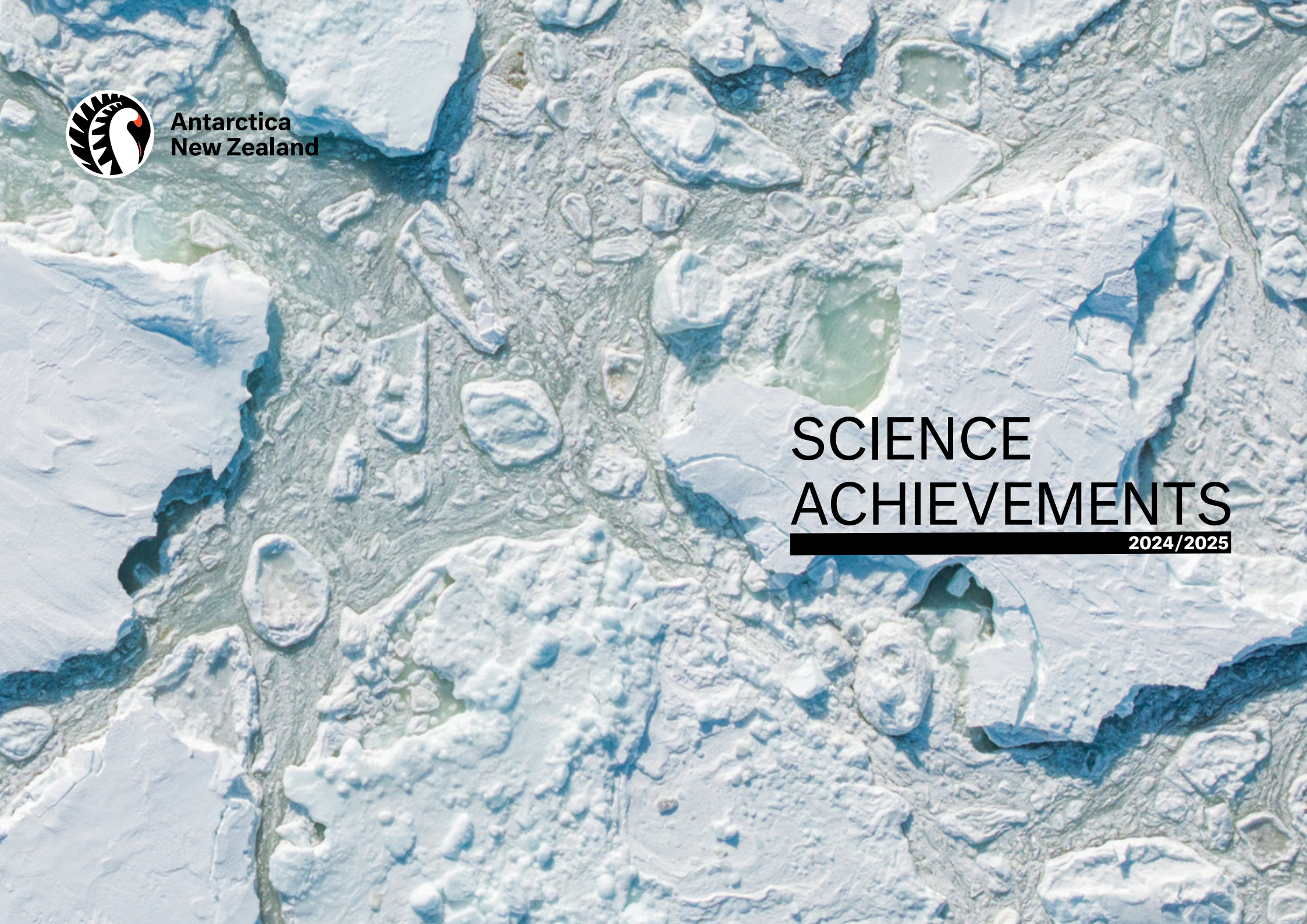

Antarctica
New Zealand

SCIENCE ACHIEVEMENTS

2024/2025

Adélie penguins at Cape Crozier. **© Anthony Powell/Antarctica New Zealand**

Cover: Sea ice from the icebreaker RV Laura Bassi. **© Lana Young/Antarctic Science Platform**

Foreword

The 2024/25 Antarctic season was notable for its sheer expanse, with research stretching ~11 degrees of latitude, from Morozumi Range in the north (~71°S) to the Siple Coast in the south (~82°S). That's comparable to the distance between Auckland and Invercargill, in some of the most extreme conditions on the planet. Such a far-reaching programme is testament to the urgency of the research, scientists' ability to secure funding, and Antarctica New Zealand's capability. Science in Antarctica is a true partnership.

Much of the world-class research supported by Antarctica New Zealand focuses on improving understanding of the impacts of climate change for Antarctica and the Southern Ocean, and the links to changes in New Zealand and the rest of the world. This includes investigations of the cryosphere, oceans, and atmosphere, and both marine and terrestrial ecosystems. Teams are sampling geothermal soils on Mt Erebus, diving under sea ice to examine silica sponges, measuring methane seeps on the ocean floor, collecting measurements on the Ross Ice Shelf, sampling for terrestrial biodiversity in remote areas, and studying emperor penguins. The quality, breadth and complexity of the research is impressive.

In addition to efforts launched from Scott Base, we supported science events on the *HMNZS Aotearoa* resupply mission to McMurdo Sound, in support of the New Zealand–United States Joint Logistics Pool. This work was coordinated with research undertaken during NIWA's *RV Tangaroa* Ross Sea voyage, maximising the functionality and capabilities of each vessel.

This season also marked the twilight of Phase 1 of the Antarctic Science Platform, a 7-year programme funded by the Ministry of Business, Innovation, and Employment's Strategic Science Investment Fund, and hosted by Antarctica New Zealand. I would like to thank the science, leadership and governance teams — especially outgoing Director Prof Nancy Bertler and Steering Group Chair Dr Gillian Wratt — for their incredible work driving this research and its impressive array of outcomes. Verification of Phase 1 success was the announcement of another seven years' funding by Science, Innovation and Technology Minister Dr Shane Reti in May.

We continue to collaborate with researchers from the United States, Italy, Germany, Korea, Australia, the United Kingdom, France, and many others. These international partnerships highlight the importance of cooperation across both science and logistics in Antarctica. Partnerships have been reinforced or expanded with new memorandums of arrangement with Germany's Alfred Wegener Institute and Khalifa University in the United Arab Emirates. We successfully obtained funding for a new strategic science collaboration with Antarctic researchers funded by the National Science Foundation, strengthening our science relationship with the United States.

I want to acknowledge the significant role staff, scientists, funders, research institutes, universities, and other National Antarctic Programme partners play in the successful delivery of our research programme. Only with everyone working together and aligned with a common goal are we able to achieve these ambitious objectives. This report details the 2024/25 season highlights and key achievements — we hope you enjoy it and join with me in the appreciation of what has been accomplished.

Prof Jordy Hendrikx
Chief Executive and Chief Scientific Advisor
Antarctica New Zealand

K023A working on Mt Erebus.
© Stephen Noell/University of Waikato

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2024/25 AT A GLANCE

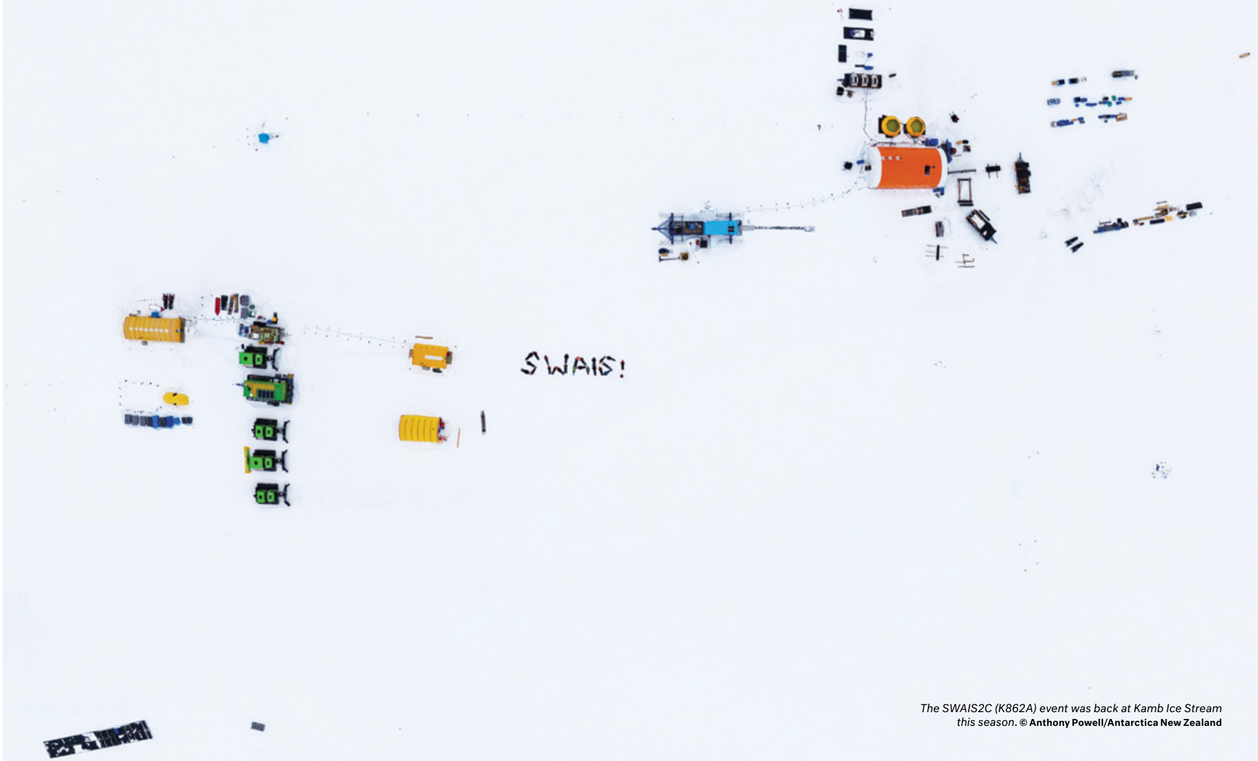
32
science events

113
scientists supported in Antarctica

78
publications

114 years
since magnetic recordings began at Cape Evans

3,974
cumulative days of science



The SWAIS2C (K862A) event was back at Kamb Ice Stream this season. © **Anthony Powell/Antarctica New Zealand**

The importance of Antarctic research for New Zealand

New Zealand researchers collaborate with international colleagues to deliver a world-class science programme, with a primary focus to understand the implications of global climate change for Antarctica and the Southern Ocean, and how these are linked to changes in New Zealand, and the rest of the world. While Antarctica and New Zealand are geographically separated by the vastness of the Southern Ocean, they are also inseparably linked by the circulation patterns of the same ocean, and by the atmosphere above.

