ACEAS

Australian Centre for Excellence in Antarctic Science

ACEAS 2025
ANNUAL REPORT HIGHLIGHTS

Director's Message

In 2025, ACEAS accomplished some of its most comprehensive research to date, delivering science which matters for Australia and the world. The year's defining effort was the Denman Marine Voyage. This followed two seasons of the Denman Terrestrial Campaign and linked land-based and ocean-based observations across this critical transition zone for the very first time.

Aboard RSV *Nuyina*, teams collected data and samples to build a more complete picture of how ocean, ice and atmosphere processes interact to accelerate change at the Denman Glacier – a system of global significance.

Field campaigns were complemented by internationally recognised research outputs. ACEAS-led research published in *Nature* showed key Antarctic systems – including sea ice, ice shelves and deep ocean circulation – are now undergoing rapid, self-reinforcing abrupt changes, with major global consequences. Meanwhile, our high-resolution modelling showed the Antarctic Circumpolar Current could slow markedly under high-emissions scenarios, and groundbreaking work on subglacial hydrology revealed the potential for much faster future ice discharge and sea level rise. Together, these studies sharpen our projections and highlight how urgently the world needs this knowledge.

Importantly, 2025 also saw a new momentum in how we delivered policy-relevant science. Through targeted policy briefings, new science explainers, and policy engagement events – including presentations at Parliament House and the Shine Dome in Canberra, and to COP30 in Brazil – we provided clear, timely insights to elected leaders and policy practitioners, ensuring Australian and global decision makers have access to the best available Antarctic research.

I am deeply proud of the dedication shown across the ACEAS community. The year ahead will be pivotal, as we build on 2025's achievements and continue delivering science that directly informs policy, planning and Australia's climate resilience.

Matt King – Director

Chair's Message

2025 has been a year that affirmed both the global importance of Antarctic science and Australia's leadership in it. As climate risks from East Antarctica and the Southern Ocean continue to materialise, the need for a long-term vision has never been clearer.

Australia's major voyage to the Denman Glacier in East Antarctica – many years in the making – stands as a testament to what Australia can achieve when we commit to ambitious, collaborative Antarctic science. As the first dedicated science mission aboard Australia's world-leading icebreaker RSV *Nuyina*, the Denman Marine Voyage brought together around 60 researchers from ACEAS, AAPP, SAEF and AAD to study one of the fastest retreating glaciers in East Antarctica.

The Denman Glacier is a colossal system perched above the deepest land trench on the planet and holds enough ice to raise global sea levels by 1.5 metres if fully melted. Understanding this region is essential for Australia's climate preparedness, coastal planning and regional stability.

The Commonwealth Government December announcement of stop-gap funding for ACEAS signalled welcome support for our researchers. We are grateful for this interim commitment and the recognition it brings, especially in a tight funding environment.

As we look ahead, ACEAS remains a symbol of what coordinated national capability can achieve. With every milestone, we deepen our understanding of a rapidly changing region whose future is inseparable from our own.

Mary O'Kane – Chair

Credit: Pete Harmsen / AAD

Report Highlights

33 postdoctoral researchers employed

19 PhD students supported by top-up scholarships

38 participants in major international fieldwork programs

161 attendees at ACEAS Research Forum

3 new explainers and 2 new policy briefings published, accompanied by one-on-one briefings and policy events

Completed the landmark Denman Marine Voyage – this was the most ambitious ship-based science program undertaken by Australia for many decades and the first marine science voyage aboard the RSV *Nuyina*

Contributed to the Scientific Committee for Antarctic Research (SCAR) scientific research programs, notably through SCARFISH, helping support best practice in Southern Ocean fish modelling for research and management

Created an *Impact, Engagement and Equipment Program* that competitively awarded $500,000 to projects that enhanced impact or engagement with policymakers, the public, or end users

Increase in social media followers, from 5,400+ to 9,700+ in a one-year period

Increase in website visits from 11,800+ to 31,500+ in a one-year period

130 journal articles published. 16 in high-profile journals / 91% in top-quartile discipline journals

