UK Antarctic Science Conference 2026

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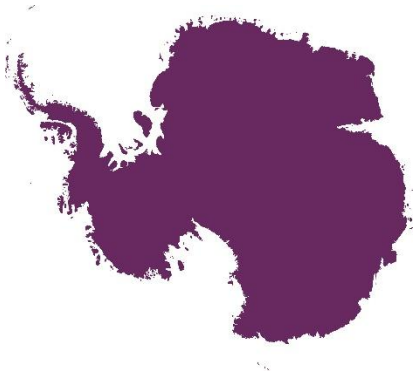
Abstracts



Carbon and Nitrogen Stable Isotope Analysis of Antarctic Macroalgae: a 35-Year Record for Environmental Change

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Carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) isotope analysis provides insights into nutrient uptake, productivity and response to environmental change. All available biogeochemical data for Antarctic macroalgae was collated for review, spanning a 35-year period from 1987−2022. Both $\delta^{15}N$ and $\delta^{13}C$ varied between species as well as spatially, $\delta^{13}C$ recorded a wider range (~25 ‰) than for $\delta^{15}N$ (~16 ‰). Spatial variation was assumed to be driven by site specific differences as well as latitudinal changes with light availability. $\delta^{13}C$ was more negative for the Rhodophyta phylum, however no significant difference was found between Rhodophyta and Phaeophyta and all recorded $\delta^{13}C$ values indicative of both passive CO_2 uptake and carbon concentration mechanism use. When plotted temporally, $\delta^{13}C$ showed variation with sea ice extent across the 35-year record. Within the last decade, both sea ice extent and macroalgae $\delta^{13}C$ became more variable, suggesting an unexplored link between primary producer response and sea ice instability. Significantly more research is required for stable isotope analysis of Antarctic seaweeds. Variability in both $\delta^{15}N$ and $\delta^{13}C$ will impact trophic food web studies, both spatially and temporally. There is a lack of data for sites outside of the Antarctic Peninsula as well as ~100 species currently having no data available. This review also highlights the potential for macroalgae to be an additional proxy for monitoring primary producer response to ongoing climatological changes for the Southern Ocean.

Stable Carbon ($\delta^{13}C$) and Nitrogen ($\delta^{15}N$) profiles of the brown seaweed *Himantothallus grandifolius*: a case study at Chiriguano Bay, Brabant Island, Antarctica

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Himantothallus grandifolius is a large brown seaweed endemic to the Southern Ocean that represents < 75 % of the benthic biomass. Stable carbon ($\delta^{13}C$) and nitrogen ($\delta^{15}N$) analysis can vary on a scale of ~1 ‰ to > 10 ‰ within a single organism, providing a proxy for photosynthetic method, nutrient sources and productivity. Incremental sub-samples were taken from eight blades from Chiriguano Bay in December 2024. Blades recorded significant variation in both $\delta^{13}C$ and $\delta^{15}N$, with depth and light the likely control over $\delta^{13}C$. Nitrogen showed no clear trend with depth. Incremental profiles showed cyclical trends in carbon, suggesting the seaweed changed photosynthetic method to utilise a carbon concentration mechanism (CCM) as energy demands increased across the growth period. Nitrogen became depleted ^{15}N from meristem to blade tip. Primary producer response to ongoing climate change is uncertain, this species may respond to an earlier sea ice break up with accelerated CCM use or become limited through increased turbidity. Establishing current biogeochemical data is key to assessing how this species productivity may change under future warming scenarios and how environmental proxy data could be recorded by tissue.

An updated census of southern elephant seals *Mirounga leonina* at South Georgia using satellite imagery

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As of the last comprehensive census in 1995, South Georgia supported ~54% of the global breeding population of southern elephant seals (Mirounga leonina). Since then, the absence of island-wide surveys has resulted in a 30-year gap in our understanding of this population. Local sensing efforts suggested stability, potentially slight growth. However, this remains unsubstantiated at an island scale. In 2023, highly pathogenic avian influenza (HPAI) was detected at South Georgia and was associated with substantial mortality, including an estimated ~47% reduction in breeding females elephant seals. These impacts necessitate re-establishment of a contemporary population baseline.

Here we present the first island-wide reassessment of the South Georgia breeding population since 1995. Very-high-resolution satellite imagery acquired during the 2024

and 2025 breeding seasons was combined with targeted UAV surveys for calibration and validation. Machine-learning detection methods were used to estimate breeding aggregations at surveyed colonies, and spatial models were applied to predict abundance at unsurveyed locations, enabling derivation of an island-wide population estimate with associated uncertainty. Using this approach, we estimate 107,630 (95% CI: 93,945 – 123,342) breeding females at South Georgia, compared to 113,444 (se = 4,902) in 1995. This corresponds to a total population of 373,474 individuals (95% CI: 325,991 - 427,997). In the context of recent HPAI-associated mortality, this updated baseline is indicative of a perturbed population, one that has been recently reduced from contemporary peaks, and should not be interpreted as evidence of stability since the last census in 1995.

This integrated remote-sensing and modelling framework will provide an updated population estimate and distributional baseline at a critical point in the species' recent history, allowing comparison with historical census data and improved assessment of recovery trajectories following HPAI impacts. The results will provide essential context for future monitoring and evaluation of environmental change influences on this globally significant Southern Ocean predator.

A Holocene relative sea level database for Antarctica

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The pattern of past sea-level change around Antarctica is complicated and records the complex interplay of barystatic sea-level change, solid Earth deformation in response to ice loading changes, and -gravitational effects. This record of relative sea level therefore has the potential to constrain models of these processes - especially glacial-isostatic adjustment (GIA) models - but to do so requires the data to be in a standard format. Here we compile indicators of past relative sea level from around Antarctica. These indicators come from raised beaches, isolation basins and other environments, and utilise a wide range of methods and dating approaches.

We present the data in a standard format, following the HOLSEA initiative. We report over 1200 sea-level data points most of which date from the Holocene but a significant number date from Marine Isotope Stages 2 and 3. These come from a wide range of sea-level indicator types; most are marine limiting or terrestrial limiting points but includes some sea-level index points where we can constrain both the former RSL and its tendency (rising or falling).

We discuss some of the challenges of such RSL records in Antarctica and limitations of the dataset, and highlight good practice for future work. We show here some of the patterns of sea-level change around Antarctica, and discuss some of the ways the dataset might be used to constrain models of ice sheet change and GIA.

Shallow-water benthic ecosystems of the Arctic and Antarctic: food web architecture and responses to climate change

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Polar marine ecosystems are undergoing some of the most rapid climate-induced changes on the planet. The Arctic has warmed at nearly quadruple the global average rate and is losing sea ice at a pace unmatched in the last 1500 years. Antarctica is warming at double the global average rate, and while the oceans have absorbed over 90% of excess anthropogenic heat energy since 1970, 75% of this heat capture was from the Southern Ocean alone. Predicting polar marine ecosystem responses to climate change is impeded by the fact that they remain some of the least researched ecosystems of any geographic region. This is particularly true for the benthos; though 90% of Arctic and Antarctic marine species are benthic, they have received far less research attention than their pelagic counterparts. The development of ecosystem management strategies that include the benthos is paramount and requires a comprehensive understanding of polar benthic ecosystem functioning. To advance this understanding, we will build detailed food web models using stable isotopes for shallow-water benthic ecosystems in Nuup Kangerlua, Greenland and at Rothera Point, West Antarctic Peninsula. As stable isotope turnover rates from seminal temperate studies are currently used to inform invertebrate trophic level assignment in polar food webs, we will also investigate and incorporate turnover rates for polar benthic invertebrates specifically. Finally, using a faecal output experimental methodology novel in food web research, we will calculate the rates of energy transfer between key food web branches and assess the impact of warming temperatures on those transfers.

Publishing Antarctic Data with the UK Polar Data Centre

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The value of data as a research output is being increasingly recognised by the scientific community, with emphasis on the importance of leveraging the FAIR (Findable, Accessible, Interoperable, Reusable) principles to support open science. Open data is not only required by the Antarctic Treaty (section III.1.c), but also by the data policies of journals and funders (such as NERC & UKRI). Beyond adherence to requirements, publishing your data with a trusted repository promotes innovation, collaboration and recognition for those involved, and has even been shown to increase article citations.

The UK Polar Data Centre (PDC) is one of five data centres forming the NERC Environmental Data Service. As part of British Antarctic Survey, it is a CoreTrustSeal-certified specialist repository for polar and cryospheric data. The PDC aims to increase access to open, FAIR data by supporting polar scientists with research data management activities such as data management planning, in-project data management, and the publication of datasets, alongside in-house development of data products such as portals.

We present an overview of the support offered by the PDC throughout the research data management lifecycle, highlighting critical considerations such as preparation of rich metadata, structuring data for reusability, applying relevant standards, and obtaining a DOI for your dataset.

Demystifying Data: a practical guide to research data management with the UK Polar Data Centre

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Open data are increasingly recognised as a valuable research output in their own right, and a fundamental part of the open science landscape. Making data open is also a requirement of funders, journals, and the Antarctic Treaty System. But knowing how to plan, manage, document, publish, and find data can be overwhelming.

The UK Polar Data Centre (PDC) is a CoreTrustSeal-certified specialist repository for polar and cryospheric data, supporting researchers at every stage of the data lifecycle. Whether you're writing a data management plan, organising files during a project, creating metadata, or getting ready to publish a dataset, we can help you make your data FAIR (Findable, Accessible, Interoperable, Reusable), maximising the benefits both for you and the wider scientific community.

This poster is a practical introduction to the research data lifecycle and the support we offer along the way. Bring your questions, challenges, or even that long-neglected dataset, and we'll do our best to help you move forward with confidence. Come and have chat so we can answer your questions and help you make the most of your research outputs.

Resilient Polar Expedition Well-being: The Role of Basic Psychological Needs

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Understanding what supports well-being among people living and working in Antarctica requires recognising that placements can have contrasting psychological consequences. Environmental and psychosocial demands may contribute to sleep disruption, negative affect and interpersonal tensions, while adaptation can foster self-sufficiency, well-being and personal growth. Yet polar resilience research has predominantly emphasised individual characteristics, prompting calls for socioecological explanations encompassing personal, relational and environmental resources. Drawing on Self-Determination Theory, this research examined whether satisfaction of autonomy, competence and relatedness explained associations between individual resources (personal resilience and coping flexibility), family, friend and community support, and nature connection with expeditioners' well-being and ill-being.

The mixed-methods programme comprised three studies: a cross-sectional survey (45 Antarctic; 50 Arctic), a daily repeated-measures study (2 Antarctic; 10 Arctic), and qualitative interviews (12 Antarctic; 10 Arctic). Study 1 supported the explanatory role of need satisfaction across levels: indirect effects operated primarily through autonomy for well-being and relatedness for ill-being. Coping flexibility and nature connection were directly associated with well-being. Family support related to well-being, friend support to lower ill-being, and community support to both. Study 2 showed convergence: daily need satisfaction predicted both outcomes, while nature relatedness and coping flexibility predicted well-being, with nature relatedness the strongest predictor. Study 3 identified multilevel challenges and supports, salutogenic nature experiences and identity-related marginalisation and safety concerns among women.

In conclusion, need fulfilment offers a mechanism connecting socioecological resources with resilient outcomes, providing a framework for developing needs-supportive preparation, from the individual to organisational levels for those working in Antarctica.

Antarctic sea ice and snow thickness retrievals in the Southern Ocean Marginal Ice Zone: A multi-frequency analysis with SWOT

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The marginal ice zone (MIZ) is a highly dynamic environment. Wind, waves and ocean currents displace and deform sea ice floes. Leads can open, refreeze and close rapidly. Satellites equipped with radar and laser instruments are the primary tools for observing sea ice over sustained periods of time and wide spatial extents. However, the dynamical processes in the MIZ make observing sea ice in this region complex and challenging.

Advances have been made with instruments onboard platforms such as CryoSat-2, ICESat-2 and Sentinel-3. However, retrievals of snow depth and sea ice thickness, both designated Essential Climate Variables, remain a challenge. The understanding of microwave scattering within the sea ice and snowpack is uncertain. Meanwhile, the current need for co-located sensors on separate platforms constrains spatial and temporal coverage, particularly important for the highly dynamic MIZ.

