erosion Mechanics
Frank Mackenzie	Paleoclimate Modelling
Alexander Mattin	Paleoclimatology and Volcanism
Julia Martin	Sea Ice Evolution
Vanessa Monteiro	Environmental Studies
Ruby Muir	Physical Geography
Ihanshu Rane	Antarctic foehn winds
Prasad Shelke	Geophysics
Matthew Tankersley*#	Geopotential modelling
Yaowen Zheng*	Antarctic climatology
Huiling Zou	Antarctic Paleoclimatology

### MSc Candidates

Linda Balfort*	Sedimentology and Paleoclimatology
Emma De Jong*	Environmental Science
Aileen Gordon*	Biomarkers

\* Thesis submitted for examination in 2023  
# Thesis included in VUW Dean's List 2023

## Postgraduate student awards

### Endowed Development Fund

Awarded annually to Victoria University postgraduate students or early career academics studying a topic relating to the Antarctic region or Antarctica's influence on New Zealand.

#### 2023 recipients:

Linda Balfort  
Julianne Burns (see page 35)  
Emma De Jong  
Sydney Dean  
Hana Ishii (see page 35)  
Frank Mackenzie (see page 35)  
Huiling Zou (see page 35)

### Arnold Heine Antarctic Award

New Zealand and Antarctic glaciologist Arnold Heine has generously donated to the Antarctic Research Centre to establish the Arnold Heine Antarctic Research Award to support future generations of Antarctic researchers.

**2023 recipient:** Matthew Tankersley

### Ray Hoare Scholarship

**2023 recipient:** Lottie Stevenson (see page 29)

### S.T. Lee Travel Award Young Scientist Exchange

Graduate exchange between the ARC and Te Herenga Waka—Victoria University of Wellington and the International Arctic Research Center of the University of Alaska Fairbanks (IARC) to promote polar research. Awarded biannually to a PhD student or early career scientist.

#### 2023 recipients from Victoria University:

Yaowen Zheng  
Billy van Uitregt

#### 2023 recipients from University of Alaska

**Fairbanks:**  
Eric Petersen  
Kristin Timm

### Ella Yelich-O'Connor Antarctic Doctoral Scholarship

Supporting research that advances understanding and promotes protection of Antarctica and the Southern Ocean.

**2023 recipient:** Nikhil Hale

## ARC staff awards

In 2023, Professor Nick Golledge was awarded the Hutton Medal.

The annual awards ceremony of the Royal Society Te Apārangi was held at the end of November last year, at Government House in Wellington. One of the 2023 awards recipients was co-leader of the ARC Modelling Hub, Prof. Nick Golledge.

The Hutton Medal is awarded annually within the Earth, plant and animal sciences for outstanding work by a researcher in New Zealand. Nick won the medal for “cutting-edge contributions to modelling of the Antarctic Ice Sheet, and research on climate change, including his role as a Lead Author for the most recent Assessment Report from the Intergovernmental Panel on Climate Change (IPCC)”. The award recognised the new capability in ice sheet modelling that Nick brought to New Zealand over a decade ago, and his ongoing commitment to building and maintaining modelling expertise ever since.

The award was presented by the 22nd Governor-General of New Zealand, Her Excellency The Right Honourable Dame Cindy Kiro.



## New philanthropic partnership established

The Antarctic Research Centre is delighted to share the news of a fantastic new philanthropic partnership with MAC3 Impact Philanthropies, developed in 2023. Through a gift of 250,000 EUR from MAC3, and in collaboration with the Antarctic Science Platform, we have established the MAC3 Antarctic Fellows programme. MAC3 Impact Philanthropies' incredible generosity is enabling New Zealand and Italian early career researchers and postgraduate students to use the 2024 Ross Sea Voyage on the Italian Laura Bassi icebreaker to grow their Antarctic research careers.

MAC3 Impact Philanthropies note that they “have high hopes for our MAC3 Antarctic Fellows. We aspire that their work and passion not only help decipher some of

the key unknowns in the complex interactions at work in Antarctic physical and biological systems, but also demonstrate that deeply collaborative trans-national research teams can generate truly significant and much needed evidence thus igniting transformative changes in the actions taken by our regulators and politicians. By doing so, we trust that each of them will enrich Antarctic conservation knowledge and contribute to help us confront, together, the climate and nature emergency which is the defining challenge of our generation (and quite possibly of generations to follow).”

We are deeply grateful for this incredible philanthropic investment in the future of Antarctic research for a better world.

