IceSked

Issue 45 - December 2025

Newsletter of Te Puna Pātiotio—Antarctic Research Centre
Te Herenga Waka—Victoria University of Wellington

A word from our Director

For over a decade, our Hot Water Drilling program has achieved remarkable success in unlocking the hidden world beneath the Ross Ice Shelf. Today, we can routinely drill through 600 metres of floating ice, giving researchers across New Zealand unprecedented access to the ocean waters and surface sediments below. In this issue, we showcase how these efforts are revealing the critical role of sub–ice shelf oceanographic processes in driving glacial melting—insights that are also essential for understanding changes in the offshore regions of the Ross Sea. We also introduce two new team members who are investigating rapid shifts in the biology and sea ice of these marine regions, both in recent years and as well as those projected for the future.

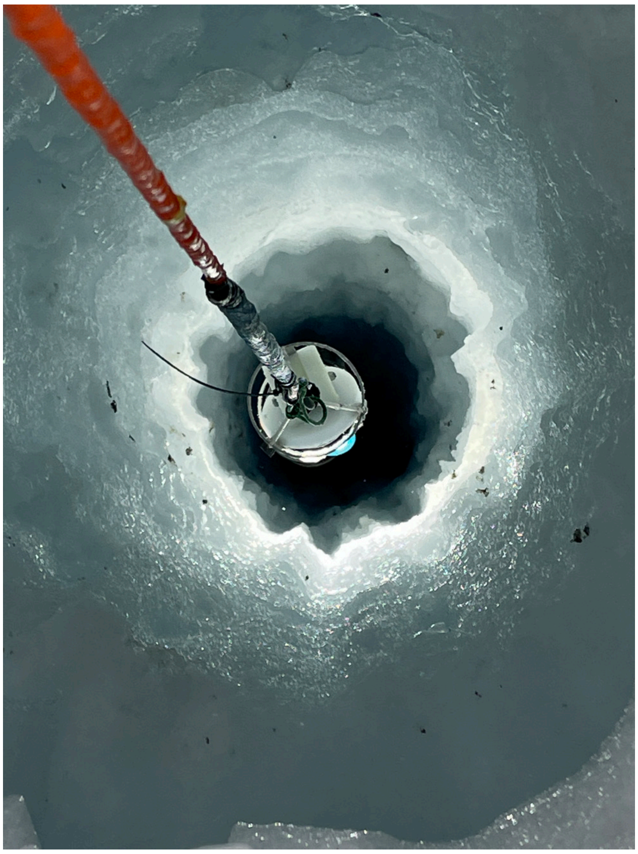
Rob McKay

Trickles and floods – water flow from beneath the West Antarctic Ice Sheet

Huw Horgan

Beneath the thick ice cover of the West Antarctic Ice Sheet lies a system of rivers and lakes. Water beneath the ice sheets is generated by geothermal heat flux and frictional heating and its distribution varies in space and time. Subglacial lakes fill and drain and eventually subglacial water crosses from beneath the ice sheet, often entering the ocean cavity beneath ice shelves. This hidden water system is important for how ice sheets flow as it enables the rapid sliding of ice streams. Once water reaches the ice shelf cavity its importance is compounded, as its buoyancy leads to concentrated melt of the ice shelf base.

Earlier this year in Nature Geoscience Horgan et al published the first direct evidence of subglacial water entering the ice shelf cavity in the deep interior of the Ross Ice Shelf. By drilling through the ice at the transition between the grounded ice sheet and floating ice shelf, the team were able to show that subglacial water had melted a narrow 200 m high channel in the base of the ice. Water properties within the channel revealed an inward flow of warm salty water at the base of the channel and a plume of turbid fresher water emerging from beneath the ice sheet. The rate of water output was low, and sediment coring showed that this background trickle of water from beneath the ice is punctuated by the episodic release of water and sediment. The investigation demonstrated what can be learnt using Antarctica New Zealand's deep field traverse, the ARC's hot water drilling direct access system and the Antarctic Science Platform's integration of glaciology, oceanography and sedimentology.



Borehole, photo by Craig Stevens

Horgan, H.J., Stewart, C., Stevens, C. et al. A West Antarctic grounding-zone environment shaped by episodic water flow. Nat. Geosci. 18, 389–395 (2025). https://doi.org/10.1038/s41561-025-01687-3

2025 ST Lee Lecture in Antarctic Studies

From left, Prof. Rob McKay, Prof. Tamsin Edwards, DVCR Prof. Margaret Hyland, Prof. Nick Golledge. Copyright: Victoria University of Wellington, photo by Colin McDiarmid, VUW Image Services.