Climate change is causing alteration to both oceanic and atmospheric processes in Antarctica and the Southern Ocean, and this is manifested in many physical systems, including altered trends in sea ice formation, mass balance of ice sheets and ice shelves, sea level rise, and oceanographic circulation. Understanding current states and anticipating future conditions in these systems will ultimately advance New Zealand's climate change mitigation and adaptation policies. Climate change is also modifying polar marine and terrestrial habitats, impacting the uniquely adapted organisms that call it home. Understanding the vulnerabilities of Antarctic species informs improved understanding of ecosystem health and integrity, contributing to better management practices to enhance protection of Antarctic and Southern Ocean environments. New Zealand has a key role in the international fora that develop and implement environmental management plans. In addition to a focus on multi-time scales of climate change, other areas of work have included studies of extremophile bacteria, including those that thrive in geothermal soils and those under lake ice in the Dry Valleys.

International leadership and cooperation

New Zealand's Antarctic research is strengthened through collaborative relationships with other National Antarctic Programmes, particularly those operating in the Ross Sea region. These international relationships provide opportunities to build strong interdisciplinary science teams, as well as delivering financial benefits through shared logistics and research costs. New Zealand has an important and long-established relationship with the United States Antarctic Program on Ross Island and works closely with other neighbouring programmes in Northern Victoria Land, including Italy, Korea and Germany. In 2024, New Zealand's collaborative relationship with a portion of Germany's polar research programme was formally recognised through the signing of a Memorandum of Arrangement between Antarctica New Zealand and the Alfred Wegener Institute. A new partnership between the polar programmes of New Zealand and Khalifa University in the United Arab Emirates was also established in 2025, and this was also formalised with the landmark signing of a Memorandum of Arrangement. The partnerships with Germany and the United Arab Emirates will support research and knowledge sharing and provide new opportunities for innovation and scientific discovery. Participating in international science initiatives and undertaking high-quality, credible scientific research strengthens New Zealand's position of leadership in the Antarctic Treaty System.

A unified research strategy

Aotearoa New Zealand Antarctic and Southern Ocean Research Directions and Priorities 2021-2030

The *Aotearoa New Zealand Antarctic Research Directions and Priorities 2021-2030* government policy sets out priority areas for New Zealand's research in Antarctica and the Southern Ocean. The plan recognises and reflects the value of mātauranga Māori, and is unified by an overarching theme of understanding change in the Southern Ocean and Antarctica. The document reaffirms New Zealand's ongoing commitment to impactful, collaborative science, and to protect and preserve Antarctica for future generations. Four priority areas for research are identified in the policy, and these provide the framework for Antarctica New Zealand's science programme:

- Quantifying the Antarctic contribution to sea level rise
- Cryosphere-ocean-atmosphere connections and implications of change
- Ecosystem dynamics and responses to change
- Protecting Antarctic and Southern Ocean environments

New Zealand's research in the Ross Sea region

The Ross Sea region of Antarctica has been home to New Zealand's Antarctic research programme since 1957. The vast extent of the region provides plentiful opportunities to study diverse marine and terrestrial environments, the cryosphere, and to understand the effects of a changing climate.

Antarctica's largest ice shelf

The southern region of the Ross Sea is hidden beneath the enormity of the Ross Ice Shelf, a floating piece of ice that is about twice the size of New Zealand. It is Antarctica's largest ice shelf by area. The ice shelf performs an important buttressing role, slowing the flow of land-based ice into the ocean. The interaction of the Ross Ice Shelf with the ocean below, and the atmosphere above, is a critical element in the rate of the potential future loss of the West Antarctic Ice Sheet and subsequent global sea level rise.

Sea ice significance

Antarctic sea ice is a critical component of Southern Ocean marine ecosystems and plays a significant role in global climate. Its extent is predicted to decline in response to anthropogenic warming, and recent consecutive summers of drastically reduced sea ice extent around the continent have raised concern that a 'regime shift' may already be underway. The Ross Sea is one of the most important sources of sea ice in Antarctica. Critical to Ross Sea ice production are coastal polynyas, where strong katabatic winds open gaps in the ice at times when the ocean is otherwise freezing. These polynyas are important, as they essentially act as large sea ice factories, rapidly producing new sea ice for the region.

The world's largest high seas marine protected area

The Ross Sea region Marine Protected Area came into force on 1 December 2017 and covers 1.55 million square kilometres of ocean habitat and foraging areas. It protects rare and vulnerable species and areas of importance for maintaining ecosystem integrity. New Zealand researchers are contributing to international research efforts to better understand and evaluate the effectiveness of this important sanctuary.

Unique ice-free environments

The McMurdo Dry Valleys in southern Victoria Land include more than half of Antarctica's ice-free land area, providing opportunities to investigate unique terrestrial ecosystems. Despite the name, the Dry Valleys are also the location of significant aquatic habitats, including streams, lakes and ponds. These systems are home to considerable biodiversity, specifically adapted to the harsh environmental conditions that prevail.

Enduring atmospheric research

Since 1957 the New Zealand Antarctic Programme has established several long-term science programmes that, after nearly 70 years, continue at Scott Base. Coupled with state-of-the-art equipment at New Zealand's Arrival Heights atmospheric research laboratory, these long-term datasets provide important contributions to the global research community.

International partnerships

International science collaborations strengthen New Zealand's Antarctic research programme, providing access to expertise and equipment, and enabling data sharing between research communities. In the 2024/25 season, scientists and divers from Germany's leading polar research organisation, the Alfred Wegener Institute joined with a New Zealand team from the University of Waikato and NIWA to investigate Antarctica's iconic glass sponges, a partnership facilitated by the Memorandum of Arrangement signed in 2024. A diver from Wageningen University and Research (Netherlands) also joined the team.

New Zealand and Germany, a rare glimpse of the glass sponge

Dense populations of glass sponges inhabit the Antarctic seafloor, typically in deep ocean water, where they perform an important function as habitat-structuring species. Glass sponges' skeletons are composed of silica (hence their 'glass' name), and it is thought that they play a significant role in the cycling of silica as well as carbon. Their usual deepwater occurrence and incompatibility with aquarium settings makes studying the sponges difficult, so many aspects of their biology remain poorly understood. Fortunately, in McMurdo Sound the glass sponges can be found in shallower depths of less than 30m that are accessible for research divers working under the sea ice. This unique opportunity for access provided the New Zealand–Germany team with a rare chance to undertake novel research combining divers and remotely operated vehicles.

The team used a blend of standard and newly developed techniques to study the sponges' diet, metabolism, growth rates and how they interact with the environment. Several traditional techniques for sponge experimentation required adaptation for the polar environment, and because of the larger size of these sponges compared with their temperate zone relatives. A specialised 'sponge hat' was developed to prevent intrusion from nosy fish onlookers, and hundreds of images were captured to enable the creation of 3D models of the sponges for determination of biomass and to allow growth to be measured. A time-lapse camera and an environmental data logger were installed to continue observations in the winter months. The team will return next season to continue the research, which provides important information for understanding the likely impact of climate change on this species and the marine life that depends on it. This research was undertaken by New Zealand field event K884A (see page 40 for further details).

The K884A event involved diving to study glass sponges on the Antarctic seafloor.
© Alex Brett/USAP

Case studies

Monitoring emperor penguins in the Ross Sea region Marine Protected Area

The Ross Sea region Marine Protected Area (MPA) spans 1.55 million square kilometres of ocean, safeguarding a diverse range of ecosystems. Among its most iconic residents are emperor penguins — top predators whose population dynamics offer vital insights into the overall health of the region's marine environment.

During the 2024/25 season, a joint New Zealand–United States research team established a field camp on the sea ice at Cape Crozier to study emperor penguins, a key indicator species for the Ross Sea marine ecosystem. This was the third and final field season for the programme, which first visited Cape Crozier in the 2019/20 season. Their goal was to understand the birds' foraging ecology and habitat use. To achieve this, they deployed underwater cameras and specialised physiological equipment to examine how penguin movement patterns relate to feeding behaviours in breeding adults. The team collected biological samples for penguin sex identification and will conduct a detailed analysis of the penguins' diet. Additionally, they will help validate population estimates derived from satellite imagery, providing critical ground-truth data. Preliminary results suggest shorter foraging trips and greater mass gain in 2024 compared to results from previous seasons, indicating favourable feeding conditions.

This research is aligned with the NIWA–led Ross Sea Region Research and Monitoring Programme. Funding for the programme has now ended, and the research has generated significant new insights into the foraging behaviour, movement, and breeding success of key species, including Weddell seals, Adélie penguins, and emperor penguins. The data gathered will deepen our understanding of emperor penguin population dynamics and dietary habits — information essential for evaluating the ecological health and effectiveness of the MPA. This research was undertaken by the field event K083E (see page 40).

The K083E team was working at Cape Crozier studying Emperor penguins.
© Anthony Powell/Antarctica New Zealand

Top predators to terrestrial mites

International partnerships were integral to the success of many other New Zealand programmes working in the 2024/25 season. These included investigations of seafloor seeps (United States), terrestrial biodiversity assessments in the Morozumi Range (Australia), permafrost gas measurements in the McMurdo Dry Valleys (Italy) and a top predator study at Cape Crozier (United States). More details on these programmes can be found in the field highlights section on the following pages.

The K023A team was working on Mt Erebus again this season. **© Stephen Noell/University of Waikato**

K082A were using a remotely operated vehicle to investigate seafloor seeps. **© Megan Nicholl/ Antarctica New Zealand**

The K891A team. **© Megan Nicholl/Antarctica New Zealand**

Antarctic field programme highlights 2024/25

Antarctica New Zealand supported the work of 32 science teams on ice during the 2024/25 summer season. The following pages describe the field programme highlights and accomplishments. The research discussed relates to the themes identified in the New Zealand Government policy document Aotearoa New Zealand Antarctic and Southern Ocean Research Directions and Priorities 2021–2030. While events are separated within these themes, it is important to note the multiple connections between research programmes, and that many programmes address more than one research priority.

Bracketed K(***) numbers are the Antarctica New Zealand identifiers for field events. The table on page 40 provides more information on lead institutions, funders and field event managers.

Quantifying the Antarctic contribution to sea level rise

Ice loss from the Antarctic Ice Sheet is contributing to sea level rise in New Zealand and globally. Predicting the future rate of ice loss from the Antarctic Ice Sheet is complex, contributing to a level of uncertainty in sea level rise projections. Research will improve understanding of the causes and rates of ice sheet melt.

Movement and melting of the Ross Ice Shelf

The Ross Ice Shelf has a critical role in slowing the flow of the Antarctic Ice Sheet towards the ocean, stemming its contribution to global sea level rise. Monitoring lateral movement and basal melt rates (melting underneath) of the shelf is important for understanding its current state and for developing projections of its sensitivity to future climate change. The northwestern zone of the shelf is a critical location, helping to stabilise the whole of the ice shelf. It is also a location subject to inflow of ocean surface water that is contributing to accelerated rates of basal melting. Two teams are operating a range of instrument networks to provide real-time measurements of the behaviour and movement of the Ross Ice Shelf in this zone.

This season, a team from Te Herenga Waka—Victoria University of Wellington travelled to Antarctica to download data from a network of Global Navigation Satellite System receivers that cover an area of over 300km across the Ross Ice Shelf, including its northwest corner. Positional data collected by receivers is processed to produce measurements of ice shelf flow speed (velocity) and subsequently illuminate seasonal patterns of flow speed. This is the fourth field season for the programme, which has provided important insights into the health of the Ross Ice Shelf and contributed to improved modelling of the sensitivity of the ice shelf to climate change (Event K865A).