*MAC3 Antarctic Fellows and senior science leaders from both NZ and Italy onboard the Laura Bassi voyage, February 2024. Photo by Lana Young.*



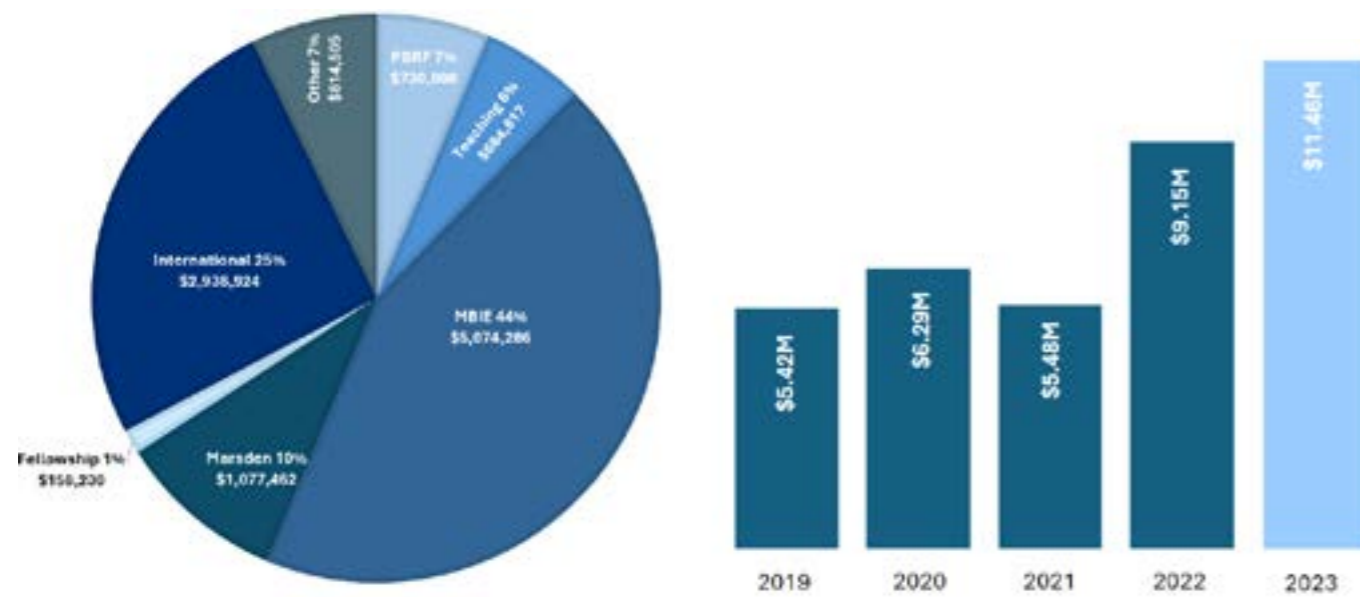
# FINANCIAL SUMMARY

The ARC finances include both a Centre budget and 36 grants held by the Research Trust of Victoria University of Wellington (RTV). Our consolidated revenue sources and expenditure areas as well as five year

summaries are summarized in the charts below (all figures are exclusive of GST). These charts combine the Centre budget that operates over the University financial year (January-December) and RTV budgets which

operate over the life of the projects, as such, the year-end balances for revenue versus expenditure are often out-of-phase.

In 2023, the ARC generated \$11.46M in total revenue, with the majority of this committed for project expenditure in 2024. In 2023, our expenditure was \$7.55M, including \$675K of overheads returned to the University from grants, and generated an operational surplus of \$195,547.



## Revenue

Overall, 87% of ARC's revenue was from external funding sources. Funding from the Ministry of Business, Innovation and Employment (MBIE) accounted for 44% of this revenue.

The ARC saw another large increase in revenue in 2023, due to an additional \$2.94M of funding from the international consortium for the SWAIS2C project, which is held in the Research Trust of Victoria University of Wellington. We had seven active Marsden grants and one Rutherford Fellowship. Our \$815K of

'Other' external funding came from national funding sources such as the Department of Conservation, as well as reimbursement of costs from other institutes and private donations held by the Victoria University of Wellington Foundation, and transferred to the Centre for the ARC Endowed Development Fund and Arnold Heine Antarctic Research awards.