The annual ST Lee Lecture in Antarctic Studies, took place at Te Herenga Waka—Victoria University of Wellington on November 5th, presented by internationally recognised climate scientist Prof. Tamsin Edwards of King's College, London. Tamsin's talk entitled *Antarctic update 2025: evolving uncertainty in the future of the ice sheet*, took a deep dive into developments in climate change research since the 2021 Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment Report, and the complexities around predicting potential outcomes of Antarctic instability and sea-level rise. You can listen to Prof. Edwards' talk via our website (https://www.wgtn.ac.nz/antarctic/about/events/s-t-lee-lecture).

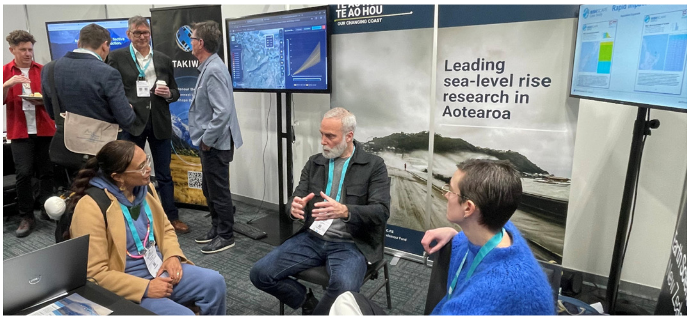
In her role as expert advisor on climate science to the public, policymakers, media and businesses, Tamsin acknowledges uncertainty in the face of continually evolving science, but is proud to offer tangible solutions to help the planet, and ease the sense of dread and helplessness experienced by so many facing this topic. Following her time in NZ, Tamsin returned to Europe for the first Lead Author Meeting of the IPCC Seventh Assessment Report, taking place in Paris in December. As a Coordinating Lead Author for the 'Global Projections' chapter, Tamsin will help shape the assessment of likely future changes to our climate as simulated by computer models. The Working Group I report (Physical Science basis) is expected to be completed by 2028. Read Tamsin's interview with RNZ here (*Sea level rise 'a very complicated area of science', renowned climate scientist says*, 11 Nov 2025).

Panelists:
Emeritus Professor Jonathan Boston, Public Policy Expert
Victoria University of Wellington
Adjunct Professor Judy Lawrence, Adaptation Expert
Victoria University of Wellington and a Climate Change Commissioner
Dr Iain Dawe, Coastal Hazards Practitioner
Greater Wellington Regional Council
Cheryl Dilks, environmental engineer & climate change adaptation advisor
Beca Consulting

Adaptation Futures Conference

Tim Naish

The 8th international Adaptation Futures Conference (AF2025), held in Ōtautahi Christchurch, 13-16 October, 2025, was hosted by the University of Canterbury Te Whare Wānanga o Waitaha with regional Oceania and international partners. Te Herenga Waka—Victoria University of Wellington was a Consortium Sponsor. Staff and students from the ARC's Our Changing Coast Programme (OCC) attended, contributing to aspects of the conference including a Masterclass on Sea-Level Rise impacts and projections for Aotearoa New Zealand (led by Tim Naish and Richard Levy) and a post conference workshop on Managed Retreat and Coastal Cities and Settlements (led by Judy Lawrence). As a flagship event of the United Nations World Adaptation Science Programme (WASP), this premier international climate change adaptation conference enabled more than 1000 practitioners, policymakers, researchers, and academics from across the world to gather to network, collaborate, learn, and inspire.



Prof. Richard Levy discussing sea-level rise with delegates at the OCC conference booth, AF25

The following week, the ARC and OCC hosted a public lecture by Professor Marjolijn Haasnoot, an expert on climate change adaptation in deltas and coasts, based at Utrecht University and Deltares. Professor Haasnoot, who was in New Zealand presenting at the Adaptation Futures conference, has a background in environment science, water management, integrated assessment modelling and decision making under high uncertainty. She is the founder of the Dynamic Adaptive Policy Pathways climate adaptation approach which now in wide use globally and in New Zealand.