17 workshops, sessions and events for ECR development

Further inroads to gender parity in our Chief Investigators, with 18 women researchers as Chief Investigators of ACEAS (out of 43 total)

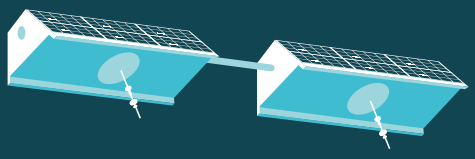
Provided 9 ship-to-classroom calls from the Denman Marine Voyage, engaging more than 500 students aged between 4 and 18 years from Australia, the United States, and Germany in real-world Antarctic science

Co-hosted the FishMIP Regional Modelling Workshop in Hobart, bringing together marine ecosystem researchers from across the globe to help project the future of fisheries and marine ecosystems under rapid environmental change

Successful art and science partnership with a Tasmanian-based arts organisation to produce science-informed artworks which were used at engagement events in Canberra

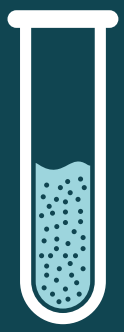
Organised and delivered the *Southern Ocean Bio-optics Workshop: Reconciling bio-optics, photophysiology and floristics in the PACE era*, helping facilitate new and innovative ways to measure and understand change in the Southern Ocean

PROGRAM HIGHLIGHTS



Demonstrated a long-term decline in Antarctic Bottom Water since 1992, with satellite technology enabling year-round monitoring of dense water formation

Generated new insights into Antarctic ice–ocean interaction by enabling Australia's ACCESS OM3 model to simulate ice shelf cavities for the first time



Advanced understanding of Southern Ocean productivity through studies of trace metals, bio-optics, and under-ice biogeochemistry, supported by international workshops

Revealed likely subglacial meltwater pathways beneath the Denman Glacier and established a new model of crustal structure and geothermal heat flow for Wilkes Land

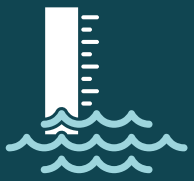
Revealed how heat moves across the Antarctic Circumpolar Current through deep ocean processes, improving estimates of global heat and carbon transport

Seamap Antarctica

Successfully completed elephant seal tagging campaigns at Kerguelen and Macquarie Islands

Completed and launched a federated open-access platform integrating seafloor imagery, habitat data and environmental layers across the Southern Ocean

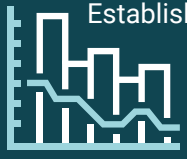
Led a circumpolar assessment of Antarctic seafloor biodiversity, identifying new hotspots linked to cold, food-rich shelf waters and conservation priorities



Improved estimates of Antarctic Ice Sheet mass loss and sea level rise using new satellite gravity data and updated assessments of long-term land movement

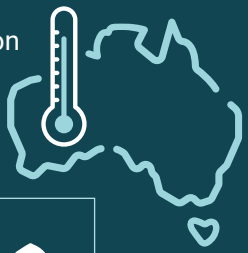
Delivered policy-focused outputs, including the *Climate Change Impacts on Southern Ocean Fisheries* briefing, strengthening links between science and decision-making

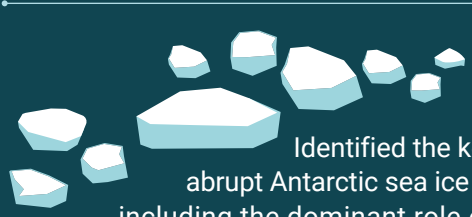
Improved understanding of Antarctic land uplift, hidden sediment layers beneath the ice, and the evolution of major basins using combined ground-based and modelling techniques



Established new geological and geochemical reconstructions of Southern Ocean and Antarctic margin evolution, strengthening projections of future ice sheet change

Delivered policy-relevant insights on Antarctic climate risk, contributing directly to Australia's National Climate Risk Assessment





Identified the key drivers of the abrupt Antarctic sea ice decline in 2016, including the dominant role of the Southern Annular Mode and newly recognised under-ice mixing