The remaining sources of revenue are from internal sources. The \$730K PBRF (Performance-Based Research Fund) accounted for 7% and has

continued to increase every year over the last six years. Our teaching revenue of \$665K was from EFTS (Equivalent Full-time Student) for teaching and co-ordinating School of Geography, Environment and Earth Sciences courses and tuition fees for supervising postgraduate students. This has decreased from the previous year due to a decline in University enrolments.

## Expenditure

Overall, our expenditure was higher than in the previous year. ARC expenditure is divided between costs incurred directly within grants held in the Research Trust of Victoria University of Wellington, and those directly from the Centre's budget.

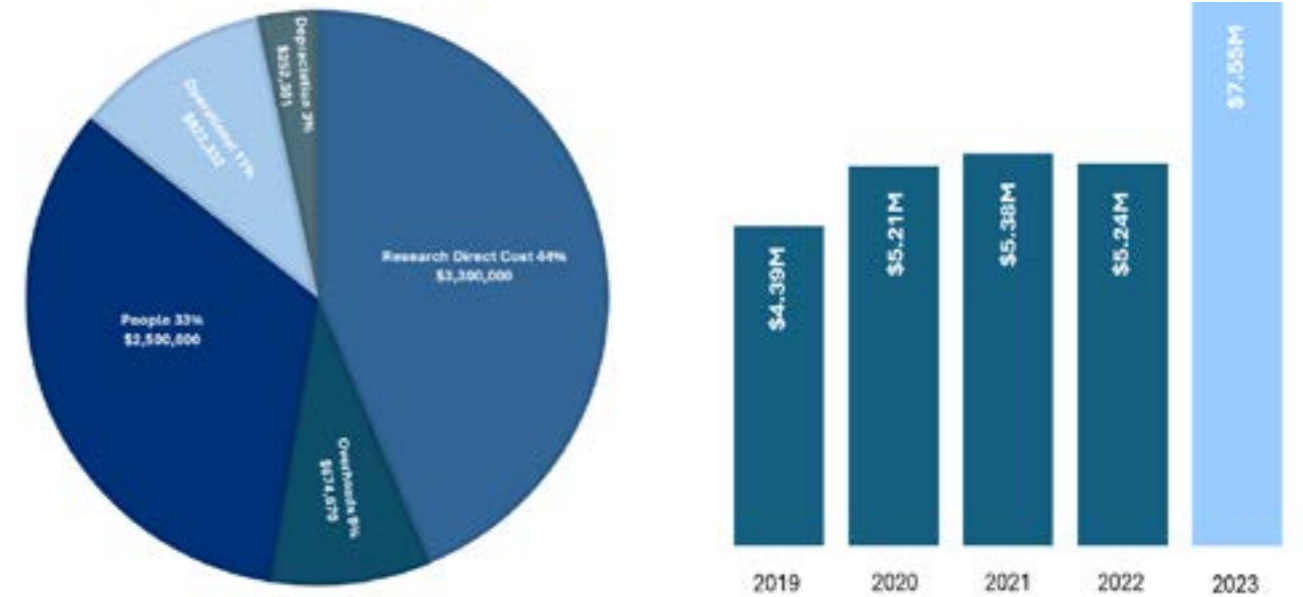
Our 'People' costs accounted for 33% (\$2.5M) and covered salaries, annual leave and superannuation for permanent and fixed term staff including research assistants paid from grants.

The Centre's 'Operational' costs include \$311K for occupancy charges for office and workshop space, \$245K to support students through scholarships and grants, \$30K for consultancy fees and \$29K for IT related charges. The remaining \$208K covered general operational costs such as office supplies, catering, printing, and domestic and international travel costs.

The Centre budget also included \$252K of expenditure for the depreciation of CAPEX equipment.

The almost \$3.3M of Research Direct Costs includes \$1.9M of subcontracts to our research partners, \$445K for student stipends and fees. The remainder supported costs such as fieldwork, analytical costs, consumables and travel costs.

The ARC's \$675K overhead contribution included \$429K to the Research Office and \$245K to the University.



# PUBLICATIONS AND PRESENTATIONS

## Peer-reviewed publications

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- Désy, B.**, Desrosiers, P. & Allard, A. 2023. Dimension matters when modelling network communities in hyperbolic spaces. *PNAS Nexus*, 2.
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## Books/reports

**P J Barrett** (2022), Reflections from Antarctic research at Victoria University of Wellington, Antarctic, 42 (3-4), 3.

**P J Barrett** (2022), Remarkable record of Antarctic climate cooling transition 15 million years ago, Antarctic, 42 (3-4), 4-7.

