SUPPORTING IMPACTFUL UK ARCTIC SCIENCE ENGAGEMENT

2025–2026

Project Summaries

Photo: Dr Iain Rudkin, British Antarctic Survey

Arctic Office
NATURAL ENVIRONMENT RESEARCH COUNCIL

UK Government

Background:

This publication shares details of new work from UK-based research teams funded by the UK Government in 2025–2026.

The Arctic Council is the leading intergovernmental forum promoting cooperation in the Arctic. As the current Arctic Council Chair, The Kingdom of Denmark is actively pursuing an ambitious programme for their Chairship (2025–27).

The United Kingdom has been an active Observer to the Arctic Council since 1998. Researchers based in the UK have contributed extensively to the work of the six Working Groups and associated Expert Groups and Taskforces over many years, sharing expertise, working in partnership, collaborating on new data sources and conducting important analysis.

In recognition of the importance of the work of the Arctic Council, and the potential for increased engagement by researchers based in the United Kingdom, the Government has funded the 'Supporting Impactful UK Arctic Science Engagement' scheme for 2025–2026. 25 projects have been funded through this scheme which supports UK-based researchers in practical engagement that aligns with the work programmes of the six Arctic Council Working Groups and the priorities and initiatives of The Kingdom of Denmark's Chairship of the Arctic Council.

The Arctic Council Working Groups are:

ACAP - Arctic Contaminants Action Programme

AMAP - Arctic Monitoring and Assessment Programme

CAFF - Conservation of Arctic Flora and Fauna

EPPR – Emergency Prevention, Preparedness and Response

PAME - Protection of the Arctic Marine Environment

SDWG – Sustainable Development Working Group

The scheme is being delivered in active partnership with the NERC Arctic Office and the UK Science and Technology Network.

Further information about the work of the NERC Arctic Office can be found at www.arctic.ac.uk

Projects

Principal Investigator	Institute	Project title	Relevant Arctic Council Working Group/s
Prof. Bethan Davies	Newcastle University	The Greenland Connection: uncovering the hidden histories of UK Greenland exploration.	SDWG
Dr Karen Cameron	University of Glasgow	Snow Trap: investigating the impact of glacial snow cover on trapping winter gases	AMAP
Dr Iestyn Barr	Manchester Metropolitan University	FOrever Chemicals in Arctic Lakes (FOCAL)	AMAP, CAFF
Prof. William Austin	University of St Andrews	Seabed disturbance and the climate mitigation potential of Arctic fjords	PAME
Dr Jinoop Arackal Narayanan	Teesside University	Sustainable large-scale 3D printing of composite hydrogen storage and transportation systems for Arctic Maritime decarbonisation (SAM)	PAME, SDWG
Dr Paul Mann	Northumbria University	Together for Resilient Air and Climate Engagement (TRACE)	AMAP, SDWG, ACAP
Dr Lauren McWhinnie	Heriot-Watt University	Mapping whale watching activities in Arctic waters II	PAME
Prof. Richard Essery	University of Edinburgh	InSnowLation (A study of the effect of snow on roofs)	SDWG, AMAP
Prof. Kate Hendry	British Antarctic Survey	Feeding biology with glacial flour	CAFF, PAME, AMAP
Dr Darren Ghent	University of Leicester	Arctic radiometer deployment to validate satellite-derived surface temperatures for climate services	AMAP
Dr Laura Hobbs	Scottish Association for Marine Science	Midnight feast: what drives migration variability in a keystone Arctic species?	AMAP
Dr Cath Waller	University of Hull	Marine Plastics in the Arctic (MaPinA)	AMAP, PAME
Dr Filippa Lentzos	King's College London	Navigating Online Risks for Trusted Health Emergency Response in the North – Strengthening Health Infrastructure and Emergency Literacy for Disaster readiness (NORTHERN SHIELD)	EPPR
Dr Liam Kelleher	University of Birmingham	POLARSENSE+: airborne nano and microplastic sensing across Svalbard	AMAP
Prof. Marc Macias Fauria	Scott Polar Research Institute	Leveraging sub-meter satellite imagery to support management of West Greenland's heritage and natural systems	SDWG, AMAP, CAFF
Dr Hamish Pritchard	British Antarctic Survey	Arctic snowfall	AMAP
Dr Craig Smeaton	University of St Andrews	Aquaculture & the Arctic carbon cycle (AC2)	AMAP, ACAP, PAME
Dr Ishfaq Malik	University of Leeds	TRAILS – Tracking Risk Assessment and Indigenous-Led Strategies: ethnoclimatology of trail mobility in the Arctic	AMAP
Prof. Sarah-Anne Munoz	NHS Education for Scotland	Traditions of care: Gaelic and Indigenous knowledge for rural mental wellbeing	SDWG
Prof. Helen Wheeler	Anglia Ruskin University	Borealisation of the Arctic: understanding region- and ecosystem-specific ecological and societal impacts through research synthesis	AMAP, CAFF
Prof. Philip Steinberg	Durham University	Developing a legal assessment of Arctic geoengineering to support AMAP's scoping exercise	AMAP
Prof. Iwan Jones	Queen Mary University of London	Establishing the origin of the invasive pink salmon, *Oncorhynchus gorbuscha*, spawning in Icelandic rivers	CAFF, PAME
Prof. Karen Milek	Durham University	Sustainable agriculture in Iceland: archaeological and agricultural science knowledge-exchange and partnership-building	SDWG
Prof. Helen Wilson	Durham University	Designing for coexistence in the Arctic: urban kittiwake hotels	CAFF, AMAP
Dr Yifeng Yang	University College London	HyAIce-Dr: a hybrid Hydrodynamic–AI framework for predicting ice floe Drift in the Arctic marginal ice zone	PAME, AMAP