The talk concluded with a panel discussion facilitated by Prof. Tim Naish, Chair—World Climate Research Programme, Te Herenga Waka—Victoria University of Wellington, and Dr Richard Levy, Sea-level scientist, Co-Leader—Our Changing Coast Programme, Earth Sciences NZ. Panelists (at left) fielded New Zealand- and Pacific-related questions including the slow pace of emissions mitigation and a long discussion on how effective adaptation could be accelerated, given there are climate impacts and hazards we can now no longer avoid, but need to be prepared for. The discussion recognised the importance of local context, ranging from the hard engineering solutions used in developed nations such as The Netherlands, to Pacific Islands such as Tuvalu and Kirabiti which are already at the limits of adaptation. All of the panelists communicated hope for the future and recognised the importance of acting now to minimise future damage and loss from climate change.

Widespread Antarctic ice sheet surface melt during the Miocene

Rob McKay

A study led by Rob McKay in the Bulletin of the Geological Society of America, as part of the International Ocean Discovery Program's Expedition 374 to the Ross Sea, sheds new light on how Antarctica's ice sheets behaved during the Miocene epoch (18–13 million years ago). The Miocene contains periods of global warmth strikingly similar to what we may face in the future, and sediment cores from this period in the study reveal dramatic cycles of ice sheet advance and retreat, showing that Antarctic ice responded in surprisingly complex and non-linear ways to climate change.

During the Miocene Climate Optimum, when atmospheric CO_2 soared above 500 ppm, vast areas of East Antarctica's terrestrial ice sheets experienced surface melt, sending large volumes of turbid meltwater into the ocean. The research also delivers the first direct evidence of grounded ice sheets reaching the outer continental shelf during the Middle Miocene Climate Transition (~14 million years ago), driven by cooling when CO_2 declined below 300 ppm, and shallowing of the seafloor due to high levels of sediment input that reduced ocean heat influences on the ice sheet margin.

Why does this matter today? Because current CO_2 levels are rapidly approaching those same Miocene thresholds—levels linked not only to destabilization of West Antarctica's marine-based ice but also to widespread surface melt across East Antarctica. The observation of complex geological feedbacks in the study make the risk even greater: as millions of years of glacial erosion have carved the inner continental shelf deep below sea level, leaving today's ice sheets far more vulnerable to runaway marine ice sheet instability than they were in the Miocene—a process that accelerates ice loss under warming.

This research is a stark reminder: cutting greenhouse gas emissions is urgent to avoid a sudden shift in the drivers of ice sheet loss. Antarctic geological records remain a powerful tool for predicting tipping points and shaping strategies to protect our coastlines from future sea-level rise.

McKay, R.M. et al. Miocene ice sheet dynamics and sediment deposition in the central Ross Sea, Antarctica. GSA Bulletin 2025;; 137 (3-4): 1267–1291. doi: https://doi-org.helicon.vuw.ac.nz/10.1130/B37613.1

The JOIDES Resolution drilling in calm and ice free waters of the central Ross Sea during IODP Expedition 374. (Credit: William Crawford, IODP JRSO)

How will Southern Hemisphere climate and the Antarctic ice sheet be impacted by a fundamental change in global ocean circulation?

Shaun Eaves

In the [2025 Marsden Fund,] an international team of researchers led by Shaun Eaves were awarded funding to better constrain the impacts of weakening of the Atlantic Meridional Overturning Circulation (AMOC) on the climate and cryosphere of the Southern Hemisphere.

The AMOC is a major component of global ocean circulation that moves warm, salty surface waters from the Southern Hemisphere and tropics to the sub-polar North Atlantic, where they then cool, sink, and return southwards at depth. There is strong evidence in the recent geological record that the AMOC has previously flipped abruptly between strong and weak states, with severe impacts on global climate. Recently, a prominent oceanographer elegantly summed up the fragility of the system: "The AMOC flows because the northern Atlantic is salty, and it is salty because the AMOC flows". In other words, the AMOC is self-dependent and thus highly sensitive to external salinity perturbations. Today, human-caused climate change is disturbing the salinity of the North Atlantic via freshwater inputs from increasing melt of the Greenland Ice Sheet and enhanced precipitation rates, which may force the AMOC across a critical threshold once again.

A future weakening of the AMOC would likely warm the Southern Hemisphere. However, the rates and spatial distribution of warming, as well as the attendant impacts on regional atmospheric and oceanic circulation, are uncertain. Furthermore, the potential impacts on the Antarctic Ice Sheet, and thus global sea level, are largely unknown. In this new project, Eaves and the team will deploy state-of-the-art climate and ice sheet models to address these questions and better quantify the potential impacts of this critical tipping point in the Earth system.