The SWOT satellite mission was launched in 2022 to observe Earth's surface water features. Year-round complete coverage of Antarctic sea ice, frequent orbital revisits and Ku-, C- and Ka-band instruments on a single platform make it an exciting mission for the sea ice community.

This research explores SWOT's capabilities for observing sea ice and snow thickness in the MIZ. Insights for existing and future missions, such as ESA's Sentinel-3, CryoSat-2 and CRISTAL, are presented. The different scattering ranges of SWOT's

Ku- and C-band nadir altimeters are analysed, with considerations of sea ice freeboard, ice/ocean surface roughness and lead-floe classification from SWOT's 120 km-wide swath Ka-band interferometer, KaRIn.

Elemental Accumulation in Hydrothermal Vent Fauna of the East Scotia Ridge

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Hydrothermal vents are deep-sea habitats, situated in areas of tectonic activity. Chemically distinct from surrounding sea water, hydrothermal vents are characterised by high temperatures, trace-element rich fluid and chemically reducing conditions. Hydrothermal vents support a large biomass of benthic macrofauna. However, hydrothermal fauna are constantly bathed in element-rich fluid. Many of these elements are considered essential elements, necessary for proper biological function but above species-specific thresholds, they become toxic. To further understand trace-element uptake by hydrothermal fauna as well as subsequent element-tissue partitioning, faunal samples from hydrothermally active regions of the East Scotia Ridge and Kemp Caldera were collected during the NERC-funded research expedition aboard the R.R.S James Cook Cruise, JC42. Samples were dissected, freeze-dried, ground into a homogenous powder and processed via a modified aqua regia digestion method. Tissue concentrations of macro-minerals (Mg, P, K, Ca, S, Sr), essential elements (Al, Si, V, Mn, Fe, Co, Ni, Cu, Zn, Se, Mo, Ba), and non-essential elements (As, Cd, U) were then quantified using Inductively Coupled Plasma Mass Spectrometry. Subsiquent data exploration via a PCA and analysis via Beta dispersion and PERMANOVA revealed significant differences in element uptake between species, as well as significant differences between individuals of the same species of different locations. As well as distinct patterns of tissue-element partitioning within species. As such, this study quantified element concentrations for fauna of the ESR and Kemp Caldera, strengthening understanding of factors influencing hydrothermal species-element accumulation at both a community and tissue level.

Polar Observation and Modelling Datasets to Facilitate Polar Research

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The UK Centre for Polar Observation and Modelling (CPOM) is a world leading research centre, funded by the Natural Environment Research Council (NERC) in partnership with the British Antarctic Survey (BAS). Led by Northumbria University, we work across 8 partner and associated universities in the UK.

CPOM have worked on providing observational and modelling products to the polar sciences community and beyond for 25 years. Following recent improvements to our data portals, here we share some of the datasets and model code available to facilitate and enhance polar research.

Our observational datasets include a land ice data portal, providing Surface Elevation Change data of the Greenland and Antarctic Ice Sheets measured from ESA Radar Altimetry Missions from 1991 to 2026 and Mass Change data for Antarctica. For sea ice research we provide Sea Ice Thickness, Volume and Mass Data with Arctic and Antarctic coverage, including Near Real Time Arctic sea ice products. Our portals provide this data in an accessible format with automatically generated visualisations available which we demonstrate here.

Furthermore, our expertise in modelling allows us to provide code and guidance on models such as MONARCHS, the only existing high fidelity model of Antarctic ice shelf surface hydrology.

Modelled Antarctic Ice Sheet loss during the Miocene Climatic Optimum

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When considering Antarctic Ice Sheet response during warmer palaeoclimates, models and proxies often disagree. One reason for this is that palaeoclimate models struggle to successfully reproduce the magnitude of polar amplification recorded during past warm periods. When these climate models are then used to force an ice sheet model, this cold bias at high latitudes means that mass loss is poorly represented and modelled ice sheets are more stable than suggested in proxy records. To reproduce widespread mass loss and retreat, ice sheet models therefore require increased CO_2 to well above what is recorded in proxy records. The Miocene Climate Optimum ~15-17Ma is an example of such a period where proxy records document warm temperatures, a smaller Antarctic Ice Sheet than today, and sea level 10s of meters above present, but models struggle to reproduce this without unrealistically increasing CO_2.

By forcing an ice sheet model (PSUISM) with a climate model (HadCM3B) that has been updated to include greater polar amplification we aim to capture surface melting and retreat of the Antarctic Ice Sheet, during the Miocene Climate Optimum, that more closely matches proxy records. Early results show, with the improved representation of polar amplification in the climate model, the ice sheet model produces greater ice loss even at low CO_2 levels. Future work will consider impacts of the changing ice sheet on the climate system by offline coupling of the models to include ice sheet-climate feedbacks from: changes in topography and freshwater input to the Southern Ocean.

Interannual variability of supraglacial drainage networks and meltwater transport across the Nansen Ice Shelf, East Antarctica

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Surface drainage on Antarctic ice shelves plays a critical role in influencing ice-shelf stability. This study investigates multi-decadal variability in surface meltwater extent and drainage connectivity on the Nansen Ice Shelf, where a waterfall provides a rare pathway for direct meltwater export to the ocean. These waterfalls may efficiently export surface meltwater to the ocean. However, the spatial and temporal variability of this meltwater export system has not been directly measured. Using multi-year Landsat satellite imagery, we investigate interannual variability in meltwater extent, drainage connectivity and the development of waterfalls in relation to major rifts and calving events. Preliminary observations indicate significant interannual variability in the extent of surface meltwater, the number of channels and their drainage areas. Meltwater extent does not scale proportionally with drainage connectivity, indicating that the Nansen waterfall is not fed by an ice-shelf-wide drainage system. Instead, it captures meltwater from a partial and interannually variable contributing area. We also identify a new transverse fracture that has disrupted the previously documented main drainage pathway to the waterfall, and we propose that meltwater from the inland portion of the ice shelf is now being rerouted through this fracture, potentially draining into the sub-ice-shelf cavity, while the lower ice-shelf region continues to be captured by the original waterfall terminus. These patterns suggest that the export capacity of the waterfall is dynamic and that it is driven both by meltwater availability and by ice shelf structure.

Accelerating range expansion and habitat occupation by the invading chironomid midge, *Eretmoptera murphyi*, on Signy Island, South Orkney Islands

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Eretmoptera murphyi is a sub-Antarctic fly native to South Georgia, where its palaeoendemic status has made it a key species in reconstructions of Antarctic and Southern Ocean island biogeography. However, it is also an invading species, inadvertently introduced further south to Maritime Antarctic Signy Island (South Orkney Islands) during plant transplant experiments in the 1960s. With its small size and cryptic behaviour, it was not immediately discovered and was first observed close to the original experimental site almost 20 years later, at that time with a very restricted local distribution and with only slow expansion recorded by the mid-1990s.

While there has been no regular monitoring, an assessment in the mid-2010s documented an acceleration in distribution expansion, although still limited to the local slopes close to the introduction site. Opportunistic sampling in early 2024 identified several individual occurrence locations beyond this limit, as well as recording abundant larvae in a moss habitat not previously noted. Lower intensity sampling across large parts of the island did not identify wider presence. Targeted survey in early 2026 confirmed more widespread presence beyond the previous limits, consistent with unassisted local dispersal of the adult flies. We consider implications for future dispersal, including for the newly-approved Signy Island ASPA.

The Antarctic Peninsula under present day climate and future low, medium-high and very high emissions scenarios

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The Antarctic Peninsula is warming rapidly, with more frequent extreme temperature and precipitation events, reduced sea ice, glacier retreat, ice shelf collapse, and ecological shifts. Here, we review its behaviour under present-day climate, and low (SSP 1–2.6), medium-high (SSP 3–7.0) and very high (SSP 5–8.5) future emissions scenarios, corresponding to global temperature increases of 1.8 °C, 3.6 °C and 4.4 °C by 2100. Higher emissions will bring more days above 0 °C, increased liquid precipitation, ocean warming, and more intense extreme weather events such as ocean heat waves and atmospheric rivers. Surface melt on ice shelves will increase, depleting firn air content and promoting meltwater ponding. Under the highest emission scenario, collapse of the Larsen C and Wilkins ice shelves is likely by 2100 CE, and loss of sea ice and ice shelves around the Peninsula will exacerbate the current trends of land-ice mass loss. Collapse of George VI Ice Shelf by 2300 under SSP 5–8.5 would substantially increase sea level contributions. Under this very high emissions scenario, sea level contributions from the Peninsula could reach 7.5 ± 14.1 mm by 2100 CE and 116.3 ± 66.9 mm by 2300 CE. Conversely, under the lower

emissions scenarios, the Antarctic Peninsula's sea ice remains similar to present, and land ice is predicted to undergo only minor grounding line recession and thinning. Changes in sea surface temperatures and the change from snow to rain will impact marine and terrestrial biota, altering species richness and enhancing colonisation by non-native species. Ranges of key species such as krill and salps are likely to contract to the south, impacting their marine vertebrate predators. These changing conditions will also influence Antarctic Peninsula research, fisheries, tourism, infrastructure and logistics. The future of the Peninsula depends on the choices made today. Limiting temperatures to below 2 °C, and as close as possible to 1.5 °C (by following the SSP 1–1.9 or 1–2.6 scenarios), combined with effective governance, will result in increased resilience and relatively modest changes. Any higher emissions scenarios will damage pristine systems, cause sustained, irreversible ice loss on human timescales, and spread to Antarctic regions beyond the Peninsula.

Controls on the distribution of Antarctic ice tongues

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Ice tongues are unconstrained, floating extensions of marine-terminating outlet glaciers which are found intermittently around the Antarctic coastline. They may extend tens of kilometres into the Southern Ocean and can therefore impede sea-ice movement and ocean surface currents, making them highly important for coastal polynya formation and ice-marginal ecosystems. Such direct exposure to ocean conditions means that ice tongues may also serve as valuable early-warning signals of environmental change. Previous studies suggest that basal melt and landfast sea ice may be important controls on ice tongue formation and stability. However, the spatial and temporal prevalence of ice tongues around Antarctica, as well as the factors governing their distribution, remain poorly constrained. Here we present results from the first effort to systematically map all Antarctic ice tongues and investigate controls on their formation, defining ice tongues as glacier extensions that are longer than they are wide. Analysis of optical and synthetic aperture radar imagery in Google Earth Engine reveals 58 Antarctic glacier tongues present during the 2023–24 austral summer, while an additional 24 outlet glacier extensions narrowly fall outside our definition, which we refer to as quasi-ice tongues. Nearly all ice tongues are found in East Antarctica, with a particular concentration in Victoria Land and Oates Land, and range from ~1.2 to 133 km in length. We digitise all identified ice tongues and derive key geometric and ice-dynamic characteristics, integrating these with oceanographic, atmospheric and sea-ice datasets to attempt to identify the dominant controls on their formation and distribution.

The RRS Sir David Attenborough UK polar research vessel: science systems update and ways to access

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The RRS Sir David Attenborough (SDA) is the UK's polar research vessel. Since 2023 it has delivered complex multidisciplinary science cruises in the Antarctic and the Arctic. These science cruises have utilised capabilities such as the trace metal clean facilities (Ti CTD, clean sampling labs), coring facilities including a Multi-Sensor Core Logging (MSCL) container; ability to host helicopters for field party input and a science workboat with its own acoustic sensors and winch for shallow water work. The next exciting phase is commissioning of its Giant Piston Coring facility. We present an overview of these capabilities, including improvements made to the vessel (e.g. modifications to the uncontaminated water system, changes in trim) to improve science systems, and tests of moonpool function to provide confidence in its use to the science community.

The SDA not only supports marine science cruises, but it is also the key logistic vessel to supply the UK's Antarctic stations including supporting the Antarctic Infrastructure Modernisation Programme. We will outline the proposed complex itinerary, highlighting some of the challenges coming up in the next 5 years. We will also summarise the ways in which the community can access the SDA for marine science cruises (Ship and Marine Equipment requests), berths during transits and not requiring ship-time (Collaborative Antarctic Science Scheme and Operational Support Planning Questionnaire), as well as adding instrumentation to the vessel for longer periods of time that have low supervision requirements (SDA User Equipment Installation).