The SWAIS2C team (K862A and B) outside the drill tent.
© Anthony Powell/Antarctica New Zealand

NIWA researchers operate another long-term monitoring network on the northwest corner of the Ross Ice Shelf, using custom radar instruments called Autonomous phase-sensitive Radio Echo Sounders. These instruments record hourly estimates of ice shelf thickness throughout the year, providing measurements of basal melt rates in this critical zone. The network continued to operate successfully this season and will collect important new measurements over the coming months (Event K872B).

New tools for measuring the ice

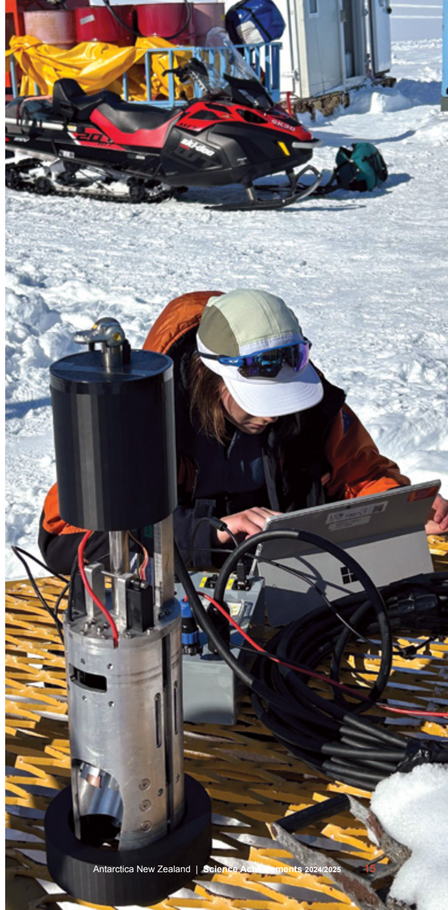
Two previous seasons of testing in Antarctica, combined with innovation, modification and development in New Zealand, came to fruition in 2024/25 as a team of scientists and engineers successfully deployed a new hot water drilling system on the McMurdo Ice Shelf. The programme, led by the University of Otago, is developing the advanced drilling system which allows ice samples to be taken rapidly and in difficult to access locations. The ice samples provide critical input parameters for ice sheet models. These models are fundamental for understanding the future response of the Antarctic Ice Sheet to a warming climate, and the resulting implications for sea level rise (Event K062B).

Monitoring sea level

Sea level has been monitored at Scott Base since 1957, and this season a team from LINZ worked at Scott Base and at Cape Roberts in Victoria Land to continue this significant long-term record. The team undertook maintenance activities and calibrated the two tide gauges to verify the accuracy and quality of the collected data. The data is a useful marker for sea level rise in other parts of the world and informs climate change research (Event K150A).

Marine sediments — clues to the past behaviour of the Antarctic Ice Sheet

Understanding how the Antarctic Ice Sheet behaved in past climate conditions helps to inform the development of models of future change. Archives of past ice sheet behaviour can be found in marine sediments retrieved using specialised drilling techniques. The large international SWAIS2C programme returned to the 2023/24 Ross Ice Shelf drilling site to undertake a second attempt to collect deep marine sediment cores. The cores will provide information on the Antarctic Ice Sheet behaviour reaching back many hundreds of thousands of years. Unfortunately, technical challenges prevented deep sediment core recovery. However, useful data from the open borehole were able to be gathered, including seafloor imagery and CTD data (ocean conductivity, temperature and depth). Short gravity cores were retrieved from the seafloor, and sub-sampled for unique microbiology and ancient DNA analysis. The oceanographic mooring installed in 2023/24 is still functional and the geophysical monitoring stations were serviced (Event K862A & B).



K062B was working at Windless Bight.
© Megan Nicholl/Antarctica New Zealand

A joint team from New Zealand and Italy were working in the Dry Valleys as part of K064A. **© Gary Wilson/University of Waikato**

Cryosphere-ocean-atmosphere connections and implications of change

Interactions between the cryosphere (the frozen water of the Earth's surface), the ocean and the atmosphere drive our global climate systems. Understanding these interactions is key to predicting future climate.

Atmospheric gases: ancient to present

About 180 million years ago, massive volcanic eruptions in Antarctica and southern Africa heated the Earth's crust, releasing carbon dioxide and contributing to a mass extinction. These eruptions formed regions of intense volcanic activity known as Large Igneous Provinces (LIP), which likely triggered greenhouse gas emissions when magma heated coal and organic-rich rocks, a process that could still occur today.

This season, University of Auckland researchers explored Antarctica's McMurdo Dry Valleys to investigate whether the 183-million-year-old Ferrar LIP produced enough heat to release greenhouse gases at extinction levels. Their study — featuring the first vertical transect of its kind — examined crustal heating and carbon release. Early findings from Mount Fleming suggest that magma and coal interactions likely released significant greenhouse gases. These insights help us understand the long-term impacts of carbon release on Earth's atmosphere, climate and life (Event K012A).

A collaborative New Zealand-Italy team researched present-day gas fluxes in the McMurdo Dry Valleys. Recent studies have found that permafrost in the Taylor and Wright Valleys is emitting greenhouse gases, though the sources and mechanisms remain unclear. This season, a team from GNS and Italian universities conducted fieldwork in Taylor, Wright and Hidden Valleys, collecting soil gas, gas flux, and sediment samples to explore possible causes and origins (Event K064A).

Antarctica's isolation from local pollution makes it an ideal place to study changes in atmospheric gases. Since 1982, scientists have used specialised instruments to monitor the stratosphere 30–50 km above Earth's surface (Event K085A). Long-term measurements made by NIWA researchers from this programme have also revealed how effectively Earth's atmosphere removes several climate-warming gases (more on the atmosphere as a 'detergent' can be found on page 33.)

Taking gas measurements in the Dry Valleys.
© Gary Wilson/University of Waikato

Climate observations, space weather and Earth's magnetic field

Arrival Heights is an internationally renowned atmospheric research laboratory located on Ross Island. The site is important for the study of space weather, magnetic field measurements and climate observations in a region that is geographically under-represented in observational data.

Teams worked at Scott Base and Arrival Heights collecting key data on temperature, wind, barometric pressure and solar radiation – maintaining a continuous climate record dating back to 1957. This long-term dataset is vital for tracking changes in both local and global climate, supporting operational decisions, and advancing research into climate-sensitive processes and ecosystems. To ensure accuracy, the stations undergo regular inspection, calibration and sensor maintenance. During the 2024/25 season, the NIWA research team successfully rebuilt a damaged anemometer mast, restoring wind measurement capabilities. Preliminary results show that 2024 wind run observations (a measure of how much wind has passed a certain point over time) have been consistently higher than long-term averages, with a notable spike in June. These climate measurements are part of a pilot programme developing a global network of surface-based climate measurements (Event K089A; see page 32 for more detail).

In further climate-focused work, a University of Canterbury research team concentrated on weather station maintenance and upgrades this season. Their work aims to understand how a warming climate may lead to increased local melting and wetness, and how these changes will impact Antarctic ecosystems. Data from a network of automatic weather stations will contribute to the development of regional and detailed local-scale climate models, offering a more precise understanding of climate-driven changes in the physical environment and their effects on land-based ecosystems (Event K881B).

Powerful explosions on the Sun can influence Earth's atmosphere, and this season a research team based at Scott Base and Arrival Heights studied these effects. The team uses equipment for monitoring very low frequency (VLF) radio waves, which plays a key role in the polar atmospheric monitoring network known as AARDDVARK (Antarctic–Arctic Radiation–belt Dynamic Deposition–VLF Atmospheric Research Konsortium). AARDDVARK aims to deepen our understanding of space weather processes, ultimately helping to improve knowledge of global atmospheric changes and the effects of space weather on communication and navigation systems. The data also feeds into the global, real-time World Wide Lightning Location Network, which tracks lightning activity around the planet (Event K060A).

Earth's magnetic field is a dynamic energy field stretching from the planet's core out into space, shielding us from solar wind (a continuous stream of charged particles) as well as more intense space weather events like solar storms. This field is constantly shifting, and its changes have been monitored at Scott Base since 1958. This season, a team from GNS worked at Arrival Heights to ensure all geomagnetic instruments were functioning correctly, and to carry out absolute observations at the Scott Base Geomagnetic Observatory. The data collected contributes to INTERMAGNET, the global magnetic field database which supports practical applications such as orientation systems in smartphones (Event K102A).

Sea Ice, methane seeps and a changing climate

Antarctic sea ice plays a crucial role in regulating the Earth's climate. It influences ocean circulation, moderates temperatures, drives ocean-atmosphere interactions and provides essential habitat for marine ecosystems. Acting like the planet's thermostat, sea ice reflects solar energy back into space, helping to keep Earth cooler.

In winter 2024, long-term research into sea ice growth in McMurdo Sound continued. A sea ice mass balance station was deployed to monitor key factors influencing ice formation, such as the thickness of overlying snow and the characteristics of the water column at the ice-ocean interface. The data gathered will help the University of Otago team understand how inflows of meltwater from upstream ice shelves, known as ice shelf water, affect sea ice development in McMurdo Sound. This work contributes to a 20-year dataset, deepening our understanding of how evolving sea ice conditions influence global climate (Event K891A).

K082A lowering the remotely operated vehicle into the water to investigate seafloor seeps. **© Megan Nicholl/Antarctica New Zealand**

Another focus this season was the investigation of methane seeps (natural gas leaks from beneath the seafloor) which could accelerate as the climate warms. These 'seafloor seeps' have been identified in the Ross Sea region and may be reshaping local ecosystems. A research team travelled to Cape Evans, using a remotely operated vehicle to explore the seafloor and sample surrounding water and sediments. Their work aims to identify the source of these seeps and assess their impact. By investigating how fluid flows and gas emissions from beneath the seafloor affect the Antarctic marine environment, this project will help establish a baseline for monitoring future changes in coastal ecosystems. The New Zealand researchers received important support from a United States research dive team (Event K082A).