**P J Barrett** (2023), Birth and the early days – Victoria University of Wellington Antarctic Expeditions (VUWAE), Antarctic, 43 (1-2), 22-25.

**Nancy Bertler** and Ian Hawes (2023) A Risk Assessment of Changing Climate on Antarctica and the Southern Ocean. Report to the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Climate Change Workshop (4-9th Sep 2023, jointly held in NZ and UK) . The paper suggests for CCAMLR to consider a risk assessment of extreme events that could alter ecosystem health and ecosystem functions well outside the current envelop of baselines.

# MEDIA

**Nancy Bertler** served as science advisor to the NZ Delegation to the XLV ATCM and XXV CEP meetings (29May – 08 June 2023)

**Nancy Bertler** served as science advisor to the NZ Delegation to the CCMALR Climate Change Workshop (4-9 Sep 2023)

**Holly L. Winton**, G. Sinnl and O.L. Williams (2023). Ice Core Young Scientists spotlight new developments in ice-core science. Past Global Changes Magazine, 31(2) 89 2023<https://doi.org/10.22498/pages.31.2.89>.

POLICY BRIEF: Global Sea Level Rise. This briefing note was prepared by International Science Council, the Informal Plenary Meeting on Sea-Level Rise, 3 November 2023, convened by the President of the UN General Assembly. Authored by Théophile Bongarts Lebbe; John Church; Florence Colleoni; Michael Elliott; Jochen Hinkel; Héléne Jacot des Combes; Michelle Mycoo; **Tim Naish**; Joanna Post; Michelle Scobie; Anne Sophie Stevance; Adelle Thomas; Roderik van de Wal; D.G. (2023). <https://council.science/publications/policy-brief-global-sea-level-rise/>

Helsinki Declaration on Climate Change and the Antarctic, (2023), drafted by Consultative Parties of the Antarctic Treaty and the Members of the Committee on Environmental Protection (CEP) at the 45th Antarctic Treaty Consultative Meeting (ATCM), Helsinki, Finland. **Tim Naish** contributed as World Meteorological Organisation observer. <https://www.ats.aq/devAS/Meetings/Measure/806>.

World Climate Research Programme (WCRP), 2023. Kigali Declaration: Climate science for a sustainable future for all. WCRP Open Science Conference, 23-27 October 2023. Kigali, Rwanda. January 2024. **Tim Naish** authored section S05 and S16: Changes in the Cryosphere and their implications <https://www.wcrp-climate.org/conferences/WCRP-OSC-2023/KD/WCRP-Kigali-Declaration-2024-c.pdf>.

Global Tipping Points Report (2023) was launched at COP28 on 6 December 2023. The report is an authoritative assessment of the risks and opportunities of both negative and positive tipping points in the Earth system and society. **Tim Naish** Review Editor Chapter 1. Earth System Tipping Points. <https://global-tipping-points.org/section1/1-earth-system-tipping-points/>

Report co-authored by **Tim Naish** on Antarctic Tipping Points. <https://www.bas.ac.uk/data/our-data/publication/antarctic-tipping-points/>

## Invited presentations

**Anderson, B., Horgan, H.**, and Purdie, H (2023). Observations of lake-calving constrain glacier evolution modelling at Haupapa/Tasman Glacier, New Zealand. XXVIII General Assembly of the International Union of Geodesy and Geophysics (IUGG) (Berlin 2023).

**Anderson, B.** and **Horgan, H.** (2023). Calving at Haupapa / Tasman Glacier. Invited talk at ETH, Zurich. July 1, 2023, Zurich, Switzerland

**De Jong, E.**, and **Winton, H.** (2023). Ocean derived aerosol-cloud-climate interactions in the Ross Sea region. New Zealand Antarctic Society Fresh off the Ice, NIWA Wellington, 16 March 2023.

**Golledge, N.** (2023). “Models, uncertainty, and projections”. Invited talk for NZAS Annual Conference

**Golledge, N.** (2023). “Ice sheets as tipping elements”. Invited talk for Australian Bureau of Meteorology workshop on tipping points.

**Golledge, N.** (2023). - “Earth, Life, and Climate: in search of Nature’s ‘invisible hand’” Invited Keynote for the Spirituality Mind Body Institute, Columbia University, New York

**Golledge, N.** (2023). - “Awakening World”. Invited Keynote for the Spirituality Mind Body Institute, Columbia University, New York

**Levy, R. and Naish, T.** (2023). Invited to give the 80th Annual Thomas Cawthron Annual Lecture – Ice and Us – Adapting to Sea-Level Rise. Cawthron Institute Nelson. <https://www.cawthron.org.nz/annual-lecture/>.