Revealing buried continental landscape structure through residual analysis of Antarctic Ice Sheet surface elevation

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Large regions of the Antarctic Ice Sheet bed remain poorly resolved, despite controlling ice flow, sea-level rise and preserving a record of landscape evolution. The ice surface retains an imprint of the underlying bed. We apply Residual Surface Elevation (RSE) analysis across the grounded ice sheet, removing long-wavelength geometry from the Reference Elevation Model of Antarctica to isolate kilometer-scale texture without imposing ice-sheet physics. The resulting 'texture' map resolves rugged terrain, basins and uplands, previously unrecognized drainage networks and structural lineations in data-sparse regions. In Dronning Maud Land, a dendritic drainage system crosses modern ice divides, indicating ancient landscape preservation. In the Gamburtsev Subglacial Mountains, RSE reveals extensive foothills beyond maps the well-surveyed, high-relief core. These rough, high-relief landscapes are more widespread than previously recognized. By capturing landscape structure and roughness, we suggest RSE inform ice-sheet modelling as a frictional control and identify, near grounding lines, future potential pinning points.

Strategic Imperatives for UK Antarctic Science: Aligning Science Drivers and Policy Frameworks for IPY-5

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The rapid transformation of the Antarctic region presents fundamental risks to global climate and biodiversity, as evidenced through sea-level rise, and loss of marine ecosystem functions, creating an urgent mandate for sustained UK polar research. The 5th International Polar Year (IPY-5, 2032–2033) offers a strategic operational and international window to address key scientific uncertainties and to improve our knowledge of tipping point and overshoot scenarios.

To maximize the impact of UK Antarctic investment, the research community must identify and clearly articulate its strategic position outlining core scientific priorities and their direct (and indirect) governance implications. This requires mapping key physical and biological scientific drivers directly to advice and actionable intelligence required by the Antarctic Treaty System, IPCC/IPBES/IUCN assessments, and global climate policy frameworks. Addressing these complex challenges requires integrated research across physical, environmental, and social sciences. By synthesizing cross-disciplinary priorities now, the UK community will establish clear research pathways, optimize infrastructure deployment, and ensure national polar capabilities deliver the robust evidence base necessary to inform future international governance and environmental policy.

Antarctic and Southern Ocean science into policy across spatial and temporal scales

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Antarctica and the Southern Ocean are experiencing rapid changes in response to global climate and environmental change, against a background of longer-term variability and trends. An increase in human activity in the region may be compounding these pressures and potentially accelerating the changes underway. Extreme events are becoming more common, abrupt shifts have been observed in multiple components of the coupled ocean-ice-land-atmosphere system, and important tipping points are being approached or even breached. Within this context, we examine the mechanisms by which scientific evidence informs governance for Antarctica and the Southern Ocean, at the regional scale (i.e., in the Antarctic Treaty System) and at the global scale through frameworks like the IPCC and IPBES. We consider the importance of timelines from long-term (decades to centuries, and longer) to medium-term (years to decades) to short-term (weeks to years) with respect to science informing policy, and in particular assess the capacity of each of these governance frameworks to account for and respond to extreme events, rapid shifts and potential tipping points. We highlight a substantial mismatch between the timescales over which policies are made and have influence and the timescales of change in Antarctica and the Southern Ocean. We also identify other challenges for effective policy implementation and make recommendations to improve incorporation of the best available science into regional and global governance and policy-making for Antarctica

and the Southern Ocean, and ultimately to strengthen the safeguarding of this critically-important region and its role in the Earth system.

Sources of ice-nucleating particles influencing the Southern Ocean and Antarctica

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Ice-nucleating particles (INPs) are a rare subset of aerosols that help to trigger ice formation in clouds. Over the Southern Ocean, they critically influence cloud properties and large-scale radiative flux profiles. Quantifying the regional and climatic impacts of INPs requires trustworthy models validated against robust observational ground truths. However, the rare nature of these particles, coupled with the challenging conditions presented by the Southern Ocean and Antarctica, has left models largely untested in this region.

This study leverages a novel dataset of 30,000 ambient INP measurements to develop an optimized method for linking simulated aerosol distributions to INP concentrations. This new approach reproduces INP measurements from across the globe, including the Southern Ocean, obtained using different instruments and techniques and outperforms existing alternatives. Having established a validated modelling framework, we can identify the specific sources of aerosol particles driving high-latitude Southern Hemisphere cloud glaciation and project how they may evolve under future climate scenarios.

Subglacial cosmogenic nuclide and luminescence evidence of Quaternary West Antarctic Ice Sheet deglaciation

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Direct access to the bed of the Antarctic Ice Sheet, and analysis of its subglacial sediments has long been proposed as one way to determine which parts of the ice sheet lost mass and contributed to past interglacial sea-level high stands. However, direct access to, and sampling of, subglacial environments has remained technically challenging. Carrying out the deepest West Antarctic Ice Sheet hot water drilling to date we extracted a 12 cm core from the bed 2.2 km under the Rutford Ice Stream. Analyses of the geological provenance of the subglacial till and its exposure history show that it was sourced from rock outcrops on the southwestern side of the Ellsworth Mountains and the ice sheet interior, with parts of it last exposed to sunlight during Marine Isotope Stage 6. In situ cosmogenic nuclide inventories in the subglacial till are similar to, or greater than, those measured in the source areas above the ice sheet today and exceed those previously used to infer deglaciation of the Greenland Ice

Sheet. This suggests last interglacial transport of large volumes of subaerially exposed rocks into the subglacial till via tidewater glaciers and icebergs, consistent with seaways being established between the Weddell and Amundsen Seas resulting from the loss of marine based sectors of the West Antarctic Ice Sheet.

Ice, Ice, Babies! Larval Connectivity Modelling for Porifera Populations Beneath an Antarctic Ice Shelf Under Future Warming Scenarios

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The discovery of a sponge assemblage on a boulder beneath the Filchner-Ronne Ice Shelf (FRIS) in the Weddell Sea, Antarctica, was the first sessile life observed within an ice shelf cavity. This research utilises a hydrodynamic model operational within the WED025 domain – encompassing the Weddell Sea and surrounding ice shelves – to investigate whether pathways of larval connectivity exist between the sponge grounds of the Weddell Sea and the FRIS boulder assemblage. Within our model, the dynamics of the planktonic larval stage and the mature, sessile stage of phylum Porifera are parameterised, and it is the first of its kind in operation within the Weddell Sea. Several dispersal simulations have been conducted from multiple release sites, with each integration running for a duration of 25 years – the aim being to assess whether larval connectivity exists between sponge populations on Berkner Bank and the Eckström Shelf, and the boulder assemblage observed within the Filchner-Ronne Ice Shelf cavity. Ongoing research utilises the NEMO ocean model and predicted future climate scenarios to investigate how current pathways connecting sponge populations may be influenced by changing water masses within the Weddell Sea and beneath the FRIS.

Reconstructing Antarctic Sea Ice across Past Climate States via Marine Proxy Data Synthesis

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Antarctic sea ice is integral to the climate system; regulating ocean-atmosphere heat exchange, supporting Southern Ocean ecosystems, and shaping global ocean circulation. However, its pronounced seasonal and regional variability, together with the short duration of satellite observations, makes it difficult to place recent changes in a longer-term context to enable predictions of its future trajectory.

As part of the EU Horizon Past-to-Future (P2F) project, we are compiling, integrating and re-evaluating marine proxy evidence to define the states and variability of Antarctic sea ice across key intervals, including the Mid-Holocene (~6a ka), Last Glacial Maximum (23-19 ka), Last Interglacial (130-115 ka) and mid-Pliocene Warm Period (3.264-3.025 Ma). These intervals encompass colder and warmer climates, atmospheric CO_2 concentrations below and above pre-industrial levels, and contrasting responses to different types of climate forcing.

The synthesis of past Southern Ocean sea-ice conditions uses evidence from diatom assemblages and lipid biomarker produced by sea ice-associated diatoms such as $IPSO_{25}$, alongside open-water productivity biomarkers and complementary palaeoceanographic evidence. Individual proxies vary in the seasons, environments and ecological processes they record, while their interpretation is influenced by analytical, ecological, and calibration uncertainties.

Harmonising and mapping records within a multiproxy approach will enable reconstruction of past sea ice extent and spatial variability, revealing regional patterns, transitions and critical data gaps. The sea ice marine proxy record synthesis will support Earth System Model data-model comparison to improve understanding of climate processes, abrupt transitions and potential tipping points.

Sedimentology of the SWAIS2C Crary Ice Rise Core

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The international SWAIS2C team recovered 228 m of sediment core from beneath the Crary Ice Rise during the 2025-2026 drill season. This material is being used to investigate the sensitivity of the West Antarctic Ice Sheet to 2˚C of warming. In June 2026, the core was split and described at the Otago Repository for Core Analysis, New Zealand. Here, we present the preliminary overview of the Crary Ice Rise core, which identified five principal lithostratigraphic (LS1-5) units. The upper unit, LS1 (7 m), comprises diatom-rich to diatom-bearing clast-rich muddy diamict. LS2a (29 m) contains mud-rich diatom ooze with dispersed to common clasts. LS2b (16 m) additionally has contorted bedding, suggesting intensified deformation from sediment loading. LS3 (4 m) hosts stratified diatom-bearing clast-rich muddy diamict interbedded with diatom ooze. LS4 (148 m) is divided into three sub-units (LS4a-c). LS4a (44 m) and LS4c (103 m) consist of massive diatom-bearing clast-rich muddy to sandy diamicts, which are separated by a 1 m thick diatom-rich mud with weakly stratified sandy beds and common clasts (LS4b). LS5 comprises >24 m of mud-rich diatom ooze with abundant clasts. These lithostratigraphic units reflect transitions between subglacial and open ocean settings, with or without an ice shelf. Future work will aim to refine these depositional environments using information from sediment cores recovered from beneath extant ice shelves and to place these results in the context of WAIS variations during past warm periods.

The Ice Chemistry Facility at the British Antarctic Survey

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Here we present the Ice Chemistry Facility at the British Antarctic Survey (BAS) in Cambridge. The NERC national-capability-funded Ice Chemistry Facility is designed to facilitate the analysis of ice and snow samples for a wide range of science projects. The facility includes -23°C walk-in cold laboratories for sample storage, processing and preparation; a class-100 cleanroom for trace analyses and sample preparation; a bespoke continuous flow analysis (CFA) system coupled to a suite of analytical instrumentation; and an Ice Core Gas Laboratory for high-resolution discrete gas analyses.

The Facility offers analytical capabilities for ultra-trace elemental analysis, trace major ions, fluorometry, electrical conductivity; insoluble particulate size distribution, stable water isotopes; fraction collectors for the collection of discrete meltwater samples for subsequent analyses; and gas analysis. It should be noted that most of these techniques can be coupled to our CFA system for the efficient analysis of whole ice core records, or operated independently, for targeted higher-resolution analyses of discrete samples.

In addition, we can measure physical properties and conduct optical line-scanning and hyperspectral imaging of ice cores. The Gas Laboratory has a state-of-the-art total air content (TAC) system, and a dry extraction system for the concentration and isotopic composition of CO_2.

We will outline the process to access the facilities through the Facility and Science managers. Finally, we will present how the Beyond EPICA Oldest Ice (BE-OI) project recently used this facility for the Impurities analysis of the world's oldest continuous ice core record.

Sentinel-1 Synthetic Aperture Radar (SAR) Enables Year-Round Remote Sensing Observations of Emperor Penguins

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Emperor penguins are threatened by climate change and their population is predicted to decline rapidly this century in response to changes in Antarctic sea ice. Remote sensing is a key tool for monitoring emperor penguins but analysis has been restricted to spring/summer due to a lack of optical imagery during the polar night. In this study, we use Sentinel-1 synthetic aperture radar (SAR) data to observe the movement of penguin colonies throughout winter for the first time. We combine winter SAR imagery with Landsat 8-9 and Sentinel-2 medium-resolution summer optical imagery to track the year-round movement of colonies at Atka Bay, Coulman Island, and Cape Washington between 2017 and 2024. We find that although emperor penguins are less mobile than during summer, all three colonies exhibit movement in winter, but which varies between years and between colonies. At times, different groups within the colonies synchronously move away from the fast ice edge despite its apparent stability, suggesting that meteorological conditions may be a major influence on their movement. Additionally, we find that SAR can sometimes be used to identify guano on ice shelves during summer. We demonstrate that SAR is an important tool for understanding emperor penguin behaviour throughout their breeding cycle, and particularly their response to environmental forcing and change during winter. The ability to observe the species during winter also offers potential for monitoring and conservation efforts.