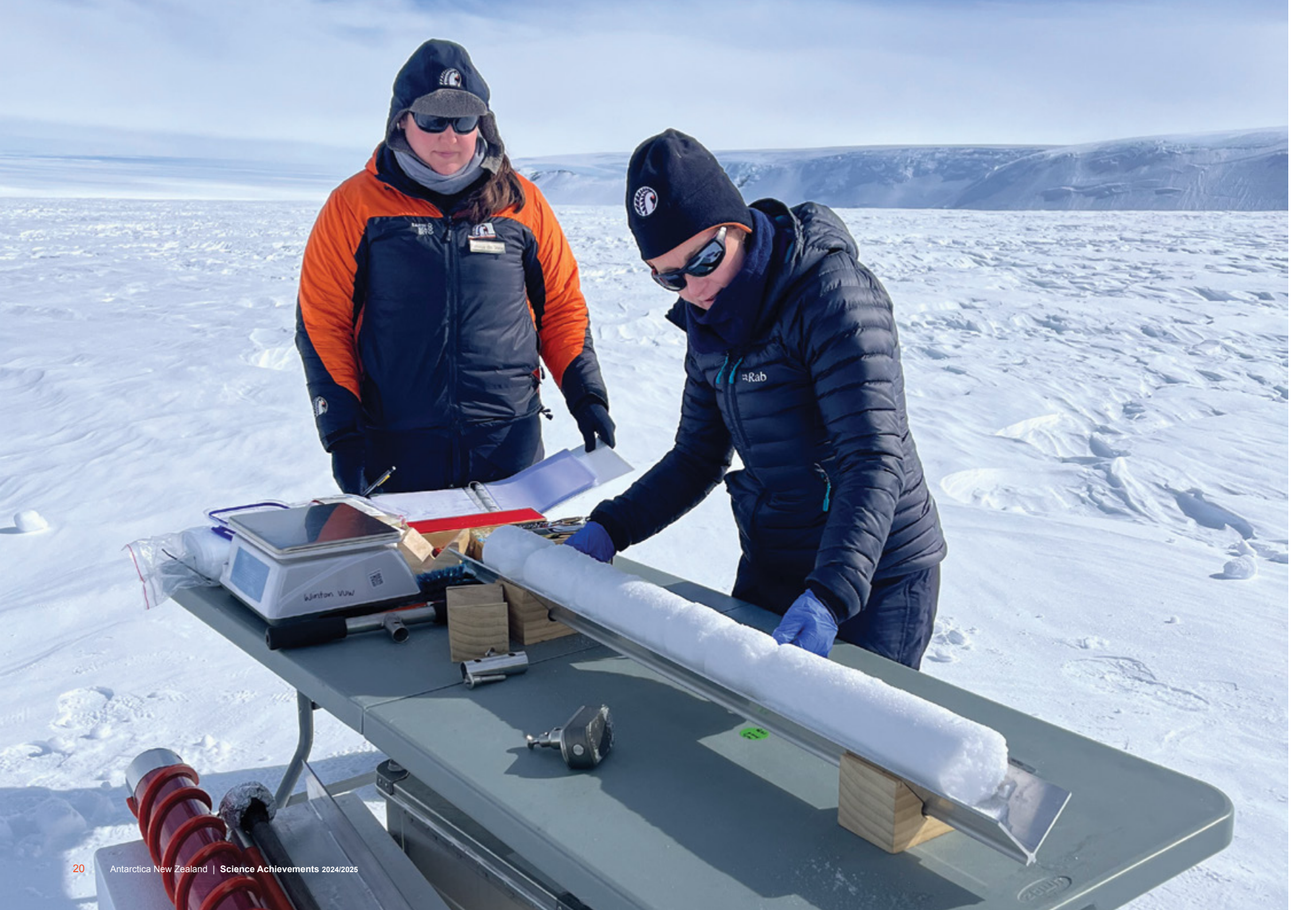
Ecosystem dynamics and responses to change

Extreme conditions drive specialised adaptation in Antarctic biota and make Antarctic ecosystems vulnerable to climate change and direct human impacts. Research aims to determine the status of marine, terrestrial and inland aquatic ecosystems, and to understand the responses of these ecosystems to environmental change.

Lakes of the McMurdo Dry Valleys — oases of diversity

The McMurdo Dry Valleys are paradoxically the location of many streams, lakes and ponds that are home to uniquely adapted microbial communities. The Dry Valleys are named due to their notable lack of snow and ice, but not the complete absence of water. Understanding the complex impacts of climate change on these ecosystems was the focus for a collaborative New Zealand-United States research programme working at Lake Bonney and Lake Fryxell this season. The research brings together scientists from the University of Waikato, the University of California, and the US Long-term Ecological Research Programme. The New Zealand component of the research is specifically focused on the impacts of thinning ice cover and rising lake levels on the structure and function of lake floor microbial communities. The team used a combination of under-ice diving and remotely operated vehicle exploration to take samples of lake-floor microbial mats and deploy instruments to measure the physical conditions of the lake environment. The project began in 2017, and researchers now have a valuable long-term record highlighting a period of significant change in the lake environment. There has been substantial ice thinning, leading to increased transmission of light into the lake that disrupts lake-floor microbial mats through a process called mat 'lift-off'. Mat lift-off occurs when gas bubbles form within mats through photosynthesis, causing portions to detach from the lake floor and float to the surface. At the surface, they either freeze into the underside of the ice or sink back to the lake floor. This process is reshaping the lake floor community, equivalent to the terrestrial events of a forest fire, and research into whether this is a trend or just variability is now underway. Results will build into broader projections of how the Dry Valleys ecosystems are responding to climate change (Event K882U).

K882U involved diving in two lakes in the McMurdo Dry Valleys.
© Megan Nicholl/Antarctica New Zealand



The K044A team processing an ice core.
© Merijn Thornton/Antarctica New Zealand

Microbes, foundations of the marine food web

The sea ice of McMurdo Sound provides an important habitat for microbes, which are the foundation of the marine food web. Research led by Te Herenga Waka—Victoria University of Wellington is investigating the energy production pathways of sea ice microbes. The team is interested in microbial phototrophy (where light energy is captured from the sun and converted into chemical energy), specifically one such process brought about by the cellular protein rhodopsin. This season, researchers worked through holes drilled in the McMurdo Sound sea ice to collect sea ice cores and water samples. These will be used to determine bacterial community composition and rhodopsin abundance at different depths of the water column. This was the third and final field season for the programme, which has generated important new knowledge on the role of rhodopsin in energy flux and the ability of sea ice microbes to adapt to environmental changes (Event K043A).

Sea ice conditions also influence the seasonal blooms of marine phytoplankton (microscopic algae that drift in currents at the ocean surface). It is expected that changing sea ice conditions will alter phytoplankton community composition and the timing of phytoplankton blooms. However, it is difficult to predict the future response as the observational record of past phytoplankton distribution and abundance is short. Research led by Te Herenga Waka—Victoria University of Wellington aims to extend the length of the record from 20 to 200 years using information from archived and newly collected ice cores. This season, researchers worked at Thern Promontory to collect new ice cores and accompanying daily snow samples and aerosol measurements, building on work conducted last season at Priestly Glacier. Both sites in Northern Victoria Land regularly receive marine aerosols containing phytoplankton signatures, which can be used to develop reconstructions of past conditions (Event K044A).

Ross Sea ecosystem dynamics

Changing sea ice dynamics and other environmental parameters will impact Ross Sea ecosystems at a range of levels. Understanding the composition of these marine ecosystems, and how energy and nutrients flow through these (food webs) is pivotal to predicting future responses to climate change. Several teams worked from the sea ice in McMurdo Sound and on coastal Ross Island to study different parts of the food web and to build up pictures of the linkages between them. A team from the University of Otago worked through holes drilled in the sea ice in McMurdo Sound to collect water and fish samples for eDNA analysis and for a range of other biodiversity measurements. The team also visited sites at Cape Royds, Cape Evans and Cape Bird on Ross Island to collect penguin guano and seal scat. This set of samples are representative of different parts of the marine food web. Analysis will track the flow of energy all the way from sea ice algae through to penguins and seals at the top of the food web. The work will provide insight into food web structure and information on the relationship between changing sea ice dynamics and ecosystem function (Event K882C). Researchers also worked on Ross Island, at Cape Armitage to study glass sponges (Event K884A) and at Cape Crozier to study the foraging behaviour and habitat use of the large marine predators, emperor penguins, Weddell seals and Adélie penguins (Events K083E). More information on these events can be found on page 10.

Collecting samples as part of the K044A event. **© Emma de Jong/ Te Herenga Waka—Victoria University of Wellington**

The K044A team doing snow pit sampling with lenticular clouds in the background. **© Pepper Cook/Antarctica New Zealand**

Protecting Antarctic and Southern Ocean environments

Increasing impact from intensifying human activities, coupled with climate change, is putting pressure on Antarctic ecosystems. Understanding the complexities of function of Antarctic ecosystems, and the nature of the stressors they experience, is critical for designing and implementing effective management and protection measures.

Morozumi Range biodiversity project

A joint research expedition by the Antarctic Science Platform and Australia's Securing Antarctica's Environmental Future (SAEF) carried out a comprehensive habitat and biodiversity survey in the remote Morozumi Range of Northern Victoria Land this season. This little-studied region is increasingly attracting scientific interest from both New Zealand and Australian researchers.

Believed to be the first biological investigation of the area, the expedition aimed to fill critical knowledge gaps by collecting environmental data and physical samples to characterise both terrestrial and aquatic habitats. Microscopic and molecular analyses of these samples will reveal the present biodiversity, and its relationship to other parts of the continent, while rock samples will undergo cosmogenic dating (a way to determine how long a rock has been exposed at the Earth's surface) to reconstruct the region's ice history and shed light on how past climate conditions shaped current biodiversity patterns.

Notably, the team confirmed the presence of a springtail species — likely *Cryptopygus antarctica* — as well as at least one mite species. The widespread distribution and abundance of springtails in the area suggest the mountains may have served as a refugial habitat (a rare safe zone where life could persist through extreme glaciation) during the Last Glacial Maximum.

These findings enhance our understanding of the region's unique ecosystems and contribute valuable insights to guide broader efforts in Antarctic conservation and environmental protection (Event K881D).

Marine predators in the Southern Ocean: monitoring a changing ecosystem

Top predators such as Weddell seals, emperor penguins, and Adélie penguins are vital indicators of ecosystem health in the Southern Ocean. Their survival depends on the availability of sea ice and access to key prey species, making them sensitive to environmental changes. Traditionally, scientists have monitored fluctuations in individual specie populations as early warning signs of broader ecological shifts. However, these predators don't exist in isolation — they interact with each other and their environment in complex ways. Focusing on a single species can miss the bigger picture.

This season, a University of Canterbury-led research team worked at Cape Crozier, where they tagged all three predator species (Weddell seals, emperor penguins and Adélie penguins) to study how they share space and resources in real time. A trail camera was also installed to monitor population dynamics and phenology (the timing of key life events) and how these are influenced by changing environmental conditions (Event K051A).

The 2024/25 season also marked the successful continuation of the Ross Island Adélie penguin census, a long-term monitoring project led by Antarctica New Zealand in collaboration with Manaaki Whenua.

Since the early 1980s, aerial surveys using high-resolution photography from helicopters have captured nest counts during the early incubation period. This data provides a crucial benchmark for tracking population trends and understanding how natural and human-driven changes are affecting the Antarctic marine ecosystem. The census also plays an important role in evaluating the conservation effectiveness of the Ross Sea region Marine Protected Area, with findings regularly submitted to the Commission for the Conservation of Antarctic Marine Living Resources (Event K850A).

Another key monitoring effort is the annual toothfish survey, which has been conducted since 2012 to study the population structure and variability of Ross Sea toothfish. The survey team transits through Scott Base before boarding a research vessel operating in the deep waters (500–900m) of the southern Ross Sea. Using longline fishing techniques, the team collects data to assess the strength of different year classes of fish, which is crucial for understanding population dynamics and informing sustainable fishery management. Initial findings from this season show strong recruitment, with large numbers of juvenile fish appearing in the catch (Event K091A).

Together, these research efforts are building a more holistic understanding of how climate change, human activity and ecological interactions are shaping the Southern Ocean, ensuring that future conservation and management decisions are based on sound integrated science.