Project Summaries:

The Greenland Connection: uncovering the hidden histories of UK Greenland exploration

Principal Investigator:
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CoIs/Team Members:
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International Partners:
Dr Kirstine Møller Gray (University of Groningen)

Funding:
FCDO

Research Locations:
UK research institutions including Newcastle University, The Royal Geographical Society, Middlesex University, University of Nottingham, University of Liverpool, Royal Museums Greenwich and the University of Groningen (NED)

Photos: Courtesy of Project team.

Overview:

The UK was heavily involved in the historical exploration of Greenland and supported numerous expeditions from the 18th century onwards. Most published accounts of these expeditions focus on their male leaders and their immediate teams, such as John Franklin, John Ross and James Clark Ross, but rarely discuss the vital contributions of Greenlandic people, women or working-class crews members to expedition planning, implementation and reception. Recent reanalysis of extensive archives holding material related to historical Greenland expeditions has revealed more diverse and inclusive stories. Indigenous peoples, women and crew members from a variety of classes were crucial in externally sponsored Greenlandic exploration, observation and knowledge production, but their deep involvement is often omitted from official records and expedition publications. Our project aims to address the absence of records documenting the contributions of diverse expedition crews in the narratives surrounding these expeditions. We will create six interactive, multimedia ArcGIS StoryMaps that showcase the roles of Indigenous peoples, women, and working-class men in UK-led expeditions from the last 200 years. The six StoryMaps will be hosted on www.antarcticglaciers.org and will be available in English, Danish and Greenlandic.

Highlights:

1. Joint workshop of all project members at the Royal Geographical Society (November 2025) to present and discuss archived material retrieved from archives held at the Royal Geographical Society, Royal Museums Greenwich and in published literature. The workshop allowed us to review the compiled archived information and create templates for six 'StoryMaps', which address different topics associated with historical UK-led expeditions to Greenland. The six StoryMaps will address: 1) The Peoples of Greenland through time; 2) Scrambles for the Arctic; 3) Women in the history of expeditions in Greenland; 4) Indigenous Peoples in the history of expeditions in Greenland; 5) the sailors and soldiers in the expeditions, and 6) scientific expeditions in Greenland today.
2. Attendance of the 2026 Arctic Frontiers conference in Tromsø by 4 project members (Dr Owen King, Professor Bethan Davies, Professor Klaus Dodds and Dr Kirstine Møller Gray). Our team contributed to the conference programme through two events. On Monday 2nd February we held a workshop, which was well attended (25-30 attendees) and positively reviewed. The workshop involved three presentations by project members on topics including 'best practice in science communication to the public and for policy' (Professor Bethan Davies); 'recentring allyship and agency in the Arctic' (Professor Klaus Dodds); and on 'the Greenland connection' project itself (Dr Owen King). We then held a panel-based discussion involving both pre-prepared and audience questions on the topics introduced during the presentations. Also on Monday 2nd February, we presented two posters in an interdisciplinary poster session at the conference, with which we summarised the six StoryMap topics which will form the final outputs of the project.
3. A second workshop involving all project members will be held on 2nd March 2026 at Newcastle University to review the final drafts of the six StoryMaps. The StoryMaps will then be translated into Danish and Greenlandic before they are published online at www.antarcticglaciers.org at the end of March.

Next steps:

We are discussing future plans and have some ideas for future funding, but still early days.

Publications:

Six StoryMaps will be published and promoted on www.antarcticglaciers.org at the end of March 2026.

Snow Trap: investigating the impact of glacial snow cover on trapping winter gases

Principal Investigator:
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CoIs/Team Members:
Prof. Andrew Mitchell, Aberystwyth University; Dr Adrian Bass, University of Glasgow; Prof. Arwyn Edwards, Aberystwyth University

Funding:
FCDO

Research Locations:
Ny-Ålesund, Svalbard

Overview:

The Arctic is changing, with warmer, wetter, winters becoming the norm. Changes in climate have led to changes to Arctic environments, including increased observations of thick ice lenses within Arctic glacial snowpacks; formed as a result of substantial rain or freeze-thaw events during the winter. This project will study the impact of these lenses on the exchange of greenhouse gases (carbon dioxide and methane) from glaciers to the atmosphere. The results of this project will be of significance when considering whether contemporary snowpacks release a pulse of greenhouse gases to the atmosphere upon spring snowmelt; whether glacial microbial communities are active through the winter; and whether future glacial greenhouse gas flux dynamics will be affected by future reduced glacial snowpacks. Through this project, we will profile the spatial variability of snowpack gases and their relationship to ice lenses across multiple glacier surfaces, and in association with supraglacial microbial features. We will additionally test for the sources of these gases, and we will examine how they move through the snowpack environment. This project aligns with Arctic Council projects and Chair-ship priorities; presenting an innovative opportunity to study how climate change impacts glacial ecosystems, and how glacial ecosystems can impact the climate.

Photos: Dr Iain Rudkin, British Antarctic Survey

Highlights:

Our aim is to produce the first report of gases being trapped within glacier snowpacks, providing the potential for a pulse of greenhouse gas to be released upon glacier snow melt. The novelty of this work, and our ability to report findings from two end-of-season snowpacks (2025, 2026), would support publication within a high impact journal. We also aim to contribute to the work of the Arctic Monitoring and Assessment Programme (AMAP) Arctic Council Working Group, and we have previously discussed our GECO-21 research with Janet Pawlak, AMAP Deputy Secretary and climate change co-ordinator. Notably, both our projects (GECO-21 and Snow Trap) align well with the "Climate change impacts on Arctic ecosystems and associated climate feedbacks" Arctic Council AMAP/CAFF project. Furthermore, Climate Change in the Arctic is one of the Kingdom of Denmark's priority topics for their Chair-ship, which this project maps well to.

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Mr. James Kay, MMU

International Partners:
Prof. Kirsten Seestern Christoffersen, University of Copenhagen

Funding:
DSIT

Research Locations:
Qeqertarsuaq
(West Greenland)

FOrever Chemicals in Arctic Lakes (FOCAL)

Overview:

'Forever chemicals' are a large group of synthetic compounds first manufactured in the early 20th century. They are now found worldwide but are known to be toxic to humans and wildlife, prone to bioaccumulation and are degradation resistant or 'persistent'.