First Direct Observations of Dilute Antarctic Turbidity Currents

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Turbidity currents are increasingly recognised as a key mechanism for transporting large volumes of sediment into the deep ocean, yet their structure, catalysts, and long-term impact in Antarctic submarine canyons remain poorly understood. Using a year-long mooring in Wilson Canyon, western Ross Sea, equipped with an acoustic Doppler current profiler (ADCP), conductivity temperature depth sensor (CTD) and optical backscatter sensor (OBS), we recorded the first direct measurements of turbidity currents in Antarctica. The mooring documents a single event that lasted for thirteen days, exhibiting a distinct internal structure characterised by a dense frontal head containing coarse sediment and cold, saline water. This was followed by a prolonged body composed of finer sediment mixed with entrained ambient water, consistent with a forcing mechanism driven by dense shelf water (DSW) overflow. These observations support new insights into sediment resuspension and bottom water formation in Antarctic submarine canyons.

The current state of ice-shelf calving in numerical models

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There is currently poor confidence in the representation of ice shelf calving in numerical ice models used to predict the future sea level rise contribution of Antarctica. This has the potential to lead to an underestimate in these predictions when using these models. CalvingMIP (Calving Model Intercomparison Project) is an ongoing, community driven effort to address this key issue.

We present here results from thirteen different modelling groups that participated in the first phase of CalvingMIP experiments. These experiments focussed on the implementation of Calving algorithms (how models represent the calving process) within ice models, acting as a test on their capabilities.

We also present a framework for the soon to begin second phase of Calving MIP. This will focus on the impact of the chosen calving law (how much ice is calved over a given time period) on ice shelf behaviour.

Capabilities of new airborne NZArC-CReSIS ice-penetrating radar on Windracers ULTRA UAV

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Miniaturisation of radar technology and improving size, reliability and range of platforms means that the future of airborne radio-echo sounding is moving towards the use of uncrewed aerial vehicles (UAVs). UAVs have key advantages as logistical challenges (fuel placement and cost), and environmental considerations (CO2 emissions) come to the fore in polar research. The Windracers ULTRA UAV is a platform hosting the newly developed NZArC-CReSIS radar system, consisting of 4 H-polarised under wing antennas and 3 dual-polarised fuselage antennas, with 2 transmitting and 8 receiving channels. The radar has a centre frequency of 300 MHz (bandwidth of 250-350 MHz) and up to 1 kW peak power. The UAV platform has a wingspan of 10 m, speed of 39 m/s, and a flight range of 1000 km, and can co-host magnetometer and optical camera systems. Here, we present preliminary test results demonstrating the capabilities of the radar system conducted offshore in the UK. Ultimately the system will include deep-ice sounding, polarimetric, and swath-mode radar capabilities. The system will be deployed in Greenland at Petermann Glacier during the 2027 summer season, as part of the ARIA GIANT project. This will focus on the grounding zone of the glacier with a closely spaced swath-mode survey, as well as a 1 km spaced wider survey from the ice shelf front to 50 km inland.

A Dataset of Sediment Core Carbon Properties from the Southern Ocean and Wider Polar Front: Distribution, Composition, and Metadata for Future Blue Carbon Assessment.

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Pathways to marine carbon sequestration are poorly quantified around Antarctica yet are a key source of mitigating feedback on climate linked to biodiversity. Sediment carbon values from around the Southern Ocean and adjacent sub-Antarctic regions were collated and curated into the most comprehensive collection to date. Drawing from a range of sources this work compiled carbon data from over 2,000 sediment cores. Each entry is enriched with spatial, methodological, and supplementary metadata to improve consistency and allow for usability.

This database was generated through a combination of mechanised and manual approaches to address inconsistencies in reporting practices, variable carbon metrics, and gaps in spatial coverage. The result is a high-resolution, georeferenced dataset that supports improved understanding of benthic carbon storage across diverse oceanographic settings in the Southern Ocean. The full database is available on the UK Polar Data Centre hosted by the British Antarctic Survey website.

The dataset lays the groundwork for future research into carbon burial, biogeochemical zonation, and blue carbon stock assessments. The report also highlights the need for a standardised reporting framework to ensure compatibility across studies and sets out three recommendations to aid the development of the database constructed. The report recommendations focus on 1) database quality 2) Expansion of parameters and 3) the reporting framework. This resource contributes to global efforts to quantify marine carbon stocks and offers a critical step toward incorporating deep-sea and polar sedimentary environments into broader climate mitigation frameworks.

British Antarctic Surveys new Controlled Environmental Facility

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This presentation will be focussed on the opening of the British Antarctic Survey's (BAS) new Controlled Environment Facility (CEF) which includes the UK's only polar marine aquarium and three temperature-controlled laboratories, two of which can range from -5°C to +25°C, as well as -25°C, -80°C and +4°C sample storage. The British Antarctic Survey has held live Antarctic marine life in the UK since 1973. This facility brings the collection and husbandry of live animals into the modern day, engaging in the highest standards of animal welfare while ensuring scientific excellence. We will give examples of animals and samples held within the temporary facilities to highlight how scientists could use the facility in the future, allowing cross-institution collaboration on niche subsets of animals. Examples specified will include a cold microscopy project (Cold Case) which is a collaboration between BAS and the University of Cambridge Department of Chemical Engineering and Biotechnology (CEB) to provide a microscope that can view cells and proteins at 0°C.This links with Cell Culture work, to determine how *Harpagifer antarcticus* synthesise proteins at sub zero temperatures. BAS holds historical samples from as far back as 1940s, which can used to examining differences between historical and modern samples, and numerous long-term monitoring sample collections and datasets. This presentation aims to promote the open availability of this new facility for UK scientists and institutions.

From Antarctic Mosses to Southern Ocean Clouds: Ice Nucleation Activity and Its Molecular Basis

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Clouds exert a strong influence on the Antarctic climate system and their properties are sensitive to the availability of ice-nucleating particles (INPs), which trigger freezing in supercooled cloud droplets. Biological sources of INPs can be exceptionally active yet remain poorly characterised in Antarctic terrestrial ecosystems. During the 2024 Southern Ocean Clouds cruise, moss samples were collected from island stops in the South Orkney and South Georgia archipelagos. Microlitre droplet-freezing measurements of Antarctic moss extracts reveal two distinct classes of ice-nucleating macromolecules (INMs). Type A INMs are highly active, inducing ice nucleation around –7 °C and are heat-labile, suggesting their molecular basis is proteinaceous. Remarkably, the onset of ice nucleation at –7 °C is recorded for extracts of diverse species from Signy Island, including a >1000-year-old specimen, as well as temperate moss species sampled in the UK. These INMs may be produced by microbes living on the mosses or by the plants themselves. Type B INMs induce ice nucleation between –10 °C and –20 °C and are insensitive to heating. Their properties are consistent with polysaccharides extracted from vascular plants and their pollen. The presence of ice-nucleating polysaccharides in mosses supports growing evidence for their widespread production by land plants. While pollen and fertile soils are increasingly recognised as important contributors to the global population of INPs, the apparent ubiquity of ice-nucleating polysaccharides across plant tissues – in leaves, pollen, fern spores, moss spores and fragments – suggests that their contribution to ice nucleation in the environment has been significantly underestimated.

A new database to explore Antarctic Extreme Weather Events during the observational period

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Extreme weather events can lead to short-term and long-term ecological and societal disruption, especially in connection with the already globally changing climate. In Antarctica, extreme meteorological conditions can have far reaching consequences for the entire continent and its ecosystems. Melt events can indirectly lead to ice shelf destabilisation, and albedo changes, extreme winds can displace sea ice and promote calving of marine terminating glaciers, rain instead of snowfall can reduce the breeding success of penguins and other sea birds, whose chicks' plumage is not yet waterproof.

We have combined meteorological observations, mostly from between 1980 and 2024, and hindcasts covering the same period from high resolution regional climate models (RCM) into an Extreme Weather Event database for Antarctica. It allows users to study their temporal development, spatial extent, as well as investigate their drivers and their environmental consequences.

The database uses daily mean values of meteorological measurements, RCM hindcasts (MAR, RACMO2 and MetUM at ~11-12 km horizontal grid spacing), and ERA5 reanalysis (~30-35 km horizontal resolution), which were used to initialise the model simulations. It presents information for the key meteorological variables: near-surface air temperature, wind speed (including zonal and meridional components) and

specific humidity. For the RCMs additionally information based on the daily amount of solid and liquid precipitation is provided.

We will introduce the database, which will become publicly available in the near future, with its underlying datasets and methodology. We will also present some initial analyses regarding the representation of extreme weather events in observations and simulations.

Using Antarctic subglacial relic landscapes to inform past ice sheet retreat

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Constraining how the East Antarctic Ice Sheet has responded to past warm periods can provide vital clues as to its future stability. Relic fluvial landscapes preserved beneath the East Antarctic Ice Sheet have been used to place limits on retreat into the Aurora Subglacial Basin (ASB) in the warm Pliocene (~3 million years ago). Here, we use an ensemble of high-resolution ice sheet model simulations to better understand if the preservation of this landscape precludes significant glacial retreat in this sector in at least the past 3 million years. Nearly all simulations feature predominantly cold-based ice caps on the landforms through warm interglacial periods of the Pliocene, meaning the fluvial landscape could have been preserved, even with significant grounding line retreat into the ASB. Thus, we cannot exclude the possibility of significant ice sheet collapse under similar-to-modern CO_2 levels. This study highlights the utility of well-resolved subglacial landscapes when paired with numerical model simulations in informing past ice sheet retreat.

Uncertainty assessment of passive microwave sea ice concentration at a pan-Antarctic scale using MODIS imagery

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Passive microwave (PM) sensors have provided estimates of Arctic and Antarctic sea ice concentration (SIC) for the past 50 years. PM-derived SIC datasets are arguably the most widely used datasets for monitoring trends in sea ice, validating climate models, feeding into AI-driven sea ice forecasting tools, and operational use. However, the spatial and temporal distribution of their errors and uncertainties remains poorly understood. Several quantitative assessments of PM-derived SIC errors have been conducted in the Arctic, but a comparable large-scale assessment is lacking for the Antarctic. Furthermore, given the marked decline in Antarctic sea ice extent since 2017, recorded primarily by PM sensors, understanding the errors and uncertainties of this record is increasingly important. Therefore, this study presents a comprehensive assessment of the spatial and temporal uncertainties of PM-derived SIC using high-resolution MODIS satellite imagery from April 2020 to March 2021. We collect 23,500 MODIS sea ice mask chunks (250 m x 250 m resolution, 200 km x 200 km extent), paired with coincident AMSR2 brightness temperature data within a 6-hour window. PM SIC is calculated using the Bootstrap algorithm and compared with MODIS masks on a pixel-by-pixel basis. Results show good overall agreement between PM-derived SIC and MODIS masks, with a correlation coefficient > 0.9 and mean absolute error < 10 % in general. However, errors increase substantially under thin/new ice conditions, particularly within the marginal ice zone (MIZ) and polynyas. By characterizing pan-Antarctic uncertainties in PM-derived SIC, this study provides valuable insights into recent Antarctic sea ice changes.

Penguins as geomorphic agents of change on Antarctic raised beaches

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Penguin colonies commonly occur on raised beaches; accumulations of gravel and pebble-sized material around the coast of Antarctica. The impact of these colonies on the morphology of the beaches can be significant but has not previously been systematically mapped or quantified. Here we analyse a range of geospatial datasets including optical imagery and the Reference Elevation Model of Antarctica (REMA) to understand the impact of penguins on beach morphology at a range of colony sites in the Antarctic Peninsula and Ross Sea. We use elevation and elevation-derivative datasets to map penguin nest mounds across sites and analyse their spatial patterns to quantify penguin-driven modification of beach landscapes.