K881D conducting a biodiversity survey in the Morozumi Range.
© Richard Jones/SAEF

Antarctic Science Platform

Supported by the Ministry of Business, Innovation, and Employment's Strategic Science Investment Fund and hosted by Antarctica New Zealand, the Antarctic Science Platform conducts world–class research to improve understanding of Antarctica's role in the global Earth system, particularly in a +2°C or warmer world. Phase 1 of the Platform is drawing to a close, ending on 30 June 2025 after seven successful years of Antarctic research. The outgoing Steering Group Chair Dr Gillian Wratt, steering group members and Platform Director Prof. Nancy Bertler are commended for their incredible efforts over the last seven years.

With $49 million in renewed government investment, the Platform will enter its second seven-year phase starting on 1 July 2025. Phase 2 priorities were shaped through extensive consultation, prior to MBIE approval. Research will continue to focus on the stability of the West Antarctic Ice Sheet, the changing Antarctic atmosphere and Southern Ocean, impacts on Ross Sea ecosystems, and the transformation of terrestrial and nearshore environments.

The Platform will work to identify:

- Signposts of catastrophic climate change and how they can be effectively observed to support timely mitigation
- Drivers and potential implications of unprecedented change in the Ross Sea and Southern Ocean
- Critical vulnerabilities of Antarctica's ice sheets and glaciers, and the implications of likely increased melt.

Professor Jenny Webster-Brown is the incoming Steering Group Chair and Dr Natalie Robinson the incoming Platform Director.

Scientific excellence

New Zealand is globally recognised for its leadership in Antarctic science and governance. The Platform reinforces this standing by integrating diverse scientific disciplines and fostering international collaboration, from fieldwork through to modelling and projections. In 2024/25, it supported 13 field events (see highlights on pages 13- 22). The Platform's medium-term datasets are now delivering critical insights, stemming from data from the expanded Automated Weather Station network, climate observations supporting meltwater generation models, and environmental baselining of sentinel sites.

In all, Platform-supported research since 2019 has produced nearly 200 publications, including world–leading journals such as *Nature, Science*, and *Proceedings of the National Academy of Sciences*.

Collaboration

The Platform's long planning horizon has strengthened long-standing collaborations with Italy, Korea, the United States, Australia and China, while enabling new partnerships with Germany, the United Kingdom, France and Canada. A deepening relationship with Australia's Securing Antarctica's Environmental Future initiative resulted in a joint biodiversity survey in the Morozumi Range (see page 22) and creation of a Collaboration Fund (page 26). Building on last year's New Zealand–Italy voyage, this year the Platform played a leadership role in oceanographic research, including facilitating an increase in the number and quality of autonomous profiling floats in the international fleet in the Ross Sea region (page 27).

Building capability

The Antarctic Science Platform invests in innovation and emerging talent. It has supported 32 Early Career Researchers since 2019, and over 50 postgraduate students. The National Modelling Hub connects 52 researchers across Aotearoa, resulting in the development of a range of new atmospheric, oceanic and ice sheet models. In partnership with Antarctica New Zealand, the Platform has launched New Zealand's first Antarctic and Southern Ocean Metadata Catalogue (page 30). It is also making meaningful progress to embed Te Ao Māori and mātauranga Māori into its programme; the recent recruitment of a Kaiārahi Rangahau Māori (Māori Research Navigator) and Māori research leader position the Platform well to implement its Mātauranga Māori Strategy during Phase 2.

The international SWAIS2C drilling project used hot water drilling to melt a hole through 588m of the Ross Ice Shelf and achieved the first successful deployment of the sea riser connecting the drilling system at the ice shelf surface to the seafloor below. While intermediate-depth drilling was ultimately not successful, valuable science outcomes include shallow sediment cores, real-time ocean data beneath the ice shelf, microbiology and ancient DNA samples, ice shelf geophysics, and policy-relevant modelling.

Preparations have also advanced for the deployment of Hauwai-20, a robotic underwater sampler that will enhance marine data collection. A remotely operated vehicle confirmed the safe installation of its seafloor conduit in 2024/25, and sea ice conditions appear favourable for deployment next season.

Impact

The Antarctic Science Platform plays a vital role in ensuring that New Zealand's Antarctic research informs both national and international policy.

It has provided science advice and papers to the Antarctic Treaty Consultative Meeting, the Committee for Environmental Protection and the Commission for the Conservation of Antarctic Marine Living Resources and contributed to global climate efforts through the United Nations Framework Convention on Climate Change for the 29th Convention of Parties and the Intergovernmental Panel on Climate Change.

Platform researchers contribute to international initiatives, including the World Climate Research Programme, the Scientific Committee on Antarctic Research, the Southern Ocean Observing System and the Ice Sheet Model Intercomparison Project. Nationally, the Platform collaborates with agencies such as Our Changing Coast, the Ministry for Primary Industries and the recently completed Deep South National Science Challenges.

The 140 participants in the Antarctica Science Platform's biennial hui at Te Papa in April is testament to its position in the wider Antarctic community, with sessions traversing research highlights, science–policy connections and Phase 2 plans.

Antarctic Science Platform hui. © **Antarctica New Zealand**

Strengthening ties across the Tasman

As an outcome of the joint New Zealand–Australia Collaboration Workshop held at Monash University in 2024, the Antarctic Science Platform and Australia's Securing Antarctica's Environmental Future this year created a new Collaboration Fund to facilitate scientific exchange and research innovation between the two countries' Antarctic communities, while providing opportunities for early career researchers. Two awards have been made:

Dr Mia Wege

(SAEF / University of Canterbury)

Dr Sarah Bury

(ASP/National Institute of Water and Atmospheric Research)

This project will explore the diet of Weddell seals in the Weddell Sea, with a particular focus on the contribution of icefish to their diet. Weddell seals have a circumpolar distribution throughout the Southern Ocean; however, there are significant gaps in our understanding of their diet composition and foraging behaviour. One of these gaps is in the Weddell Sea. The research follows the discovery in 2021 of the largest breeding colony of icefish. The colony, which covers ~240 km² and has an estimated 60 million nests, is within the foraging area of the Weddell seal. The team will analyse isotopes within body tissue samples of Weddell seals, icefish and other likely prey to build an understanding of the Weddell seal's diet in this part of the ocean. Their results will contribute to conservation efforts across the region, including a proposal to the Conservation of Antarctic Marine Living Resources to establish the Weddell Sea Marine Protected Area.

Dr Narmilan Amarasingam

(SAEF/ University of Wollongong)

Dr Gabrielle Koerich

(ASP/ University of Canterbury)

This project seeks to fill gaps in our understanding of the health, distribution and hydrological interaction of vegetation (such as moss and lichen) across the continent. It will combine drone and satellite-based remote sensing, deep learning and hydrological modelling to study vegetation in the McMurdo Dry Valleys at the Canada Glacier Antarctic Specially Protected Area 131. The project will integrate ecological modelling and DNA-based ground validation to produce maps of the region's vegetation, to reveal links between vegetation health and water availability. The findings will help improve monitoring and conservation efforts at a time when some areas are getting greener, and others are drying out.

Science on the high seas

New Zealand mounted two Ross Sea research voyages in the 2024/25 season, with Antarctica New Zealand assisting to coordinate science across the ships.

On its second fuel resupply mission to McMurdo Station, New Zealand Defence Force vessel *HMNZS Aotearoa* flexed its scientific capabilities to support multidisciplinary investigations led by Defence Science and Technology on behalf of the Antarctic Science Platform, University of Canterbury, GNS Science, Oceanum, Cawthron Institute, University of Otago and NIWA. To improve oceanographic observations, float profilers were deployed in the Ross Sea Gyre, contributing to the global Argo programme, a critical network of autonomous ocean sensors. High-density XBT (expendable bathythermograph), a probe that measures temperature as it falls through the water, transects were also conducted, replicating measurements taken in 2022. Environmental DNA (eDNA) samples were collected between New Zealand and the Ross Sea, detecting marine organisms through genetic traces and providing insights into species presence and biodiversity patterns. Air flask samples were gathered to assess the carbon sink capacity of the Southern Ocean, a vital but understudied part of the global carbon cycle. The voyage also took opportunistic surveys of penguins and seals in pack ice habitats aimed to better understand their at-sea behaviour, abundance, and distribution. A sensor package (temperature/depth logger plus acoustic release) was deployed near a seamount (underwater mountain) along the Ross Sea transit route, which has the potential to become a long-term upper ocean observing station, fostering international collaboration and equipment deployment (K467A).

On its 16th Antarctic campaign, NIWA's *RV Tangaroa* spent six weeks at sea, including 30 days within the Antarctic Treaty area (south of 60°S); the main survey area was the Western Ross Sea from Iselin Bank to Cape Adare, and as far south as the Ross Ice Shelf front. The voyage had an international flavour, with the multi-disciplinary science team of 20 including participants from Australia, Europe, India and the United Kingdom. MBIE, the Antarctic Science Platform, NIWA Strategic Science Investment Fund, University of Auckland, University of Otago, University of Canterbury and overseas agencies provided funding. The Antarctic Science Platform took a leading role in the science planning, with emphasis on completing its research into water mass evolution, benthic (seafloor) ecology, and pelagic (surface of the open ocean) higher trophic level interactions.

A Platform priority has been to enhance the internationally coordinated network of oceanographic observations. The team deployed New Zealand's first biogeochemical Argo floats — 'souped up' ocean-monitoring robots that rise and fall to depths of 1–2km, taking measurements as they drift — as well as 12 standard Argo floats on behalf of Scripps Institute of Oceanography (USA). A further highlight was the retrieval of hydrographic moorings from the front of the Ross Ice Shelf, which had been deployed during last year's New Zealand–Italy voyage on the *RV Laura Bassi*.

The international benthic team achieved more than was planned, including some research close to the face of the Ross Ice Shelf. Samples are returning to labs across the globe and the downstream products, including eDNA analysis, promise to substantially enhance our understanding of biogeographic features.

RV Tangaroa voyage 2025

250+	sampling stations
12	Argo floats
1st	biogeochemical Argos
15	hydrographic/ biophysical moorings
53	conductivity–temperature–depth casts
~ 2500	biological specimens
~1100	water samples
72	Deep Towed Imaging System surveys
13	sled tow deployments
30	sediment grabs
7	continuous plankton recorder tows
10	RMT trawls (rectangular net)
12	zoo plankton trawls (bongo net)
220km	ocean glider mission
> 4500	nautical miles of atmospheric and surface measurements

Connecting with Antarctic science

Connecting people to Antarctic research and environmental efforts is vital for building a sense of responsibility towards one of Earth's most important, yet fragile and awe-inspiring regions. Making science accessible and engaging fosters curiosity and, at a deeper level, support for policies that protect Antarctica's environment. Sharing stories, discoveries and challenges deepens understanding of climate change and its far-reaching consequences and reminds us that what happens in Antarctica affects everyone. Our Invited Visitors and Community Engagement Programmes are a significant investment in building relationships with the continent and the people driving research

Over the 2024/25 season, three government ministers made the trip to Antarctica. Finance Minister Hon. Nicola Willis (pictured above) visited Scott Base to see progress on the Scott Base Redevelopment and meet with the people behind the science and logistics. She was accompanied by Waikato MP Tim van de Molen (pictured above), who chairs the Foreign Affairs, Defence and Trade Select Committee and co-chairs the New Zealand-Europe Parliamentary Friendship Group. Climate Change Minister Hon. Simon Watts followed soon after, keen to learn more about the impacts of climate change. Land Information and Associate Defence Minister Hon. Chris Penk travelled south to see how New Zealand supports navigation and mapping systems, and to visit defence and science teams in the field. Together, their visits showed commitment to understanding and backing New Zealand's role in Antarctica, covering science, people, infrastructure, and the cooperation that makes it all happen.