**Levy, R. and Naish, T.** (2023). Presentation to the GWRC Climate Committee on “Sea-level in the Wellington Region”. <https://www.gw.govt.nz/assets/Documents/2023/03/Climate-Committee-16-March-2023-order-paper.pdf>

**Naish, T.** (2023). Invited to give keynote address at the Metrology Society of Australasia Conference on Antarctic and NZ climate change, Te Papa. [https://metrology.asn.au/event\\_listing\\_category/msa2023/](https://metrology.asn.au/event_listing_category/msa2023/).

**Naish, T.** (2023). Presentation to US National Academies of Science – Future Directions for Southern Ocean and Antarctic Nearshore and Coastal Research Session. <https://www.nationalacademies.org/our-work/future-directions-for-southern-ocean-and-antarctic-nearshore-and-coastal-research>

**Naish, T.** (2023). Invited Lecture to British Antarctic Survey, The uncertain roll of the Antarctic Ice Sheet in global sea-level change., Cambridge UK.

**Naish, T.** (2023). Presentation on Melting

Ice, Rising Seas and the Paris Climate Agreement at ICCI sponsored Side Event at the 2023 Antarctic Treaty Consultative Meeting, Helsinki, Finland. <https://iccinet.org/atcmhelsinki2023/>

**Naish, T.** (2023). Presentation to Inland Revenue – Climate change and what it means for Aotearoa.

**Naish, T.** (2023). Public speech on climate change urgency and hope at the Christchurch Cathedral, NZ Antarctic Season Opening Service. <https://wcrp-osc2023.org/>

**Naish, T.** (2023). Presentation on key challenges facing future Antarctic research at the National Italian Antarctic Programme (PNRA) annual conference, Rome, Italy. [https://www.pnra.aq/sites/default/files/Eventi/PNRA/Naish\\_.pdf](https://www.pnra.aq/sites/default/files/Eventi/PNRA/Naish_.pdf)

**Winton, H.** (2023). Aerosol and ice core biomarkers of Southern Ocean phytoplankton and sea ice conditions. Oral presentation at CSIRO and Australian Antarctic Partnerships Program (AAPP) Seminar series, Melbourne, 31 May 2023.

## Talks to policymakers, schools & community groups

**Naish, T.** MV Oosterdam tourist trip to the Antarctic Peninsula - 16-27 January. Five lectures on Antarctic and Climate change as a member of the Holland America Lines Antarctic Expedition Team.

**Vargo, L.** Queen Margaret College, Wellington – 26 May, “Studying snow and ice at Victoria University of Wellington”.

**Vargo, L.** Tararua Tramping Club, Wellington - 6 June, “Girls\* on Ice: Expeditions in Alaska and Aotearoa”.

**Anderson, B.** Franz Josef Glacier Guides – 21 August, workshop.

**Anderson, B.** West Coast Tai Poutini Conservation Board, 21 September. “Glaciers of Te Tai Poutini / West Coast”

**Golledge, N.** Cub Scouts, Auckland – Presentation on Antarctica (via Zoom)

**Duncan, B.** Masterton District Councillors - 12 November. “Antarctic climate in the past, present and future, and local impacts for Wairarapa.”

**Duncan, B.** Institute of International Affairs, Masterton branch - 30 November. “Antarctic climate in the past, present and future, and local impacts for Wairarapa.”

## TV interviews and features

Good Morning America, ABC News - 3 February, **Brian Anderson**, Robin Roberts shares up-close look at New Zealand’s glaciers, <https://www.goodmorningamerica.com/travel/story/robin-roberts-shares-close-new-zealands-glaciers-96843594>.

BBC Frozen Planet II, Episode 3, Frozen Peaks – 13 February, **Brian Anderson** (timelapse movies).

TVNZ One News - 28 July, **Tim Naish** talks about record Antarctic sea-ice loss. <https://www.1news.co.nz/2023/07/28/off-the-charts-antarctic-sea-ice-plummets-to-worrying-low/>.

TV Interview with ZDF News (German TV News) - 22 September, **Nancy Bertler** with Elisa Miebach on the rapid decline in Antarctic sea ice <https://www.zdf.de/nachrichten/heute-journal-update/heute-journal-update-vom-22-september-2023-100.html> (available until 24 Sep 2024).