Co-delivered the flagship Denman Marine Voyage, collecting extensive new bathymetric, geological, oceanographic and biological data from a previously under-sampled region

Credit: Pete Harmsen / AAD

Denman Marine Voyage

The Denman Marine Voyage (DMV) marked a major milestone for ACEAS, transforming a long-term scientific vision into a fully realised, collaborative expedition to one of East Antarctica's most remote and consequential glacier systems. As the first dedicated marine science voyage aboard Australia's research icebreaker, RSV *Nuyina*, the DMV brought together about 60 researchers from ACEAS, AAPP, SAEF and the AAD to investigate the ocean–ice–atmosphere interactions shaping the future of the Denman Glacier – an ice system with the potential to raise global sea levels by 1.5 metres if fully melted.

For ACEAS, the voyage represented the culmination of years of planning to access a region traditionally blocked by heavy sea ice. The mission built directly on the Denman Terrestrial Campaign, extending observations from the land-based ice sheet to the ocean side, where warm water incursions and shifting circulation patterns may be accelerating ice loss.

ACEAS scientists played central roles in coordinating multidisciplinary research spanning physical oceanography, hydrochemistry, trace metals, atmospheric processes and ecosystem studies. Using tools such as CTD casts, moorings, gliders, sediment coring, bathymetric mapping and biological sampling, the team worked around the clock to characterise the drivers of glacier change and the sensitivity of the surrounding environment.

The DMV's integrated approach is already reshaping understanding of East Antarctica's vulnerability. Early findings highlight the importance of subtle ocean temperature shifts, nutrient-rich meltwater pathways and the unique biodiversity of the seafloor and water column. Much analysis still lies ahead, as researchers begin the detailed work of interpreting and synthesising the extensive datasets collected. These insights will feed into improved climate models and long-term monitoring strategies, strengthening Australia's capacity to anticipate regional and global impacts of Antarctic change.

Reaching the Denman Glacier was a core ambition embedded in the original 2019 proposal for ACEAS. The DMV stands as a flagship ACEAS achievement – demonstrating the power of coordinated and collaborative national science, advancing critical knowledge of a rapidly evolving system and strengthening Australia's leadership in Antarctic climate science.


Credit: Pete Harmsen / AAD

ACEAS Research

The Antarctic environment is undergoing abrupt and interconnected change

ACEAS's former Deputy Director and Chief Investigator, Professor Nerilie Abram (now Chief Scientist for the Australian Antarctic Division), along with colleagues from ACEAS, AAPP, SAEF and AAD, led a landmark study and meta-analysis published in *Nature* which revealed that Antarctica is undergoing rapid, unexpected and interconnected shifts across the ice, ocean, atmosphere and ecosystems. The paper challenged long-standing assumptions on stability in the Antarctic region and received significant press coverage.

An Australian policy briefing and a global policy briefing have since been developed from the paper and shared with decision makers. In addition, a panel of Australian scientists, including ACEAS Deputy Director Professor Matthew England, presented the research to COP30 in November 2025, helping inform global climate negotiations.

PAPER: Abram, N.J., Purich, A. and England, M.H. *et al.* (2025) 'Emerging evidence of abrupt changes in the Antarctic environment', *Nature*, 644, pp. 621–633. DOI:10.1038/s41586-025-09349-5.

Vast hidden network of lakes and streams beneath Antarctica revealed

A study led by ACEAS Chief Investigator Dr Chen Zhao and published in *Nature Communications* revealed that vast hidden networks of lakes and streams beneath the Antarctic ice sheet – known as subglacial water – may dramatically accelerate ice flow into the ocean. Their simulations show that accounting for evolving subglacial water pressure could triple projected ice discharge compared with conventional models, potentially adding more than two metres to global sea level rise by 2300.

PAPER: Zhao, C., Gladstone, R. and Zwinger, T. *et al.* (2025) 'Subglacial water amplifies Antarctic contributions to sea level rise', *Nature Communications*, 16, Article 3187. DOI:10.1038/s41467-025-58375-4.