Our mapping highlights that commonly-developed large nest mounds (up to 10s of meters diameter) are often arranged in chains along raised beach ridges inland of present-day beach crests. We find that mound spacing varies among sites, with evidence of self-organisation, and discuss the ecological drivers of mound formation and spacing.Finally, we quantify the geomorphological work done by the penguins over time by analysing the volume of material build up in next mounds and ridges.

We map the present-day beach crest alongside penguin nest mounds to distinguish currently inhabited areas from those no longer occupied by penguins. The mapping and geomorphological analysis of the beach and beach crests also helps us contextualise the along-coast variation in crest elevations, and the overall vertical distribution of raised beaches, both of which are critical to understanding past sea level change around Antarctica.

Key findings from the International Thwaites Glacier Collaboration and Future Challenges

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Thwaites Glacier, Antarctica's fastest changing glacier, is almost entirely marine-based and represents the largest uncertainty in sea-level rise forecasts. In 2018 the International Thwaites Glacier Collaboration, funded jointly by the UK Natural Environment Research Council and US National Science Foundation, was set up with the aim of constraining how much and how fast the glacier will contribute to sea-level rise.

Analyses of rock samples recovered from beneath shallow ice cover show this sector of the ice sheet recovered after mid-Holocene thinning to below the modern level. However, climate models indicate conditions over coming centuries will differ greatly from those under which recovery occurred. In particular, warmth of water on the continental shelf, the main driver of ice loss, is expected to increase.

Although measurements reveal less melting than expected beneath much of Thwaites Eastern Ice Shelf, retreat along most of the grounding zone continues at 0.6–1.2 km yr^{-1}. Tidally-forced intrusions of sea water several kilometres into the grounding zone, shown by satellite and field observations, may contribute to this rapid retreat. Breakup of the ice shelf is now imminent.

Even if water on the continental shelf remains relatively cool, the latest ice sheet models predict continuing rapid grounding zone retreat that will eventually accelerate as Marine Ice Sheet Instability takes hold. It is highly likely that Thwaites Glacier will eventually be lost, which will destabilise adjoining parts of the West Antarctic Ice

Sheet, increasing the committed long-term rise in global mean sea level by more than 3 m.

The First Identification of Metabolites from Antarctic Subglacial Sediment >2 km in Depth

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Antarctic subglacial environments are known to host microbial communities that are adapted to unique and extreme selection pressures, but the complexity of such communities remains unclear. To date, limited access to Antarctic subglacial environments has begun to increase our knowledge of these isolated microbial populations and their interactions. This investigation used a subglacial sediment profile to determine if: a) microbial metabolites could be identified from such a low-biomass environment, and b) if any identified metabolites may provide insight into the metabolic activity and biological pathways of the microbial populations that are present. Samples obtained from the base of the Rutford Ice Stream in the Western Antarctic were partitioned in centimetre intervals, representing the first retrieval of samples of over 2 km in depth for microbiological analysis. 46 total metabolites were identified across all samples, with 20 likely originating from endogenous biological processes. The metabolites identified suggest pathways associated with amino acid metabolism, membrane lipid metabolism, nucleotide metabolism, central carbon metabolism, membrane function and osmotic regulation, cofactor metabolism and nitrogen metabolism. Depth-associated changes in phenotypic output was also observed. This study presents the first identification and analysis of metabolites specifically retrieved from a subglacial environment of over 2 km beneath the glacial surface, providing evidence of specific microbial adaptations to unique selection pressures.

Constraining Greenland and Antarctic ice-sheet history and geology from morphological comparison of subglacial landscapes with former ice-sheet beds

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Subglacial landscapes record critical information about the long-term evolution of the Greenland and Antarctic Ice Sheets, including constraints on past ice dynamics. Moreover, basal boundary conditions such as subglacial geology, basal thermal state, and other poorly constrained factors are often recorded in the subglacial geomorphology. However, interpretation of sub-ice geomorphic features can often be challenging. For example, recent studies highlight ambiguities in the interpretation of low-relief subglacial bed surfaces, which could be either erosional or depositional features and may or may not reflect specific lithologies. A better understanding of these features can potentially be achieved by ground-truthing observations of subglacial landscapes with examples from former ice-sheet beds, whose morphology and lithology can be directly observed.

Here, we conduct a systematic and large-scale comparison of the morphology of subglacial landscapes with observable former ice-sheet beds. We extract profiles from high-resolution digital elevation model data of former ice-sheet beds (e.g., the Laurentide Ice Sheet) to sample these landscapes at a comparable resolution and scale to the way radio-echo sounding measures subglacial topography, creating a robust framework for direct morphological comparison. We use the relationships between metrics such as along-profile topographic and spectral roughness with the lithologies, sediment distributions, and ice sheet histories of the formerly glaciated regions to infer variations in geology and ice-sheet history recorded in subglacial landscapes. We identify distinct regions of low roughness within subglacial landscapes which we suggest result from accumulations of subglacial sediments, noting that these often do not lie in regions where ice is presently warm-based.

British Antarctic Survey: Polar Sediment Core Facility and Geology Labs

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At the British Antarctic Survey, the Geological labs and Polar Sediment Core Facility (PSCF) support Paleo and present-day research into changing oceans, environments, ice sheets and climate. Terrestrial and marine rocks, fossils, sediment cores and soils collected from the field can be stored and analysed at our facilities, building records of environmental change to better understand the past, present and future of a rapidly changing world.

The rock and palaeontology stores house collections of rocks, fossils and microfossils from the earliest days of Antarctic exploration up to the latest season. The first dinosaur bone to have ever been collected from Antarctica was recently rediscovered in these collections, whilst geological mapping and analysis of glacial moraines has informed on the history of Antarctica's ice sheets. Samples in BAS' collection may be searched on the database and requested for loan with rock cutting and crushing facilities also available.

Licenced cold-temperature sediment storage facilities safely maintain the quality of marine and terrestrial sediment cores. The PSCF is designed with a processing workflow in mind from the core-splitting lab into dry sampling and photography, followed by the wet lab and finally the analytical lab for microscopy and instrumental work. A containerised Multi-sensor Core Logger and a portable Vanta XRF support non-destructive physical and elemental analysis of samples. Since opening in 2024, the PSCF has supported work including the KANG-GLAC Greenland cruise characterising patterns of glacial retreat, reconstruction of paleo-wind patterns from sub-Antarctic peat cores and processing of core material linked to the Thwaites project.

Snow petrels as sentinels of modern and past sea ice ecosystems in the Weddell Sea

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Snow petrels (*Pagodroma nivea*) offer a unique opportunity to assess Antarctic sea-ice variability over tens of thousands of years and place recent observations into a longer-term context. Snow petrels forage within the summer sea ice but return to ice-free bedrock to nest, creating stomach-oil deposits that encapsulate records of their diet and the environmental conditions within the sea ice. This study examines a set of deposits spanning the last ~50,000 years collected from Dronning Maud Land, East Antarctica. The snow petrel foraging range during breeding (~700-1200 km) means that these deposits integrate information about the sea-ice environment in the eastern Weddell Sea.

We analysed the lipid, stable isotope, and elemental composition of the stomach-oil deposits to reconstruct snow petrel diet, biogeochemical cycling, and sea-ice extent. Millennial-scale variability in snow petrel diet is superimposed upon a long-term expansion and then contraction of sea ice associated with the Last Glacial Maximum (~19,000 - 23,000 years ago), which impacted both carbon and nitrogen cycling in the surface ocean. Our results are consistent with predicted snow petrel prey distributions from a combination of global climate model simulations of the Last Glacial Maximum and new prey distribution models. By integrating information about how both snow petrel diet and sea ice conditions have changed in the past we show the potential of snow petrel stomach-oil deposits as proxies for long-term ecological monitoring in polar ecosystems. Observing and tracking snow petrels today also offers an opportunity to sample and record sea ice environments and ecosystems in regions which can be challenging to access.

Larsen C Ice Shelf Rift Detection and Evolution Using C- and L-band Frequency Synthetic Aperture Radar

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Ice shelf calving accounts for more than half of ice mass loss from Antarctica, with calving along rifts identified as a precursor to ice shelf collapse. Accurate detection of rift features is crucial to understanding the processes behind their evolution. Synthetic aperture radar (SAR) provides an opportunity to monitor rift behavior during all seasons and in virtually all weather conditions. SAR typically penetrates surface snow to reveal buried features, though meltwater reduces radar penetration depth and obscures features not expressed near the surface. This study has two objectives: (1) examine the influences of SAR frequency, polarization, and melt-freeze conditions on rift detection; and (2) use SAR as the basis for evaluating rift behaviors preceding the calving of iceberg A68 from the Larsen C Ice Shelf. Towards (1), Sentinel-1 C-band frequency and PALSAR-2/SAOCOM L-band frequency SAR images of Larsen C are examined during the 2020-2021 melt season. Rift dimensions are characterized using ICESat-2 altimetry and high-resolution DEMs, and surface melt is identified using Advanced Scatterometer (ASCAT) radar backscatter imagery. Greater consistency in rift detection is found using L-band compared to C-band, with enhanced L-band capability in winter in the presence of snow bridges and thick ice mélange; L-band is also superior during surface melt. Towards (2), the A68 rift is mapped from 2013-2017 and variations in rift size are compared between Sentinel-1, PALSAR-2, and Landsat 7/8 optical imagery. Overall, optimizing SAR for rift detection will lay the groundwork for future studies into calving mechanisms and aid predictions of ice shelf collapse.

A multi-proxy analysis of Holocene ice-ocean interactions in the south-eastern Weddell Sea.

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The timing and nature of changes to the Coats Land Coast, Filchner-Ronne Ice Shelf and adjacent areas of the Weddell Sea Embayment (WSE) since the Last Glacial Maximum (LGM) are still considered somewhat uncertain, on account of high regional variability in ice-ocean dynamics and a relative lack of sedimentary data from the WSE. Here, a multi-proxy analysis is presented of the 4.08 m marine gravity core GC569 (77°15'.99 °S, 33°26.98 °W), recovered from the Albert Trough, offshore of Coats Land, East Antarctica, during British Antarctic Survey research cruise JR244. GC569 is located near several submarine moraines and a post-glacial sediment drape, with the core containing biogenic and terrigenous materials. Through the use of XRF scanning, diatom analysis, and lipid biomarker analysis, ice-ocean dynamics throughout the Holocene have been interpreted. Five distinct zones are presented: The Early-Holocene Deglaciation (Zone E), whereby deglaciation and ungrounding of the ice sheet occurred prior to the tentative age of 8.4 cal. kyr BP; The Early-Mid Holocene Boundary (Zone D), a period of terrestrial input and meltwater driven stratification; The Mid to Late Holocene Low Productivity Period (Zone C), characterised by a trend of decreasing primary productivity and development of a stable, perennial fast-ice system, which collapses at the end of the zone; The Holocene Climatic Optimum (Zone B), characterised by high productivity and low sea ice extent, paired with varying stratification conditions; and The Late-Holocene Neoglacial (Zone A), featuring a resurgence of terrigenous inputs suggesting ice sheet advance, sea ice expansion and reduced marine productivity.

Firn saturation from field observations on three Antarctic ice shelves

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Antarctic ice shelves are the floating extensions of the continental ice sheet into the ocean, buttressing the flow of inland, grounded ice from the continent's interior. Over 50% of the Antarctic ice sheet margin is fringed by such ice shelves, which have seen increased surface melting and ponding over the last few decades. Fieldwork on three Antarctic ice shelves (Larsen C, Shackleton, and McMurdo), including optical televiewer imaging of hot-water-drilled and shallow-cored boreholes, provides direct observations of firn saturation and near-surface refrozen melt layers. Preliminary results will be presented and implications for more widespread ice slab presence and formation considered.

Preliminary cloud-regime contrasts in the East Antarctic escarpment at Troll

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The Troll Integrated Cloud Observatory (TONe–ICO; 1320 m a.s.l.) provides openly available observations of clouds in the East Antarctic escarpment, where synoptic moisture transport, katabatic outflow and complex terrain interact. We present a preliminary analysis of all published Troll Cloudnet classification products from 20 February 2025 to 22 July 2026, comprising 436 days. Radar–lidar target classification is combined with collocated model-derived thermodynamic context to characterise cloud occurrence, phase, geometry and event duration across contrasting meteorological conditions.