Royal New Zealand Navy maritime and land commanders Commodore Shane Arndell and Brigadier Jason Dyhrberg and New Zealand Defence Force strategic commitments director Captain Stephen Lenik visited personnel at Scott Base and McMurdo to observe ship offload operations and *HMNZS Aotearoa*'s fuel resupply.

Claire Concannon interviewing Sarah Seabrook.
© Anthony Powell/Antarctica New Zealand

Victoria Kelly listening to the sounds of Antarctica.
© Megan Nicholl/Antarctica New Zealand

Diane Christenson and Carol Brieseman.
© Megan Nicholl/Antarctica New Zealand

To help homegrown voices tell Antarctic stories, we welcomed Radio New Zealand's Dr Claire Concannon to produce *Voice of the Sea Ice*, a landmark podcast exploring the science of sea ice and its role in the global climate system. Victoria Kelly, Wellington Orchestra's Composer in Residence, also travelled south with the Community Engagement Programme to inspire her opera that will incorporate scientific knowledge and research as part of the creative process. Her work will reach new audiences, inspiring them to better understand and protect the southern continent. To much acclaim, last year's Community Engagement Programme participants, Ruckus Media, launched *Patrick Gower: On Ice*, a documentary series about climate change. This may be the only documentary, ever, where hyperspectral imaging specialists make 2-minute noodles in a research hut at Cape Evans while soul searching about the world children will inherit! One review said: "Gower has an ability to connect with viewers whom other documentaries don't reach."

Introducing Antarctica to children sparks their curiosity about the natural world and helps them understand the importance of protecting our planet, and how even distant places are connected to their everyday lives. We were privileged to host awarding-winning science educators Carol Brieseman and Dianne Christenson, who joined research teams in a push to create curriculum-linked resources for teachers for Years 0–10.

Sharing Antarctic science data

Sharing Antarctic science data provides opportunities for increased collaboration, and strengthened research outcomes, including interpretation of research findings at both regional and circum–Antarctic scales. The New Zealand Antarctic Programme launched a new data sharing initiative in 2023 — the Antarctica New Zealand Metadata Catalogue (AntCat - https://antcat.antarcticanz.govt.nz). AntCat centralises New Zealand's Antarctic and Southern Ocean data, including thematic groupings (like sea ice, eDNA, air temperature), obtained with a range of platforms (like ships, moorings) and instruments (like magnaprobe, automatic weather stations). The catalogue now hosts over 250 distinct data records and provides significant advancements in data sharing capability. AntCat data resources are made available across several application programming interface endpoints providing data dissemination at national and international levels.

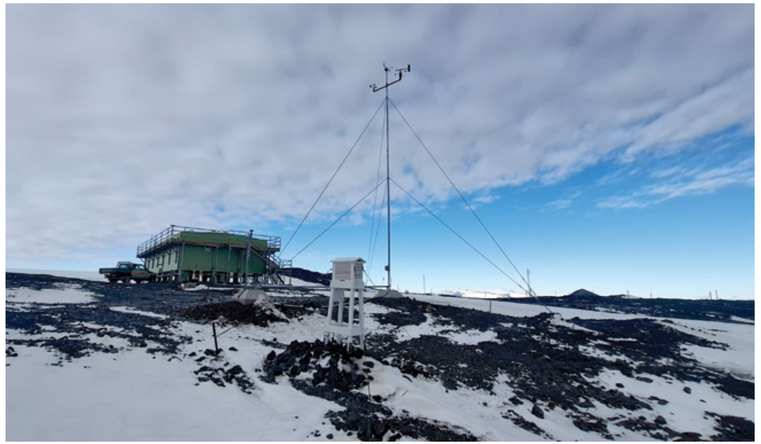
The Cape Crozier camp where K051A were working.
© Anthony Powell/Antarctica New Zealand

K051A's work involved tagging predator species to monitor how they interact.
© Anthony Powell/Antarctica New Zealand

Long-term science

Globally important climate measurements at Scott Base

The Global Climate Observing System (GCOS) is partnering with the World Meteorological Organisation to develop a network of surface-based climate measurements. A pilot programme has been launched, called the GCOS Surface Reference Network. The network includes NIWA's Scott Base Electronic Weather Station, with further Southern Hemisphere representation from NIWA's Lauder site. The goal of the GCOS Surface Reference Network is to obtain, and make available, consistent observations of 'Essential Climate Variables', which are used on a global scale to characterise Earth's climate, and to guide understanding of current and future climate patterns. This information is important for assessing climate risks and developing climate mitigation and adaptation measures. Inclusion of the Scott Base weather station in this pilot network is recognition of the high quality of the observations made by the programme, (Event K089A).



The Arrival Heights mast. © **Jeremy Rutherford/NIWA**

Research finds significant warming of Ross Sea region

University of Canterbury PhD candidate Eva Nielsen has developed a new dataset capturing two decades of Antarctic temperature data, analysing trends and extremes as part of her research using the long-term dataset from events K881B and K123A. Nielsen's dataset AntAir ICE compiles detailed satellite-based temperature records from 2003 to 2021, covering mainland Antarctica and its surrounding ice shelves. Using this tool, Nielsen and her team examined temperature trends and extremes, uncovering significant findings. They identified notable warming in the Ross Sea region — the first evidence of such a trend — affecting both summer and annual mean temperatures. In contrast, their analysis showed cooling trends in the Antarctic Peninsula, consistent with previous studies, and significant cooling in parts of Eastern Antarctica. AntAir ICE offers an invaluable resource for understanding localised temperature extremes and regional climate variability, subtle patterns often missed by broader-scale climate models. This work provides vital context for predicting future changes in the Antarctic climate system.

The 'detergent' of the atmosphere

A NIWA–led study published in *Nature Communications* (Morgenstern et al., 2025) has revealed that Earth's atmosphere has become increasingly efficient at removing several climate-warming gases, including methane. Analysis of air samples from Arrival Heights, Antarctica, and Baring Head, New Zealand, dating back to the late 1980s, shows a significant strengthening in the atmosphere's self-cleansing capacity driven by the hydroxyl radical.

Often referred to as the 'detergent of the atmosphere', the hydroxyl radical plays a key role in breaking down pollutants such as methane and carbon monoxide. It forms when ultraviolet sunlight interacts with ozone and water vapour and then reacts with gases in the troposphere, the lowest layer of the atmosphere.

Using radiocarbon monoxide as a tracer, the researchers found that hydroxyl concentrations in the Southern Hemisphere have been increasing since 1997. This strengthening of the atmospheric cleansing process is influenced by factors including nitrogen oxides from vehicle emissions, industrial activities, lightning, and wildfires. Model sensitivity simulations illustrate the roles of methane, nitrogen oxides, stratospheric ozone depletion, and global warming driving hydroxyl trends.

The study emphasises the critical importance of long-term air monitoring programmes. The datasets from Arrival Heights and Baring Head are the only continuous radiocarbon monoxide records for the entire Southern Hemisphere, making them essential for understanding global atmospheric chemistry and the planet's natural defences against climate-warming gases.

© **Lana Young/Antarctic Science Platform**

Long-term science research timeline

1900 1925 1950 1975 1990 2000

Since 1911

Magnetic measurements

Specialised equipment at the Scott Base Geomagnetic Observatory has been monitoring the magnetic field since 1958 and is now operated by GNS Science. Data are used for a multitude of purposes including accurate air and ship navigation. Magnetic measurements were first made on Ross Island by British explorer Robert Falcon Scott.

Captain Robert Falcon Scott, British Antarctic Expedition, April 13, 1911. © **Herbert Ponting. National Maritime Museum, Greenwich, London. All rights reserved.**

Edmund Hillary, Peter Mulgrew and Jim Bates at Scott Base in 1957. © **Antarctica New Zealand**

Since 1957

Sea level, GNSS and absolute gravity

The Scott Base tide gauge has been monitoring sea levels since 1957. Gravity measurements started at Scott Base in the same year, while Global Navigation Satellite System observations began in 2004 at Scott Base, and 2005 at Cape Roberts. Datasets are vital for understanding long-term sea level trends, and aiding climate change research. The research is managed by LINZ.

Since 1957

Climate measurements

Daily weather recordings at Scott Base, started in 1957, provide one of Antarctica's longest climate records. Modern automated stations have further enriched this database by collecting additional data including solar radiation. Observations are crucial for understanding climate change and aiding operational decisions. The measurements are managed by NIWA.

Climate measurements being taken in in the late 1950s. © **Antarctica New Zealand**

Since 1982

Atmospheric composition

Since 1982, NIWA has tracked greenhouse gas changes, ozone hole evolution and ozone-depleting gases. Data informs research on atmospheric composition trends and supports Southern Hemisphere climate models and satellite validation.

Since 1982

Atmospheric dynamics

University of Canterbury researchers use a middle-frequency radar to measure air movement variations in the middle atmosphere. This data aids in monitoring climate change, human-induced alterations, atmospheric ozone chemistry and the impact of ozone-depleting substances on Antarctica's climate.

Since 1981

Adélie penguin census

Aerial surveys of Ross Sea Adélie penguins began in the early 1980s. High resolution photographs are analysed in New Zealand to determine the number of breeding pairs. The abundance of the penguins provides an indication of the health of the Ross Sea ecosystem. The research is a partnership between Antarctica New Zealand and Manaaki Whenua.

Undertaking the penguin census over two decades ago. © **Antarctica New Zealand**

Since 1999

Sea ice growth

University of Otago researchers have been collecting sea ice measurements for over 20 years using a sea ice monitoring station deployed annually in McMurdo Sound. Information is used to improve understanding of how melted ice shelf water flowing from upstream ice shelves influences sea ice formation in the Sound.

Since 1999

Soil-climate stations

For over 20 years, Manaaki Whenua and the University of Waikato have operated a soil–climate monitoring network in Antarctica. Data contributes to understanding of terrestrial climate change impacts in the Ross Sea region. The sites are part of the global Circumpolar Active Layer Monitoring Network.

Since 2008

Space weather

Space weather is studied using Very Low Frequency (VLF) radio wave receivers that capture VLF waves emitted from military-operated transmitters around the globe. The receivers are part of the global AARDDVARK network, led by the University of Otago and the British Antarctic Survey.

Since 2012

Antarctic Toothfish survey

An annual survey of Antarctic toothfish has been conducted in the Southern Ross Sea since 2012, typically after the fishery has closed for the season. The survey provides valuable data on the population structure of Ross Sea toothfish, and the effectiveness of the Ross Sea region Marine Protected Area in meeting its conservation goals. The survey has been undertaken on behalf of the Ministry for Primary Industries by NIWA (2012–2023) and SoFISH Consulting (2024).

Antarctica New Zealand supports a diverse long-term science programme, that provides essential information for detecting change, and informing future projections, both in Antarctica and globally. The datasets are some of the longest records of their type in Antarctica, providing opportunities for researchers to distinguish between ephemeral variability and long-term change. Research areas include climate observations, atmospheric dynamics, soil climate, sea ice, Adélie penguin and toothfish population surveys, and measurements of the Earth's magnetic field.