Key Antarctic current could slow by up to 20% by 2050 under high-emissions scenario

ACEAS researcher Dr Taimoor Sohail and colleagues published a significant study in *Environmental Research Letters* showing that under a high-emissions scenario, the Antarctic Circumpolar Current (ACC) – the world's strongest ocean current – could slow by up to 20% by 2050 due to freshwater input from melting Antarctic ice. The ACC is a critical part of the global ocean conveyor belt – linking the Pacific, Atlantic and Indian Oceans – and a slowdown could have major implications for global climate and ocean circulation.

PAPER: Sohail, T., Gayen, B. and Klocker, A. (2025) 'Decline of Antarctic circumpolar current due to polar ocean freshening', *Environmental Research Letters*, 20(3), Article 034046. DOI:10.1088/1748-9326/adb31c.

Strong seasonal melting dynamic could impact sea-level rise projections

ACEAS researcher Dr Fabio Boeira Dias and colleagues investigated how ocean heat reaches Antarctic ice shelves and drives basal melting, a major contributor to ice-sheet mass loss and sea level rise. They found that East Antarctic ice shelves experience strong seasonal melting linked to variations in ocean heat transport, while West Antarctic ice shelves show more persistent melt due to continuous inflow of warm deep water. This dynamic will be important to incorporate into models projecting future sea level rise.

PAPER: Boeira Dias, F., England, M.H. and Morrison, A.K. *et al.* (2025) 'Seasonal variability of ocean heat transport and ice-shelf basal melt around Antarctica', *The Cryosphere*, 19, pp. 5231–5258. DOI:10.5194/tc-19-5231-2025.

ACEAS launches new policy briefings and explainer series

In 2025 ACEAS launched a new explainer series and published new policy briefings helping translate complex Antarctic and Southern Ocean science to non-specialists. This supports our goal to inform decision making and policy development, and improve the public's understanding of Antarctic and Southern Ocean science.

The first explainer *Why Antarctica matters to Australia* was released in July and explored the strong connection between the continents – and the implications of Antarctica's rapidly changing environment for Australia's weather, climate, ecosystems and coastlines.

In September, a policy briefing based on the globally significant study led by ACEAS former Deputy Director, Professor Nerilie Abram (now Chief Scientist for the Australian Antarctic Division), titled *Abrupt changes in the Antarctic environment* was developed. ACEAS and AAPP organised a mailout of the publication, along with two previous publications, to more than 400 Australian parliamentarians, NGOs and journalists. One-on-one briefings with politicians were provided upon request by ACEAS Director Professor Matt King and AAPP Leader Professor Delphine Lannuzel.

In late October, ACEAS released a specialist Antarctic fur seals explainer to coincide with the annual meeting of the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) talks held in Hobart, helping provide robust science to inform international decision-making.

In November, ACEAS published a new explainer on the Meridional Overturning Circulation (MOC). This was distributed to more than 70 senior public servants at a showcase of Antarctic and Southern Ocean research held at the Shine Dome in Canberra, and continues to generate strong online traction via the ACEAS website.

Also in November, a panel of Australian scientists – including ACEAS Deputy Director Professor Matthew England – delivered a global policy briefing to COP30 delegates based on the abrupt change research. In December, the written publication of that global briefing was published on the *Antarctic Environments Portal*.

Engagement with decision makers

Delivering policy-relevant science in Canberra

In late November, ACEAS travelled to Canberra for two important engagement events with Australian decision makers.

At Parliament House on Monday 24 November, ACEAS scientists joined colleagues from AAPP and SAEF for a university-led Antarctic science reception hosted by the Parliamentary Friends of the Antarctic. Co-chaired by Senators Richard Dowling, Jonathon Duniam, and Peter Whish-Wilson, the event brought together federal parliamentarians and scientists to hear the latest insights and research about Antarctic and Southern Ocean science, all undertaken as part of the Australian Antarctic Program.

At the Shine Dome on Tuesday 25 November, more than 70 attendees from government, research and policy sectors came together for the ACEAS Showcase to explore how Antarctic science underpins Australia's national capabilities and informs decisions that matter for generations to come.

Cover Image Credit: Pete Harmsen / AAD

Australian Government
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