In the natural environment, forever chemicals are semi-volatile and mobile, penetrating soil, water, and air. They are carcinogenic, cause liver damage, and skin diseases, among other factors. They affect the composition and productivity of phytoplankton, which, through transfer up the food chain can impact invertebrates, fish, and mammals (including humans).

The Arctic is especially at risk of chemical contamination because these pollutants accumulate there due to global atmospheric circulation patterns. This means that forever chemicals contribute considerable biochemical stressors in environments and ecosystems that are already being profoundly altered by climate-driven changes.

The project aims to assess the concentration of forever chemicals in lakes in West Greenland. The objectives of the expedition are to collect sediment cores from the bed of lakes close to Qeqertarsuaq and search for forever chemicals in those sediments.

Photos: Dr Iestyn Barr, Manchester Metropolitan University

Highlights:

Upon concluding, this project will:

- Establish the concentration of forever chemicals in Greenlandic lakes over the last ~100 years.
- Identify the Arctic environmental impacts of forever chemicals over the last century, by combining lake ecosystem monitoring data and sedimentologically-derived biogeochemical reconstructions.

Next steps:

The research will contribute to a current postgraduate project.

Seabed disturbance and the climate mitigation potential of Arctic fjords

Principal Investigator:
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International Partners:
Dr. Mikael Sejr, Aarhus University, Denmark, Dr. Philippe Archambault, Université Laval, Canada

Funding:
FCDO

Research Locations:
Disko Bay, Eqi fjord, and Disko fjord, Greenland, Young Sound, Greenland, Qikiqtarjuaq fjords, Canada

Overview:

This project has analysed surface seabed sediments and sediment cores collected over the summer/autumn season 2025 from along-fjord gradients with three goals – 1. To establish sediment accumulation rates in Greenland sediment cores to measure organic carbon accumulation, 2. To measure organic carbon content, grain size, dry bulk density, stable isotopes, and thermal reactivity in cores and surface sediments, and 3. To measure the impact of disturbance in bottle incubation experiments, where sediment is resuspended and changes in organic carbon and thermal reactivity are measured. The project will advance knowledge on the amount and quality of organic carbon in Arctic fjord sediments, which have received little attention in global published literature. Arctic sediments are thought to be relatively low in organic carbon, as the cold temperatures and intermittent light in Arctic landscapes tend to support less land and marine vegetation. However, deglaciation and potentially extremely high sedimentation rates, driving efficient burial, could result in large amounts of organic carbon accumulation. Establishing sedimentation rates using cores from along transects in fjords and combining this with broader carbon characteristics and vulnerability to resuspension has the potential to highlight a significant and previously undervalued stock of organic carbon in nearshore Arctic sediments.

Highlights:

Sediment Accumulation Rates:
Through this funding, we have been able to measure geochronologies for five sediment cores from Disko Bay in collaboration with colleagues at University College London and are in the process of measuring geochronologies at St. Andrews for additional cores collected by our Danish partner from Young Sound, East Greenland. Results from Disko Bay cores show strong signals in supported/unsupported Pb^{210}, often with clear Cs^{137} peaks to validate those results. This data will contribute to strengthening the sparse existing dataset on sediment accumulation rates in Arctic fjords and underpin fundamentally important data to constrain organic carbon burial rates in these rapidly deglaciating Arctic environments.

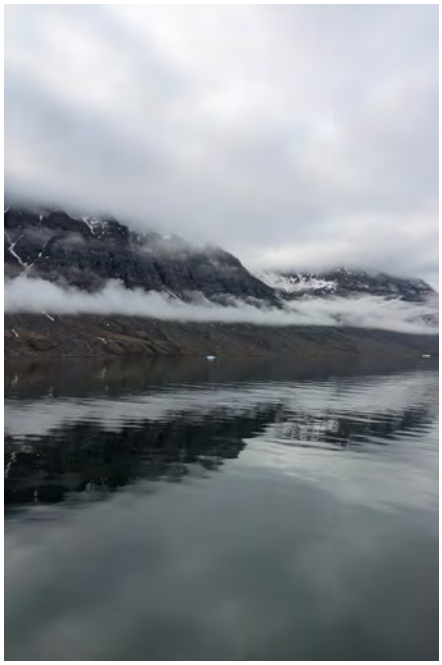
International Arctic Collaboration:
This funding has also allowed for collaboration between the team members and our Canadian and Danish colleagues, providing an opportunity for the exchange of multiple sediment samples at the Ocean Sciences Meeting 2026 in Glasgow, as well as the potential for future collaborations. Both Professor Austin and Ms South are actively collaborating with the Horizon Europe POMP (polar ocean mitigation potential) project, and the bursary is supporting the wider networking with leading European and Canadian Arctic researchers.