Postgraduate scholarship recipients 2024

Antarctica New Zealand is generously supported in the postgraduate scholarship programme by Ella Yelich-O'Connor and New Zealand Post.

"Receiving this scholarship was an incredible opportunity that allowed me to gain invaluable field experience this past season. The Scott Base and wider Antarctica NZ community were exceptionally helpful during this period, supporting me to successfully collect ice samples with my new sampling equipment and overall have a very successful science event."

New Zealand Post Antarctic Scholarship

Jessica MacFarquhar (MSc)

University of Canterbury

Design and Development of Rapid Ice Sampling Device

Ice sheet evolution models are vital tools that provide quantitative hypotheses about the response of ice sheets to climate change. The current models have limited accuracy as they have a poor representation of how the anisotropy of glacial ice modifies flow patterns in ice sheets. With the current ice sampling technology, it is not possible to collect the amount and variety of ice core samples that are required for robust ice sheet models. Jessica's research will build on the design of current ice sampling equipment and use engineering design processes to create innovative solutions to generate devices that will collect ice samples. The equipment will be able to collect samples of multiple sizes from numerous depths and locations within a week, in conjunction with hot water drilling equipment. This research will increase the number of ice samples that can be collected in a set time, therefore increasing the amount of data available on glacier ice physical properties that will contribute to ice sheet models.

"This scholarship has helped support me on a deep dive into strain rate anomalies in Ross Ice Shelf suture zones, what they might imply about the composition of these enigmatic structures, and why they contribute to ice shelf stability. I've learned how to apply a variety of analyses to remotely sensed data. I was able to develop skills in geophysical and geodetic field techniques as part of the diverse K062A team studying the McMurdo Ice Shelf suture zone in 2024, for which I was able to front the Ground Penetrating Radar campaign."

New Zealand Post Antarctic Scholarship

Ruari Macfarlane (MSc)

University of Otago

Structure and Mechanics of the McMurdo Ice Shelf

Modelling of worldwide sea-level change requires understanding of the response of the Antarctic Ice Sheet to climatic drivers. The response of the ice sheet is intrinsically linked to the behaviour of the buttressing Antarctic ice shelves. Ruari's study aims to increase understanding of the geometry and mechanics of polar ice shelves. His research will use various remote sensing techniques to study the structure of the Ross and McMurdo Ice Shelves, combined with data from ice cores collected by the University of Otago's Tere Tipako Tio project. Results from the study will be used to build a mechanical model of the McMurdo Ice Shelf.

"Thanks to the Ella Yelich-O'Connor Antarctic Doctoral Scholarship, I am able to travel to Europe to do additional analyses to extend our understanding of the biological pump in the Southern Ocean."

Ella Yelich-O'Connor Doctoral Scholarship

Marie Hennequin (PhD)

University of Otago

Trace metal micronutrients: Regulating the Southern Ocean's carbon sink during the last glacial–interglacial cycle

The expansive Southern Ocean controls global climate by drawing down atmospheric carbon dioxide into the ocean's interior via marine primary production within the 'biological pump'. This process is limited by the supply of trace-metal 'micronutrients', such as iron and zinc, but future-climate projections are constrained by traditional 'macronutrient'-based productivity tracers that are not ideally suited to Southern Ocean climate reconstructions. Marie's research aims to understand how trace-metal micronutrients like iron, zinc, and cadmium affect marine productivity using advanced climate models and stable-isotope systems. Focusing on the last 140,000 years, she will analyse fossil plankton from Southern Ocean sediments to track micronutrient uptake over time. These results will help improve climate models and predict the Southern Ocean's effectiveness at removing CO_2 during major climate changes.

New Zealand Defence Force celebrates 70 years on ice

The New Zealand Defence Force (NZDF) celebrated 70 years of working in the Antarctic this season. Over the decades, Operation Antarctic has grown to one of its largest deployments. About 220 staff take part each year, providing crucial logistical support, including flights transporting personnel and cargo to Scott Base, as well as terminal operations at Harewood and McMurdo Station. Teams also deliver fuel, manage ship offloads and provide expertise through light engineering, plant operators, cargo handlers, communications and administrative staff.

This effort underpins New Zealand's contribution to the Joint Logistics Pool, the shared network of aircraft, ships and workforce that makes scientific research in the wider Ross Sea region possible, both for New Zealand and for the neighbouring international Antarctic programmes we work closely with.

In 2024/25, across all international partners, NZDF supported 170 flights, transporting 4,500 passengers and 2.3 million pounds of cargo. Resupply operations were notably busy, with two United States–chartered container ships offloading at McMurdo and a fuel delivery by the *HMNZS Aotearoa*. The *HMNZS Aotearoa* also carried a science team that conducted multidisciplinary investigations into atmospheric, biological and oceanic processes (see page 27).

In another development for the history books, the fleet of C-130H Hercules from the Royal New Zealand Air Force was retired, marking the end of an era in Antarctic operations. The C-130H was a vital asset, supporting airlift operations to Antarctica since 1965. The introduction of newer, more efficient C-130J-30 Hercules offers enhanced speed, range and capacity, ensuring New Zealand's continued airlift capabilities. The RNZAF also supported the United States Air Force's first C-130H missions to Antarctica, with an experienced pilot serving as an air liaison officer, sharing operational protocols, ensuring smooth integration and reducing risk.

An Explosive Ordnance Disposal team assisted Antarctica New Zealand and the Antarctic Heritage Trust in assessing and remediating abandoned chemicals and explosives at historical sites like Borchgrevink's hut at Cape Adare.

The C-130H Hercules was retired last season. **© Sean Spivey/NZDF**

Scott Base Redevelopment

Three-stage masterplan to futureproof Scott Base for science

A new plan has been developed to ensure New Zealand has a fit-for-purpose base in Antarctica to support and enhance high-quality science.

An expert team is working towards submitting a Detailed Business Case for Cabinet approval in 2026, paving the way for the first stage to be completed by 2030.

The Scott Base Redevelopment Masterplan is a comprehensive document that sets out the development, design and management of the base over the next 50 years.

Broken into three stages, it was developed with design and engineering expertise and input from users, the science community and other stakeholders.

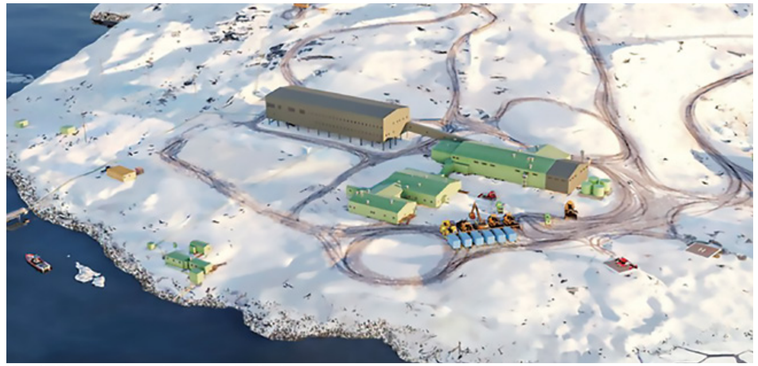
Stage 1 proposes the replacement of the oldest facilities that cannot be maintained beyond 5-10 years. This would ensure New Zealand maintains a credible presence in Antarctica.

As part of Stage 1, a new Base Services building will be constructed for living and accommodation, with the Hillary Field Centre refurbished for science activity.

Critical plant and services will be replaced or upgraded, along with the replacement of the Ross Island Wind Energy system to power Scott Base and McMurdo Station.

During the 2024/25 season, the construction team on ice completed the foundations for the new wastewater outfall and for one of the new wind turbines. The plan is to install the first turbine in 2025/26, with the other two scheduled for the following season.

The team also supported the United States Antarctic Program with its barge pier project at McMurdo.



Stage 1 of the masterplan would see a new Base Services building and the Hillary Field Centre refurbished.
© Antarctica New Zealand

Developing the masterplan and taking a long-term view of the redevelopment reduces up-front costs and project risk. However, it still addresses the most pressing needs to ensure New Zealand maintains a credible presence in Antarctica and facilitates the delivery of world-class scientific research.

The masterplan comes after the project was reset to ensure it could be delivered within budget. In 2024, an Independent Review recommended significant changes to its design, delivery and resourcing, which have now been implemented.

Concept design was completed in March 2025, and the second design phase, Preliminary Design, will be finished in the coming months.

LT McGuinness has been selected as the Early Contractor Engagement (ECE) contractor to assist with the design and delivery of the project. ECE will ensure cost efficiencies and inform the design.

Timelines and scope are subject to the Detailed Business Case sign off by Cabinet in 2026.