The observed column is dominated by ice-phase hydrometeors, but cloud occurrence and macrophysics vary strongly with atmospheric state. Moist, low-pressure conditions with strong easterly flow have an availability-weighted hydrometeor occurrence of 47%, compared with 13% under dry southerly conditions. Median cloud-event duration is 23 hours during moist easterly conditions and 4 hours under dry southerly conditions. Clouds during moist easterly conditions also have lower bases and higher tops. Liquid-containing and mixed-phase clouds remain uncommon but occur under warmer thermodynamic conditions within the moist easterly state. A preliminary ERA5 comparison of paired spring cases is consistent with the observed contrast between warm, humid easterly flow and cold, dry southerly flow.

These preliminary findings indicate that moisture-bearing easterly flow is associated with substantially more frequent, deeper and longer-lived clouds at Troll. These

conditions should therefore be prioritised for cloud-process studies and model evaluation.

The talk will also outline the NERC-NSF-funded SnøTroll project, which would extend the TONe–ICO observations to resolve the links between terrain, boundary-layer dynamics, cloud formation and precipitation as part of Antarctica InSync.

Late Holocene ice history dominates present day glacial isostatic adjustment in the northern Antarctic Peninsula

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Glacial isostatic adjustment (GIA) is the response of the Earth to past and present changes in the ice sheets. The present-day GIA signal depends on both the deglacial history of the ice sheet and the underlying Earth structure. The viscosity of the mantle plays a crucial role because the lower its viscosity, the quicker it deforms under a changing surface load. In the northern Antarctic Peninsula, the upper mantle viscosity has been shown to be several orders of magnitude lower than the global average. This means that present-day GIA is likely dominated by more recent ice loading changes rather than long term changes. In this study we assess current understanding of both ice sheet history and Earth structure in the northern Antarctic Peninsula. We run a suite of regional GIA models to investigate what time period of ice sheet change is causing present-day GIA. We show that, due to its fast response time, the Earth has completely adjusted to millennial scale deglaciation from the Last Glacial Maximum and that ice-mass change since ~1850s dominates present-day displacement rates. However, our modelled displacement rates underpredict GNSS-observed displacement rates showing that our current knowledge of ice history is lacking. More glaciological constraints on Late Holocene ice history are needed to improve GIA models further.

Geomorphological characterisation of the Wilkes and Aurora Subglacial Basins of East Antarctica: a template for long-term ice-sheet dynamics

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The Wilkes and Aurora Subglacial Basins are thought to be among the most sensitive sectors of the East Antarctic Ice Sheet to climate change. Both basins contain an ice volume equivalent to 4–6 metres of sea level rise, together constituting approximately one sixth of the entire ice sheet volume. The basins also show evidence for thinning and retreat in the geological past and are highlighted as likely loci of future mass loss in numerical ice-sheet models. However, there remains substantial uncertainty regarding how these basins have responded to past climate and ocean warning and in turn the processes that will govern the rates and patterns of future mass loss. The subglacial topography of these basins can act as: (i) a valuable record of past ice-sheet change and (ii) a key influence on contemporary and future dynamics.

Here we use digital elevation models, radio-echo sounding data, and ice-surface morphology analysis to characterise the geomorphology of the Wilkes and Aurora Subglacial Basins. We conduct regional-scale geomorphic analyses using Bedmap3 and BedMachine v4, including hypsometry, bed roughness, and hydrological flow routing. We also compare the scales of roughness captured by different datasets and compare landscape morphology to relevant analogues, including glaciated and non-glaciated terrains elsewhere on Earth. Our analysis reveals important topographic differences between the two basins and provides outputs that may help inform next-generation numerical ice-sheet modelling and guide future data collection in East Antarctica (e.g., swath radar surveying and sub-ice drilling).

The atmospheric microbiome – complexity and the Polar regions

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Aerobiological research is expanding rapidly, and although broad trends are starting to emerge globally, observations remain influenced by location, season and experimental context. In general, however, atmospheric microbial communities are shaped by interacting environmental factors such as meteorological conditions, atmospheric stratification, surface-atmosphere exchanges, biogeographic patterns, and temporal variability, all of which contribute to the complexity of interpretation. In the Polar regions, many of the traditional technical barriers to aerobiological research such as detection sensitivity, sampling resolution, and access to remote locations have largely been overcome. In consequence, spatial complexity and environmental heterogeneity are the principal remaining challenges. One promising approach to resolve such complexity is to move beyond taxonomic descriptions alone and instead focus on specific indicators of microbial function. Initial investigations in the Antarctic using functional markers have revealed patterns in atmospheric microbial biodiversity that differ markedly from those based solely on taxonomic composition alone. Looking ahead to the next International Polar Year (2032–33), there is an opportunity to develop a coordinated research effort based on a defined set of functional marker genes across different components of the environment. Such an approach could improve our understanding of the processes governing atmospheric microbiome structure and their broader role in atmospheric function.

Objective Mass-balancing of Southern Ocean Ecopath Models

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Southern Ocean food-webs sustain globally significant wildlife populations, support commercial fisheries for krill and toothfish, and play a central role in carbon sequestration. They are regionally heterogenous, varying from ice-covered continental shelves to open sub-Antarctic island systems. Characterising these regional contrasts and understanding their response to fishing and climate change increasingly depend on food-web and ecosystem models. Ecopath is a widely used food-web modelling framework where an ecosystem is represented as functional groups based on their feeding mode and the specific ecological role they play in energy transfer. However, each model is parameterised independently with region-specific decisions on the resolution of functional groups, biomass currency, and the mass-balancing procedure that enforces thermodynamic consistency so that no group sustains a predation demand exceeding its production. Balancing is conventionally achieved through subjective parameter adjustment, and the resulting "model personality" makes it difficult to distinguish genuine ecological contrasts from choices of model construction.

This ongoing study applies a single objective balancing algorithm uniformly across six regional Southern Ocean models. The method, previously developed and published for the Ross Sea model, identifies the minimum, pedigree-weighted adjustment to the input parameters required to satisfy mass balance, holding well-constrained values near their observed magnitudes while poorly constrained ones accommodate the required change. As the criterion is fixed and not dependent on the modeller, mass-balancing solutions are fully reproducible. Preliminary results indicate that objective balancing yields small, distributed parameter changes rather than the large, localised changes which are characteristic of manual balancing.

Living benthic foraminifera beneath an ice shelf in the Bellingshausen Sea revealed by a recent calving event

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To date sub-ice-shelf ecosystems remain among the least explored marine environments on Earth, and little is known about how these ecosystems will change following the collapse and/ or calving of the ice shelves. The logistical challenges of accessing ice-covered cavities have limited observations to studies taking place year(s) after collapse events or to discrete borehole observations. During the Schmidt Ocean Institute (SOI) expedition to the Bellingshausen Sea in January-February 2025, a massive iceberg (~510 km^2) calved from George VI Ice Shelf, and rapidly moved out of the Ronne Entrance, exposing a previous inaccessible sub-ice-shelf environment. Multidisciplinary observations were made just two weeks after the calving event, offering a unique opportunity to investigate an intact sub-ice-shelf benthic environment.

Sediment push cores with undisturbed core tops were collected using ROV SuBastian, and sediment samples were stained with Rose Bengal immediately after collection to identify living benthic foraminifera. Here, we report living (stained) benthic foraminiferal assemblage census counts from five sites from the newly exposed sub-ice-shelf area and compare these with assemblages from the adjacent sites in the Ronne Entrance and further offshore locations in the Bellingshausen Sea. Preliminary results reveal a diverse living benthic foraminiferal community beneath George VI Ice Shelf, characteristic of West Antarctic inner shelf environments, and comparable to assemblages found at nearby open-marine sites. These findings highlight the role of

ocean circulation in delivering nutrients to these environments in order to sustain life. Furthermore, our results may have important implications for the application of foraminifera (e.g. by using radiocarbon dating) to reconstruct past ice dynamics and ice sheet retreat events.

An Observationally Constrained Pan-Antarctic Sea Ice Volume Budget (2002–2024) and Its Dynamic–Thermodynamic Decomposition

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Antarctic sea ice has undergone a regime shift in recent years. Following a period of increasing extent and volume, Antarctic sea ice began to decline in 2016, highlighting the need for observationally constrained sea ice volume budgets capable of resolving both spatial and temporal variability across the sea ice zone.

In this study, we use the SO-SIMBA merged sea ice thickness product, derived from Envisat and CryoSat-2 observations spanning 2002 to 2024, to construct a pan-Antarctic sea ice volume budget. A key advantage of this framework is that the SO-SIMBA product is drift-corrected to daily resolution, reducing the need for temporal interpolation of thickness that has been a source of uncertainty in previous budget approaches.

Using an extended sea ice motion dataset developed within the SO-SIMBA framework, we decompose monthly sea ice volume changes into dynamic (advection and divergence) and thermodynamic components across the Antarctic basin. Our results reveal distinct shifts in dynamic patterns that align with the contrasting observed volume regimes, suggesting that changes in ice dynamics play a meaningful role in driving the recent decline alongside thermodynamic forcing.

The derived budget also provides a basis for examining variability in freshwater and brine fluxes at the ocean surface, with implications for Antarctic ocean circulation. The budget is evaluated against alternative thickness products to contextualise observational uncertainties. This work advances efforts to quantify Antarctic sea ice mass balance during a period of rapid change and lays the groundwork for linking sea ice variability to broader oceanic and climate processes.

Ice-Sheet–Ocean Interactions and the Reversibility of a Regime Shift Beneath Filchner-Ronne Ice Shelf

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Future atmospheric warming could cause an abrupt increase in ocean temperature beneath the Filchner–Ronne Ice Shelf, Antarctica, from 2.2◦C to more than 0◦C in a few decades. In simulations, such a transition leads to a twenty-fold increase in sub-shelf melt rates, driving a retreat of the ice sheet. Here we investigate the evolution and reversibility of the ocean and ice sheet states using coupled ice-sheet–ocean model simulations. We show that sub-shelf melt rates increase only half as much as in the uncoupled system, and we find that, after a period of climate cooling, the cavity is reversible from warm to cold conditions, independently of ice-ocean interactions related to regional changes in sub-shelf melting, cavity geometry, and ocean dynamics. In contrast to the abrupt warming transition, the recovery of a cold ocean state takes more than a century. Meanwhile the ice sheet continues to lose mass and contribute to sea level rise with a maximum rate of up to 0.9 mm/a.

Rothera Research Station: a gateway to Antarctic science

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Rothera Research Station is located below the Antarctic circle, 68 degrees south, on Adelaide Island in Marguerite Bay on the Antarctic Peninsula. It provides home to 120-160 people in the austral summer, and 30-40 people during winter, and is a hub for BAS' Antarctic science and logistics. Each year, various projects take place in the deep field, on the ice shelves and sounds of the continent, as well as in the local area, above and beneath the surface of the Southern Ocean. Projects range from long-term monitoring projects running for decades, to large, grant-funded projects running for a couple of seasons, to experiments and data collection trips that are completed within one Antarctic summer season. Here, we aim to introduce Rothera Station as a science facility to the UK Antarctic science community, especially its Early Career Researchers (ECRs) who might not have had the chance to get to know the UK's largest Antarctic Research Station. We provide an overview of the local area and its potential, information about the science infrastructure available on site, and an insight into one of Rothera's most precious long-term datasets, the Rothera Oceanographic Time Series (RaTS). RaTS has been supported at Rothera since 1997 and has since provided a base and context to many follow up projects and international collaborations around Marguerite Bay, ultimately shedding light on the feedbacks between coastal Antarctica, the Southern Ocean and changing climate.

Emulating Global Climate Model Downscaling over Antarctica using Machine Learning

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Regional Climate Models (RCM) traditionally apply physics-based dynamical downscaling approaches to Global Climate Models (GCM) to enhance the spatial resolution of these climate projections. While RCM outputs provide detailed insight into future climate change over Antarctica, they are computationally expensive to run-with simulations often requiring weeks to months to complete. This limits the number of ensembles members that can be generated, reducing the ability to quantify uncertainty in RCM projections.