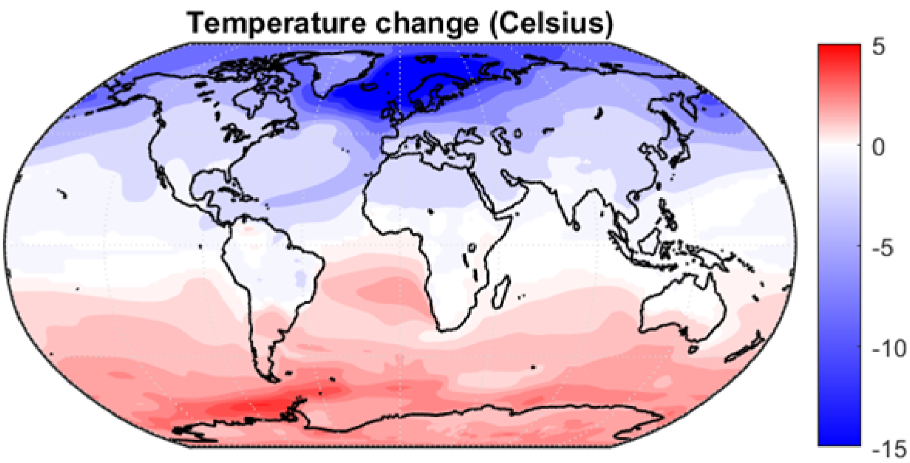


Image: Global surface temperature change from AMOC collapse under near-modern boundary conditions as simulated by project member René van Westen.

Introducing ARC's new staff

Dr Jacqui Stuart

Jacqui Stuart is an ecologist who recently completed her PhD at the Cawthron Institute and Victoria University of Wellington. Her focus is on the ice-associated, tiny-but-mighty, microalgae and what changing sea ice conditions in McMurdo Sound, Antarctica mean for them. She is interested in how changes at the base of the food web (microalgae) influence all the things that rely on the nutrients they provide to other organisms, directly or indirectly. Part of her research also looks at similar things a little closer to home, investigating the impact of changing climate on coastal microalgal communities in New Zealand.

Jacqui is one of three women profiled in the science documentary Mighty Indeed. Directed by Vanessa Wells, the film won the Best Feature (NZ) and Best Director (NZ) at the Doc Edge Awards 2025 and is in contention for the 2026 Oscars documentary awards. The film weaves the personal stories of three scientists from different generations (Pat Langhorne, ARC's Natalie Robinson and Jacqui), undertaking groundbreaking science in Antarctica. Stunningly shot on the ice, Mighty Indeed is a sobering, honest and heartwarming portrayal of women working face-to-face with climate change.

Dr Andrew Pauling

The Antarctic Research Centre is delighted to welcome Dr Andrew Pauling as a Research Fellow in Sea Ice Modelling, joining the National Modelling Hub. Formerly a Research Fellow at the University of Otago, Andrew brings extensive expertise in coupled climate modelling and polar climate research. His appointment through the Antarctic Sea Ice Switch (ASIS) programme adds critical capabilities to our growing strength in Earth system modelling.

The recent, unexpected, and sharp decline in Antarctic sea-ice extent may be one of the most significant warning signs of rapid change on the white continent—change with far-reaching global consequences. As Antarctic sea ice retreats, the ocean absorbs more heat, accelerating surface warming and destabilising ice shelves. This process could trigger rapid and potentially irreversible loss of vulnerable sectors of the Antarctic ice sheet, driving multi-metre global sea-level rise. Beyond sea-level impacts, diminishing sea ice weakens global ocean circulation, redistributes heat, reduces carbon storage, and limits nutrient supply to marine ecosystems.

Andrew's research uses state-of-the-art coupled climate models to investigate how Antarctic sea ice, the Southern Ocean, and polar climate respond to changes in the global Earth system. In his new role within ASIS, he will integrate an improved sea ice model into a high-resolution ocean–atmosphere model of the Ross Sea region, enabling more realistic simulations of sea-ice responses to climate variability and extremes. This work will advance our understanding of how Antarctica and the Southern Ocean may respond to unprecedented conditions—scenarios beyond anything observed to date—providing critical insights for future projections.

Andrew is excited to continue contributing to world-leading polar research from New Zealand.

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