Next steps:

Professor Austin has been invited to lead a conversation on behalf of POMP with members of the Arctic Council to explore how changing climate and growing anthropogenic pressures can be framed in the long-term management of seabed carbon storage; we anticipate that the results of this Bursary will underpin some of the evidence to support this emerging science-policy conversation and are mindful of the need to communicate these findings to a wide stakeholder audience, including indigenous communities across the Arctic via Arctic Council channels.

Publications:

There is at least one planned publication in development from this work and likely to be a pan-Arctic sedimentary carbon output arising from the wider collaboration with POMP.



Photos: Ms Lauren South, University of St Andrews

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Co-Investigators/Team Members:
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International Partner(s):
Technical University of Denmark (DTU)

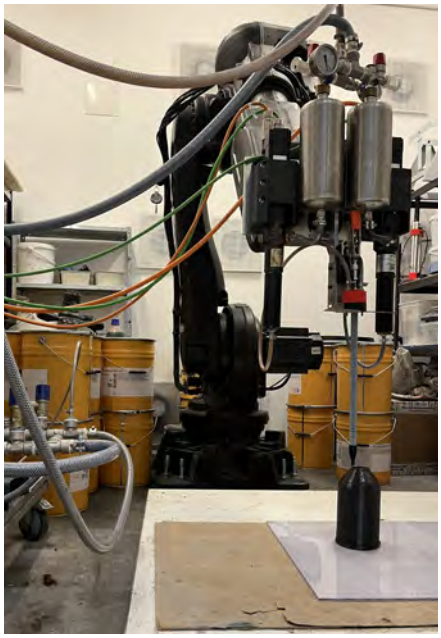
Funding:
DSIT

Research Locations:
Teesside University;
Technical University of Denmark

Sustainable large-scale 3D printing of composite hydrogen storage and transportation systems for Arctic Maritime decarbonisation (SAM)

Overview:

This project accelerates Arctic maritime decarbonisation by developing large-scale 3D-printed composite hydrogen storage and transportation systems. It combines DTU's expertise in composite additive manufacturing with Teesside University's strengths in hydrogen-material durability and environmental testing. The project focuses on carbon-fibre reinforced composites using thermoset matrices, selected for strong interlayer bonding, low permeability, chemical resistance, and high mechanical performance. Compared with conventional composite manufacturing, often labour-intensive, slow, wasteful, and geometrically restrictive large-scale 3D printing enables automated, digitally controlled fabrication of complex high-performance structures with improved repeatability and scalability. Candidate materials and printed components are evaluated under hydrogen exposure conditions with controlled pressure, temperature, and duration. Post-exposure microstructural characterisation and mechanical testing quantify durability and performance retention. Finally, comparative life cycle assessment (LCA) benchmarks the environmental impacts of 3D-printed storage systems against conventional composite alternatives, supporting evidence-based decision-making for Arctic deployment.