This presentation explores the use of Convolutional Neural Networks (CNNs) to emulate traditional downscaling approaches across multiple GCM ensemble members. A novel CNN architecture is developed to independently learn representations of the GCM variables and other auxillary information, including topography and land mask, before generating projections of surface temperature at RCM spatial resolution (~10 km).

A CNN trained using GCM temperature and geopotential height fields at the 500 hPa pressure level, produced emulated RCM outputs with a Mean Absolute Error below 1.3°C on the test physics-based RCM, but outliers of upto ±10°C remain. The best performing CNN was then applied to 20 ensemble member GCMs across two climate scenarios (SSP126 and SSP370), providing novel insight into when the ensemble members from the two scenarios diverge. Finally, timeseries of CNN-derived RCM temperatures were generated over 11 Antarctic ice shelves, allowing the first ensemble-based assessment of the Melt Potential Index (days above 0°C) through to 2100 at this spatial resolution. These results provide a computationally efficient framework for generating climate model projections, which will be valuable ahead of the release of CMIP7.

Ocean-driven dynamic thinning of Berkner Island?

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Slow-flowing Antarctic ice rises are typically little affected by short-term ice dynamics and are considered critical for buttressing inland Antarctic ice. Destabilisation or thinning of ice rises could result in acceleration, thinning and retreat of the grounded ice sheet, increasing ocean-driven mass loss, with consequences for global sea level rise.

Berkner Island (BI) ice rise is a critical, and long-term, control on grounded ice flow within the Weddell Sea, buttressing several major East Antarctic ice streams, and is assumed to have been stable over both short (10s-100s of years) and long (1000s-10000s of years) time scales.

Remote sensing reveals that BI may not be stable. The eastern margin of BI is characterised by three inlets of faster ice flow (up to ~125 m yr^{-1}) and localised zones of deep basal topography. Analysis of ICESat2 data suggests that the grounded ice within McCarthy Inlet, the largest and most ice shelf-margin proximal inlet, underwent up to 2.5 m of surface lowering between 2020 and 2026. Surface lowering was not confined to the grounded ice proximal to the inlet grounding zone; the lowering extended up to 50 km inland as far as the ice divide. The reasons for this rapid and catchment-wide dynamic change are not directly clear, but a connection to warm shelf water beneath the FRIS cavity may be important. If this is the case, McCarthy Inlet may be the ‘canary in the coalmine’ for ice-ocean driven change of the Filchner Ice Shelf, with implications for the wider Antarctic Ice Sheet.

UK Antarctic Strategy

UK Government

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Published in 2025, the UK Antarctic Strategy to 2035 is the UK Government's first comprehensive public strategy for Antarctica, bringing together the UK's objectives for governance, science, environmental protection and the peaceful use of the continent under a single framework. The strategy reaffirms the UK's long-standing commitment to the Antarctic Treaty System and sets out a vision for maintaining the UK's leadership and influence in Antarctic affairs over the coming decade.

The presentation will outline the development of the Strategy, its principal objectives, and the policy context in which it was produced. It will examine how the UK seeks to respond to accelerating environmental change in Antarctica, increasing pressures from human activity, and emerging governance challenges, while continuing to champion international cooperation and evidence-based decision making.

Scientific excellence is a central pillar of the Strategy. The UK's world-leading Antarctic science programme, delivered through the British Antarctic Survey and the wider research community, provides the evidence base for policy development, international negotiations and environmental stewardship. The Strategy commits to maintaining a strong UK scientific presence in Antarctica, investing in research infrastructure and supporting scientific collaboration to improve understanding of climate change, the Southern Ocean and Antarctic ecosystems.

The presentation will be of interest to researchers, policymakers and practitioners interested in the intersection of science, diplomacy and environmental governance in Antarctica. The presenter would be pleased to take questions on any aspect of UK Antarctic policy, including science, environmental protection, governance, fisheries, international engagement and the Antarctic Treaty System.

Internal Shortwave Absorption Drives Seasonal Subsurface Warming and Promotes Runoff in Antarctic Blue Ice

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Surface meltwater on the Antarctic Ice Sheet can be stored within snow, firn, and porous ice before reaching ice shelves, where it may promote hydrofracturing. Yet the thermal processes controlling this storage and release remain poorly constrained in coastal blue ice areas because near annual subsurface temperature records are rare. Here, we combine a 0–10 m ice temperature record from Langhovde Glacier, East Antarctica, spanning January 2024 to January 2025, with a model coupling a surface energy balance to a vertical firn and ice column. Simulations with internal shortwave absorption reproduced the observed seasonal warming and its persistence at depth better than simulations without subsurface shortwave heating. About 70% of the additional shortwave energy was absorbed within the upper metre and 30% below it, whereas about 90% of the additional sensible heat was stored below 1 m. Direct shortwave absorption below 1 m supplied most of this deeper heat, while conduction modified its vertical distribution. Progressive warming reduced the cold content of the porous 0–1 m layer to near zero before modeled runoff increased in late December. During the 2024/25 melt season, total melt was 373 mm w.e.; 225 mm w.e. (60%) refroze and 148 mm w.e. (40%) became runoff. These results indicate that internal shortwave absorption primarily depleted the upper-ice cold content, reducing refreezing capacity and promoting runoff once melting intensified, rather than directly producing large amounts of subsurface meltwater.

Abstract Title: The Foundation-Patuxent-Academy ice stream system, Antarctica

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The Foundation-Patuxent-Academy system (FPAS) is a major Antarctic ice stream system, draining both East and West Antarctica, with a global sea level potential of ~3 m. We provide a holistic catchment-scale overview of the FPAS reviewing its glaciological and hydrological systems, its glacial history, and its modelled response to past and future climate change. FPAS may be vulnerable to future change because

of: (i) a deep (~2.4 km below sea level) low-gradient retrograde bed that encourages grounding-zone retreat; (ii) a low-gradient ice surface and high tidal range, which are likely to promote flotation of grounded ice and seawater intrusion; (iii) an active and dynamic subglacial hydrological system; (iv) complex ice-meltwater-ocean interactions at the grounding zone; (v) potential for substantive expansion of the across-flow length – and cross sectional area – of the grounding zone; and (vi) susceptibility to ice flow-switching and water piracy (e.g. via the adjacent Support Force Glacier). Despite such potential vulnerabilities, existing numerical model simulations of FPAS grounding-zone retreat produce a wide and divergent range of past and future scenarios. Uncertainties in the future response of the FPAS to a warming climate result from poor constraints on its topography and hydrology, processes of ice-ocean interaction, interlinkages with the surrounding ice sheet and ice shelf, and a shortage of FPAS-specific modelling experiments. This review outlines and evaluates these critical gaps in our knowledge of the FPAS and develops a strategy to address them. This strategy would provide: (i) the first robust and comprehensive evaluation of the FPAS's vulnerability to current and near-future climate forcing; and (ii) improved constraints on projections of the future contribution of the Antarctic Ice Sheet to sea-level rise.

Sedimentation during retreat of the Late Oligocene (c. 26-27 Ma) Oi2b ice sheet on King George Island (South Shetland Islands, Antarctica) and implications for regional ice configuration

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King George Island hosts at least three important Cenozoic glacial sequences, the oldest of which is linked to a major Late Oligocene glaciation (Polonez Glaciation, represented by the Polonez Cove Formation (PCF)). It contains the only known deposits on Antarctica left by the prominent Late Oligocene (c. 27-26 Ma) Oi2b global cooling event, and the presence of clasts with a distant (East Antarctic) provenance indicate that ice was widespread during the Oi2b event and reached sea level, possibly for the first time. As a result, the PCF is one of the most intensively studied Cenozoic sedimentary units in the Antarctic region. It provides a unique record of the glacio-isostatic and glacio-eustatic effects of a major retreating ice sheet (Oi2b).

Following deposition of ice proximal deposits, initial relatively deep-water conditions become shallower up-sequence briefly due to isostasy before increasingly deeper-water conditions caused by eustasy are represented by the remaining members. The sequence also contains several marine-emplaced lava domes, which were eroded contemporaneously and shed abundant coarse sediment into the PCF. As a result, the sedimentological characteristics of the PCF deposits were controlled primarily by autogenic processes, with water depths determined allogenically.

Final infilling of the Polonez Basin is represented by hyperpycnal sandstone deposits, speculatively linked to flooding events associated with glaciovolcanic eruptions. Latest Oligocene uplift subsequently affected the PCF and was not reversed, leading to the present superb exposure of the two formations. As a result of this and other studies across Antarctica, it is now possible to reconstruct the Oi2b ice sheet right across the continent.

Nutrient release from Antarctic Sediments in synthetic sea water

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Antarctic glacial sediments contain essential nutrients like iron (Fe), manganese (Mn) and silica (Si) which can support and sustain life in the Southern Ocean. Glaciers transport these sediments and associated nutrients to the coast, where delivery has been linked to large, recurrent phytoplankton blooms, which drawdown atmospheric CO_2. As glaciers thin and retreat under climate warming, patterns of sediment delivery will change. To assess the impact of these changes, it is necessary to understand how efficiently different essential nutrients are released when Antarctic sediments enter the Southern Ocean. Such studies can then be used to assess phytoplankton uptake, and rates of CO_2 drawdown, allowing us to better characterise carbon cycles in the Southern Ocean.

In this study we investigated nutrient release from Antarctic glacial sediments in artificial seawater. We used seven sediment samples collected from glacial surfaces in the Sør Rondane Mountains, East Antarctica (where sediment assemblages from similar environments have already been shown to be iron-rich during ascorbate and dithionite treatments). Over a 986-hour laboratory experiment, we measured the dissolution of Fe, Si and Mn in artificial seawater to assess how release patterns vary through time. Samples (including an artificial seawater control) were extracted at thirteen sampling time intervals, with dissolution measured using an inductively coupled plasma optical emission spectrometry (ICP-OES) at Northumbria University.

We found that Mn and Si exhibited sustained net release after approximately 10 hours. By the final sampling point (986 hours), net Si concentrations ranged from +1.41 to +2.35 μmol L^{-1}, while Mn concentrations ranged from +0.008 to +0.059 μmol L^{-1} across the sediment samples. A strong positive relationship between cumulative Si and Mn release ($R^2 = 0.945$) suggests coupled dissolution from shared aluminosilicate mineral phases. Throughout the experiment, dissolved Fe concentrations closely followed the artificial seawater control, suggesting that oxidation and precipitation within the oxic seawater matrix largely obscured sediment-derived Fe release.

Our laboratory experiments show that nutrient release times and concentrations vary between different Antarctic sediments because of contrasts in lithology and mineral composition. This means it's important to review the source of material entering the Southern Ocean today, and assess how this may change in the future, as glaciers thin and flow directions are altered. It is positive to note that mineral dissolution was generally sustained over timescales comparable to particle residence within the euphotic zone, so once nutrient-rich sediments reach the Southern Ocean, they are likely to be useful to life. These findings improve our understanding of how changing sediment delivery patterns may influence Southern Ocean nutrient supply, marine productivity and carbon sequestration.

British Antarctic Survey's new Controlled Environmental Facility

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This poster will focus on the capabilities and features of the new state-of-the art Controlled Environment Facility (CEF) opening at the British Antarctic Survey (BAS), Cambridge.

This resource is dedicated to studying polar ecosystems and will include the UK's only polar marine aquarium, supporting a range of fish and invertebrates to the highest level of animal welfare, 3 temperature-controlled laboratories, one operating at -5 °C, and two with a range from -5 to +25°C. The facility includes cold and frozen samples storage at -25°C, -80°C and +4°C, and adjoining area for preserved material, offering a comprehensive catalogue of material from over four decades in the field.

Live Antarctic marine life has been kept in aquaria at BAS since 1973, providing material, and experimental support, for >1,000 projects and >2,500 published papers. This poster aims to promote the availability of the new UKRI NERC National Capability facility for UK scientists and institutions, and the innovative features that can be utilised in future projects.