Events supported in the 2024/25 season

K#	TITLE	EVENT MANAGER	LEAD INSTITUTION	PRIMARY FUNDER	LOCATION
K012A	Emplacement to extinction: can crustal carbon release from magmatic heating cause extinction-level environmental change?	James Muirhead	University of Auckland	Marsden (Standard)	McMurdo Dry Valleys
K023A	Erebus subsurface geothermal microbes	Ian McDonald	University of Waikato	Marsden (Standard)	Mt Erebus
K043A	Rhodopsins: shedding new light on Antarctic sea ice microbes	Andrew Martin	Te Herenga Waka—Victoria University of Wellington	Marsden (Standard)	Southern McMurdo Sound sea ice
K044A	Ice core biomarkers	Holly Winton	Te Herenga Waka—Victoria University of Wellington	Marsden (Fast Start)	Terra Nova Bay
K051A	Southern Ocean connections: a metacommunity approach to understanding changes in the marine predator guild	Michelle LaRue	University of Canterbury	Rutherford Discovery Fellowship	Cape Crozier
K053A	How is Antarctic sea ice defying the odds of climate change (EM Bird)	Wolfgang Rack	University of Canterbury, Alfred Wegener Institute, Australian Antarctic Division	Marsden (Standard)	Scott Base to Casey station
K060A	Space weather monitoring (AARDDVARK)	Craig Rodger	University of Otago	University of Otago	Scott Base and Arrival Heights
K062B	Tere Tipako Tio: rapid extensive Antarctic ice sampling	David Prior	University of Otago	MBIE (Smart Idea)	Windless Bight, McMurdo Ice Shelf
K064A	Source and impact of greenhouse gases in Antarctica 'SENECA 2'	Gary Wilson, Livio Ruggiero	University of Waikato, Programma Nazionale di Ricerche in Antartide (PNRA)	PNRA	McMurdo Dry Valleys
K082A	Antarctic seafloor seeps: a driver of ecosystem change?	Sarah Seabrook	NIWA	Marsden (Standard)	Cape Evans, Granite Harbour
K083E	Ross Sea region research and monitoring programme (Ross RAMP) emperor penguins	Birgitte McDonald	NIWA, Moss Landing Marine Laboratories	NSF	Cape Crozier
K085A	Antarctic atmosphere composition – observing changes in greenhouse and reactive gases	Dan Smale	NIWA	NIWA	Scott Base and Arrival Heights
K089A	Climate data acquisition	Jeremy Rutherford	NIWA	NIWA	Scott Base and Arrival Heights
K091A	MPI pre-recruit toothfish survey	Sophie Mormede	SoFish Consulting	MPI	Ross Sea
K102A	GNS magnetic instrument	Tanja Petersen	GNS Science	GNS Science	Scott Base, Arrival Heights, and Cape Evans
K123A	Soil climate stations	Fraser Morgan	Manaaki Whenua	Manaaki Whenua	Scott Base and McMurdo Dry Valleys
K150A	Absolute gravity, tide gauge calibrations and historic hut surveys	Matt Amos	Toitū Te Whenua Land Information New Zealand	Toitū Te Whenua Land Information New Zealand	Scott Base and Cape Roberts
K150B	SouthPAN	Matt Amos	Toitū Te Whenua Land Information New Zealand	Toitū Te Whenua Land Information New Zealand	Arrival Heights
K467A	HMNZS Aotearoa NZDF Science	Annie Robertson	New Zealand Defence Force	NZDF, multiple research organisations	Ross Sea
K850A	Aerial photography of Ross Island Adèlie penguin colonies	Esme Robinson	Antarctica New Zealand, Manaaki Whenua	MBIE (Database of National Significance)	Ross Island
K862A	Drilling for climate, ice and ocean history: science KIS3	Richard Levy	GNS Science, multiple international partnerships[1]	SWAIS2C, Antarctic Science Platform	Ross Ice Shelf
K862B	Drilling for climate, ice, and ocean history: drilling KIS3	Darcy Mandeno	GNS Science, multiple international partnerships[1]	SWAIS2C, Antarctic Science Platform	Ross Ice Shelf
K865A	Seasonal velocity changes of the Ross Ice Shelf	Nick Golledge	Te Herenga Waka—Victoria University of Wellington	Antarctic Science Platform	Ross Ice Shelf
K872B	Polynya and ice edge processes – ice shelf instrumentation	Craig Stewart	NIWA	Antarctic Science Platform	Ross Ice Shelf
K881B	Ross Sea region Ecosystem Dynamics: AWS install and maintenance	Marwan Katurji	University of Canterbury	Antarctic Science Platform	McMurdo Dry Valleys
K881D	Morozumi Range Biodiversity project	Ian Hawes	University of Waikato, Monash University	Antarctic Science Platform, SAEF	Morozumi Range
K882A	Ross Sea region Ecosystem Dynamics: benthic sentinel Sites	Vonda Cummings	NIWA	Antarctic Science Platform	Cape Evans
K882C	Ross Sea region Ecosystem Dynamics: fishes and sponges	Ian Hawes	University of Otago	Antarctic Science Platform	Cape Evans and Barne
K882U	Ross Sea region Ecosystem Dynamics – Long Term Ecological Research (LTER) collaboration (SLIME)	Ian Hawes	University of Waikato	Antarctic Science Platform	McMurdo Dry Valleys
K884A	Functional attributes of Antarctic sponge communities	Ian Hawes	University of Waikato, Alfred Wegener Institute, Wageningen University and Research	Antarctic Science Platform	McMurdo Sound sea ice
K891A	Interannual variability of sea ice in the Ross Sea	Inga Smith	University of Otago	Antarctic Science Platform	McMurdo Sound
K892A	Platelet ice as a habitat	Natalie Robinson	NIWA	Antarctic Science Platform	McMurdo Sound

1. The SWAIS2C Project Manager is GNS Science and the Drilling Services Provider is Te Herenga Waka—Victoria University of Wellington. Logistical support comes from Antarctica New Zealand (K862A-2324, K862A-2425) in collaboration with the United States Antarctic Program. Drilling is partly funded and supported by the ICDP. Significant additional funding and in-kind contributions have been provided by the Natural Environment Research Council, Alfred-Wegener-Institute Helmholtz Centre for Polar and Marine Research, Federal Institute for Geosciences and Natural Resources, National Science Foundation (NSF-2035029, 2034719, 2034883, 2034990, 2035035, and 2035138), German Research Foundation (grants KU 4292/1-1, MU 3670/3-1, KL 3314/4-1), Istituto Nazionale di Geofisica e Vulcanologia, Korea Polar Research Institute, National Institute of Polar Research, Antarctic Science Platform (ANTA1801), LIAG Institute for Applied Geophysics, AuScope, and the Australian and New Zealand IODP Consortium. This project is the first in Antarctica for the International Continental Scientific Drilling Project (ICDP) and follows on from other successful international Antarctic research programmes such as ANDRILL. More than 120 people from around 50 international research organisations are collaborating on the SWAIS2C project. SWAIS2C brings together researchers from New Zealand, the United States, Germany, Australia, Italy, Japan, Spain, Republic of Korea, the Netherlands, and the United Kingdom.

Acknowledgements

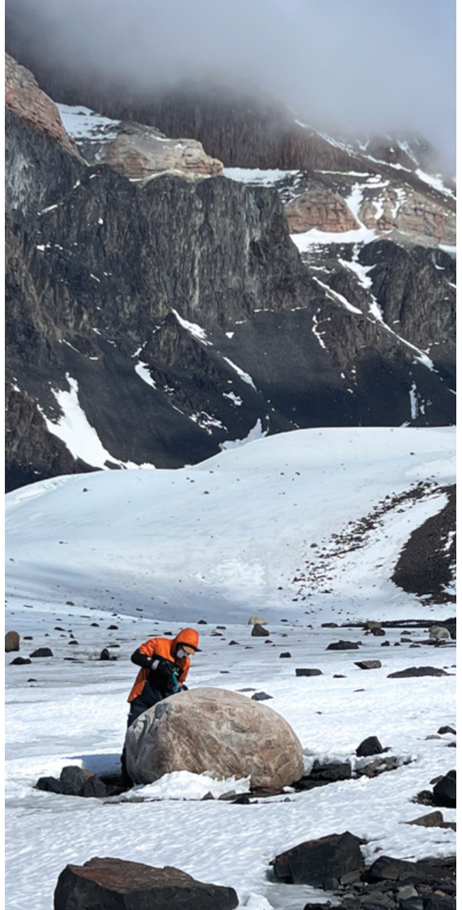
We would like to acknowledge our research partners, and support from the following funding agencies:

Research institute partnerships

- Auckland University of Technology I Te Wānanga Aronui o Tāmaki Makau Rau
- Cawthron Institute
- GNS Science I Te Pū Ao
- Lincoln University I Te Whare Wānaka O Aoraki
- Manaaki Whenua Landcare Research
- National Institute of Water and Atmospheric Research (NIWA) I Taihoro Nukurangi
- Te Herenga Waka—Victoria University of Wellington
- Toitū Te Whenua I Land Information New Zealand (LINZ)
- University of Auckland I Waipapa Taumata Rau
- University of Canterbury I Te Whare Wānanga o Waitaha
- University of Otago I Ōtākou Whakaihu Waka
- University of Waikato I Te Whare Wānanga O Waikato

Funding agencies

- Antarctic Science Platform
- Deep South National Science Challenge I Te Kōmata o Te Tonga
- Marsden Fund I Te Pūtea Rangahau a Marsden
- Ministry of Business, Innovation and Employment I Hīkina Whakatutuki



The K881D team collecting rock samples in the Morozumi Range.
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Publications

The 78 papers listed below were published in the 2024 calendar year, by researchers who received Antarctica New Zealand support.

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All publication figures in this document were informed from the most up to date information at the time of publishing in June 2025. They are provisional until verified.

Acknowledgements

We would like to acknowledge the following people who provided valuable contributions to the preparation of this document: Deborah Diaz, Michael Meredyth-Young, Annie Robertson, Esme Robinson, Bridget Rutherford, the 2024/25 Science Event Managers, and the authors and contributors to the 2024/25 Antarctica New Zealand Immediate Science and Metadata Reports.

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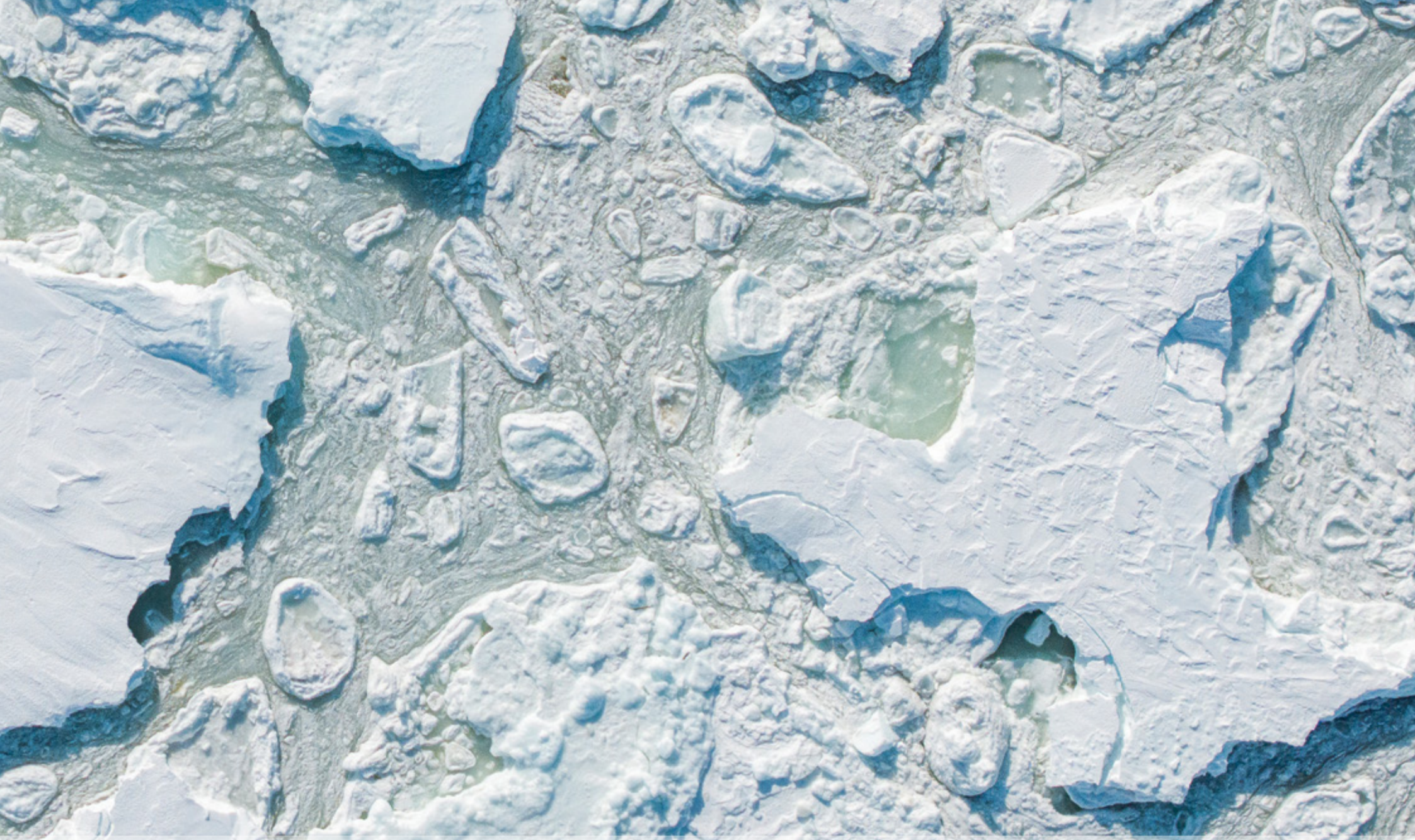

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