Newshub - October 25, **Nick Golledge**, TV interview on WAIS paper <https://www.newshub.co.nz/home/world/2023/10/rapid-melting-in-west-antarctica-is-unavoidable-with-potentially-disastrous-consequences-for-sea-level-rise-study-finds.html>.

## Radio interviews

RNZ – 30 March, **Rob McKay**, Ocean currents near Antarctica could slow by 40%, affecting climate, food chain - study <https://www.rnz.co.nz/news/national/486986/ocean-currents-near-antarctica-could-slow-by-40-percent-affecting-climate-food-chain-study>.

Stuff Newsable Podcast – 7 July, **Lauren Vargo**, “Climate records, 500 days of Ukraine, threads, fun fact Friday” <https://interactives.stuff.co.nz/newsable/>.

RNZ – 9 August, **Nancy Bertler**, Antarctica’s ecosystem changes at an unanticipated pace. <https://www.rnz.co.nz/national/programmes/morningreport/audio/2018901816/antarctica-ecosystem-changes-at-an-unanticipated-pace>

RNZ - The Panel with Wallace Chapman, Julia Hartley-Moore and Steve McCabe, 8 August, Interview with **Nancy Bertler** on Antarctic Extreme Events, 10:21min; (<https://www.rnz.co.nz/national/programmes/thepanel/audio/2018901747/the-panel-with-julia-hartley-moore-and-steve-mccabe-part-1>)

Interview with DW – Nature and Environment with Martin Kuebler on ‘Antarctica: What’s the big deal over resource exploitation?’ 22 September, N. Bertler 2<https://www.dw.com/en/antarctica-whats-the-big-deal-over-resource-exploitation/a-67131242>

Newstalk ZB – 9 August, Interview with **Nancy Bertler** by Demelza Jackson – Antarctic Extreme Events and global implications,

95bfm radio – 14 August, **Lauren Vargo**, “Girls on Ice Aotearoa with Lauren Vargo” <https://95bfm.com/bcast/girls-on-ice-aotearoa-w-lauren-vargo-august-14th-2023>.

RNZ – 25 September, **Brian Anderson**, 200 glaciers vanish in Southern Alps as ocean temperatures rise. <https://www.rnz.co.nz/news/ldr/498764/200-glaciers-vanish-in-southern-alps-as-ocean-temperatures-rise-scientist-says>

RNZ The Panel - 26 September, **Brian Anderson**, live interview

RNZ – 3 October, **Brian Anderson**, Glacier retreat at Franz Josef changing the Waiho river. <https://www.rnz.co.nz/news/national/499322/glacier-retreat-at-franz-josef-changing-the-waiho-river>

Radio One, Society and Cultures News – 4 October, **Brian Anderson**, Live Interview

## Online and printed articles

The Post – 6 January, **Tim Naish**, “How Wairarapa is preparing for sinking shorelines and rising seas.” <https://www.stuff.co.nz/environment/130796442/how-wairarapa-is-preparing-for-sinking-shorelines-and-rising-seas>.

New Zealand Herald – March 12, **Lauren Vargo**, “Why NZ’s melting glaciers likely just had their worst summer yet.” <https://www.nzherald.co.nz/why-nzs-melting-glaciers-likely-just-had-their-worst-summer-yet/6CZBAMIAOFDFM6WXM6WTAM6JVA/>.

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NZ Herald – 18 March, **Rob McKay**, “Otago Uni scientists mount eleventh-hour bid to avoid job cuts.” <https://www.nzherald.co.nz/nz/otago-uni-scientists-mount-eleventh-hour-bid-to-avoid-job-cuts/JOP27JWL6ZBBXHK3TH32WIVMYA/>

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Nelson Mail – 24 April, quoting **Richard Levy** and **Tim Naish**, “Satellite data shows airport may face sea level rise sooner

than thought.” <https://www.stuff.co.nz/nelson-mail/news/132468509/satellite-data-shows-airport-may-face-sea-level-rise-sooner-than-thought>

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*James Marschalek, Denise Kulhanek and Arne Ulfers looking south over the sea ice at Scott Base. Photo by Linda Balfourt.*





# OUR PEOPLE

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Marjolaine Verret	The University Centre in Svalbard	Permafrost geochemistry
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Meridian Energy	University of Otago
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NIWA	Webster Drilling and Exploration Ltd.



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