This includes flexible and finite control of environmental parameters such as temperature and salinity, facilitating various long- and short-term studies; the range of temperatures available allows comparative projects from polar to tropical environments, supporting world-class research not possible in Antarctica. Additionally, the collection of long-term samples allows exploration of pressing questions relating

to extreme cold adaptation and the effects of long-term environmental change in an area of rapid warming. The CEF offers the world of polar research to all, advancing polar science and training for the next generation.

Evidence for underestimated ice-nucleating particle concentrations in the Southern Ocean from the Southern Ocean Clouds (SOC) 2024 cruise

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Biases in surface radiation and sea surface temperature are larger over the Southern Ocean than anywhere else in the world, severely limiting our ability to predict global climate. These biases are partly driven by poor representation of mixed-phase clouds, including large uncertainties in aerosol-cloud interactions such as the influence of atmospheric ice-nucleating particles (INPs). INPs trigger the freezing of supercooled cloud droplets, affecting cloud lifetime and radiative properties. Understanding the sources, types and concentrations of INPs is essential for reducing model uncertainty, yet measurements remain sparse and generally indicate extremely low concentrations.

We performed INP measurements throughout the 5-week Southern Ocean Clouds (SOC) cruise aboard the RRS *Sir David Attenborough* in November–December 2024. Online INP measurements were made using a Portable Ice Nucleation Experiment (PINE) chamber, alongside two offline filter-based methods: (i) a traditional approach using polycarbonate filters washed into suspension for analysis, and (ii) direct analysis of particles collected on Teflon filters. The traditional polycarbonate method yielded very low INP concentrations, consistent with previous Southern Ocean measurements, whereas Teflon filters consistently yielded higher concentrations, including during side-by-side sampling, and agreed more closely with online PINE measurements. Alongside our recent laboratory studies, these findings suggest the widely-used polycarbonate filter method may fail to recover a fraction of biological INPs, leading to systematic underestimation of concentrations.

Our results suggest that INP concentrations in the Southern Ocean may be higher than previously reported, with important implications for our understanding of aerosol-cloud interactions and the representation of mixed-phase clouds in climate models.

New tracer functionality in the SI3 sea-ice model

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We present a new, generic tracer framework in SI3 (version 4.2), the sea-ice component of UKESM2. Tracers can now be routed through the sea ice, coupled with the ocean, and further coupled to ocean biogeochemistry, with behaviour easily definable in namelists. Our immediate use case is to track the contribution of surface flooding to sea-ice mass and we present preliminary results to validate the tracers. Work is ongoing to couple the new tracer framework to the atmosphere. We expect the new functionality to enable a range of new polar science with NEMO and UK climate modelling tools, such as isotopic studies, biogeochemical interactions, and tracking freshwater and its consequences. We are open to other use cases and are keen to get input from the community during this development stage.

Antarctic ice sheet dynamics reconstructed by identifying the sources of subglacial tills

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The West Antarctic Ice Sheet is currently undergoing rapid ice loss and contains enough ice to raise global sea levels by up to 5 m. Much of the ice sheet is grounded below sea level, and its future stability is highly debated. Reconstructing the behaviour of the ice sheet during past glacial-interglacial cycles provides important context for understanding the sensitivity of the ice sheet to environmental change and its future response. During the Last Glacial Maximum (LGM; ca. 19-23 ka), fast-flowing ice streams extended through bathymetric troughs across the continental shelf and reached the shelf edge, transporting large volumes of subglacial sediment. The detrital component of sediments can be distinguished using neodymium and strontium isotopes, which reliably trace provenance based on different geological ages.

For our project, we analyse Nd and Sr isotope data on subglacial till deposits and recent sediments recovered in cores from West Antarctic palaeo-ice stream troughs. Because the tills were deposited beneath grounded ice, these sediments have not been reworked by ocean currents and thus preserve a record of the origin of subglacially transported detritus and past ice-flow pathways.

By comparing the provenance signatures of the LGM deposits with those of modern sediments, we investigate whether drainage patterns and catchment areas have varied since the retreat of an ice stream, or whether they have remained stable. The

new dataset will provide valuable information for modelling of past ice-flow pathways and subsequent marine transport processes.

DeCAdeS – A New Array of Ocean Moorings in the Amundsen Sea

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A modified version of Circumpolar Deep Water (mCDW) is able to access the continental shelf in the Amundsen Sea. The presence of this warm mCDW leads to very high basal melt rates beneath the floating ice shelves, which motivates the study of processes transporting mCDW across the shelf break. An eastwards undercurrent is known to flow along the shelf break in the Amundsen Sea, which turns southwards and transports mCDW onto the continental shelf when it encounters a bathymetric trough intersecting the shelf break. A new array of moorings will be deployed at Pine Island-Thwaites West (PITW) trough near the shelf break as part of the Drivers of Oceanic Change in the Amundsen Sea (DeCAdeS) project. These observations will complement and extend previous work, such as the iSTAR mooring array, with the aim of improving understanding of the temporal variability in mCDW transport across the shelf break. This poster will present upcoming plans for the DeCAdeS project, including fieldwork plans.

Modelling the impact of surface melt on an Amery Ice Shelf area, East Antarctica,1980-2025

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Surface melting in Antarctica is currently most intense around the coastal areas and on low-latitude ice shelves. Antarctica's third-largest ice shelf, Amery Ice Shelf, experiences regular seasonal melting, with large supraglacial lakes and interconnected meltwater networks forming annually for at least the past 20 years. Surface meltwater is produced upstream from the ice front of Amery Ice Shelf, in regions with prevalent blue ice and exposed rock features. These features have lower albedos and higher densities than the surrounding snowfields, impacting the surface energy balance and water movement on and englacially in the ice shelf. Current models of ice shelf surface melting assume a uniform snow surface with the presence of a permeable firn pack beneath, so do not accurately reflect the conditions under which surface meltwater is produced. Crucially, without considering the impact of longwave absorption and reemission during the austral winter, these models may not be representative of the true volume of meltwater produced by Antarctic ice shelves. Here we present an updated version of MONARCHS, a model of ice shelf surface melting and supraglacial lake development, which now includes variable surface features, and preliminary modelling results of an area on Amery Ice Shelf.

Assessing the effects of ship-derived Black Carbon on Scotia Sea phytoplankton

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Black carbon (BC), a condensed carbonaceous material produced by incomplete combustion, has gained media attention recently due to its prominence as an atmospheric climate forcer. BC can also increase radiative forcing on snow and ice, disproportionately impacting polar systems and raising concerns for potential sea level rise. Produced by natural sources, but also from diesel engine combustion, emissions from ships remain an increasing source of BC to the marine environment. Very few studies have examined the impact of BC interactions with marine organisms. The Southern Ocean has high levels of biodiversity but is vulnerable to external stressors due to its isolation. Our work focuses on phytoplankton, collected at 3 locations across the Scotia Sea, to investigate their potential response to an input of ship-derived black carbon. Phytoplankton photochemical yield response was measured by fluorometer after 3 days of onboard incubation. Preliminary results suggest that phytoplankton are not acutely harmed by the addition of ship-based BC at all tested concentrations indicating limited short-term toxicity. Pigment compositions determined by HPLC post-cruise suggested each location contained different community structures, with differing response to the ship soot. Further work will assess longer-term effects on microbial processes and nutrient cycling, also including a land-based source of BC (forklift soot) to investigate any differences due to BC source. This work will improve understanding of how Black Carbon may be utilised by the base of the food web, and its potential for assimilation into the biological carbon pump in the Southern Ocean.

Moving mountains: sediment transfer in Antarctica

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Glaciers in Antarctica entrain and transfer sediment, rich in essential nutrients, from mountains and the ice/bed interface to the ocean, where they are released by melting. Because primary producers in the Southern Ocean are limited by the availability of micronutrients, such as iron, any increase in sediment supply could enhance primary production, and with it, atmospheric CO_2 drawdown. Despite the importance of this feedback, the contribution of Antarctic sediments to the Southern Ocean and the global carbon cycle are poorly constrained, and the pathways linking mountains, ice, and ocean are not well understood.

Here, I report on how we are bringing together a variety of research methods to trace glacial sediment transfer from source to sink. In the mountains, terrestrial laser scanning, structure-from-motion photogrammetry and satellite remote sensing are revealing how (and when) sediment moves from exposed peaks to the glaciers and ice sheets flowing beneath them. Ice penetrating radar reveals how this sediment accumulates and is carried downstream by ice flow, alongside material entrained at the ice/bed interface.

To assess how important these sediments are to the Southern Ocean, I will describe how we measure iron concentrations in sediment sourced from mountains, glacial moraines, the ice surface and blue ice moraines (which draw sediments up from the ice/bed interface). A case study of Gunnestad Glacier in East Antarctica shows appreciable concentrations of ascorbate and dithionite extractable iron in all samples, where recent work suggests that this iron is leached in seawater. Ice flow simulations link potential sediment tracks to recurring phytoplankton blooms in satellite imagery.

Much remains to be explored – the nutrient content of sediments elsewhere in Antarctica, the impact of iron delivery on phytoplankton production and CO_2 drawdown, and the scale of sediment reaching the Southern Ocean. One thing is clear though: we can't understand Antarctica's carbon cycle without following its sediment – from mountain, to ice, to ocean.

Antarctic Place names: From Scientific Discovery to Public Engagement

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Place-names are fundamental to scientific activity in Antarctica, providing essential reference points for fieldwork, logistics, navigation and the accurate communication of research. They are also a lasting record of human activity on the continent, reflecting its history of exploration and scientific discovery.

This poster introduces the role of Antarctic place-naming and outlines the process for proposing new names through the UK Antarctic Place-names Committee (APC), leading to inclusion in the British Antarctic Territory Gazetteer and the Composite Gazetteer of Antarctica. As scientists are often the first to identify and work with previously unnamed features, they are uniquely placed to contribute to the development of Antarctic geographical nomenclature.

The poster also showcases recent examples of thematic place-naming used to communicate wider Antarctic science and policy issues, including names associated with host cities of United Nations climate conferences and satellites that support Antarctic observation and monitoring. These examples demonstrate how place names can help connect Antarctic research with broader scientific, environmental and societal themes.

Inter-annual Microbiota Dynamics of Penguin Guts and Rookery Soils on Signy Island, Maritime Antarctic

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Antarctic penguin gut microbiome is important to the host bird's health, growth and reproductive success, and is strongly shaped by diet and foraging environments. Recent shifts in the abundance and distribution of certain penguin species are linked to regional climate change, specifically variations in sea ice extent, and alterations in the marine food web. These environmental shifts may alter penguin gut microbiota development through the ingestion of different marine and prey-associated bacteria. Because penguins feed at sea but breed and moult on land, they deposit large volumes of nutrients into the terrestrial ecosystems. Their gut microbes are transferred within this guano, potentially driving microbial succession in the surrounding terrestrial environment. However, the temporal stability and variability of the penguin gut microbiota remain poorly understood. This study examined sympatrically breeding Adélie (*Pygoscelis adeliae*) and chinstrap (*Pygoscelis antarctica*) penguins on Signy Island, South Orkney Islands. Using high-throughput sequencing, we analysed bacterial diversity in stomach regurgitates, guano, and rookery soils across three austral summer penguin breeding seasons. We detected significant inter-annual variations in the microbiota of both penguin guts and rookery soils. These results highlight complex gut microbial dynamics in a seemingly homogeneous environment and suggest a nuanced interplay between diet, environmental factors, and microbial communities. Our findings underscore the importance of microbial ecology in polar ecosystems and emphasise the need for long-term monitoring to assess the resilience of Antarctic wildlife to environmental change.

Islands in the Ice: Interpreting the future of Antarctic ecosystems

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Antarctica is experiencing rapid climatic shifts from ozone depletion and climate heating, but the impact on biodiversity in its ice-free areas is still poorly understood. Utilising a range of biological, chemical and environmental data from key locations around the Antarctic continent my team seeks to understand how vegetation in ice-free, coastal areas has responded to recent climate change. Improved spatial and temporal climate data for Antarctica's coastline, will enable more accurate modelling of the rates of environmental change and how this is affecting Antarctica's unique biodiversity. We aim to provide a toolkit for a proposed Antarctic terrestrial observing system, which could become the foundation for a whole-of continent observing system. By linking past changes in climate to current ecosystem health we can start to model future risks for Antarctic terrestrial ecosystems and better plan for their protection.