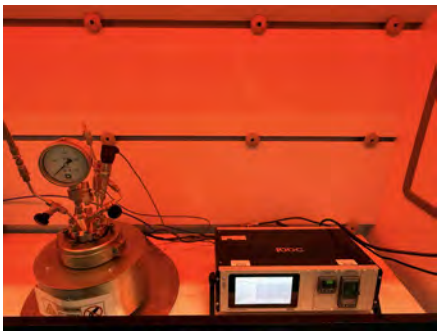
Photos: Dr Jinoop Arackal Narayanan, Teesside University

Highlights:

1. **Materials screening and first printed components delivered**
   A comprehensive literature review identified high-performance composite candidate materials suitable for hydrogen storage and compatible with additive manufacturing. Following screening, a selected material system was processed using DTU's large-scale 3D printing facilities, producing printed components that were delivered to Teesside University for mechanical testing and hydrogen exposure evaluation. In parallel, DTU successfully manufactured the first small-scale prototype of a 3D-printed composite hydrogen tank, providing an early proof-of-concept for the proposed manufacturing route. Together, these activities established a clear material down-selection pathway (from literature evidence to printed artefacts) and created the first physical test articles needed to validate hydrogen containment performance, mechanical integrity, and manufacturing feasibility.

2. **Hydrogen exposure trials and award-winning dissemination**
   Teesside University completed a focused literature review on mechanisms governing hydrogen–composite interactions and initiated experimental trials on commercially available continuous-fibre composite sheets. Samples were exposed to a hydrogen atmosphere at 80 bars for one week, then subjected to mechanical testing to quantify any changes in strength and stiffness after exposure. These early results provide baseline evidence on durability risks and testing protocols to support the next phase of material qualification for additively manufactured composites. The preliminary dataset and methodology were presented as a poster at the ISSMART 2025 conference (Teesside University), where the work received the Best Poster Award.

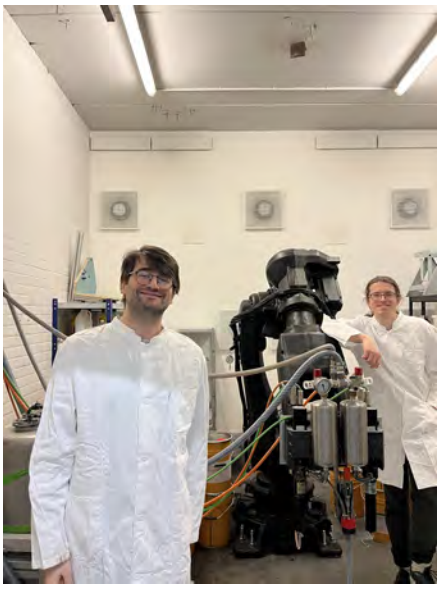
3. **International engagement, upcoming presentations, and facility exchanges**
   The DTU team has had an abstract accepted for presentation at the Arctic Observing Summit, where first results on candidate materials and the small-scale 3D-printed hydrogen tank prototype will be shared with the international Arctic research community. The project is also delivering structured knowledge exchange through reciprocal visits: the Teesside University team will visit DTU in March to present a talk, tour facilities, and scope future collaboration opportunities, while the DTU team will visit Teesside University in March to participate in a workshop hosted by Teesside University on 25 March at the Net Zero Industry Innovation Centre. These engagements strengthen international collaboration, align testing and manufacturing roadmaps, and create pathways for follow-on funding and scalable deployment.



Next steps:

The team is exploring follow-on funding opportunities, including Horizon Europe and other relevant schemes, reflecting the strong potential of sustainable hydrogen storage solutions for Arctic maritime applications. The planned research exchanges will underpin joint proposal development and longer-term collaboration. The current funding is also being used to expand material testing at Teesside University, generating datasets that will directly support future research bids and technology validation.

DTU has additionally ordered a new small-scale 3D printer equipped with an experimental print head capable of depositing continuous fibres with multiple thermoset matrices, including UV-curable systems. This will enable more flexible and material-efficient experimental campaigns, allowing systematic material development without the high material consumption typically associated with large-scale printing.



Publications / outputs linked to the bursary

1. Jos Jimoh, Chinedu Christian Amos, Chulin Jiang, Marco Brander, Berin Seta, Jinoop Arackal Narayanan. *3D Printing of Composite Materials: A Pathway to Next-Generation Hydrogen Storage*. Presented at the International Symposium on Smart Energy, Materials, Manufacturing and Digital Technologies (ISSMART 2025), 1 Dec 2025, UK. ISBN: 978-1-0369-6269-2.
2. Chinedu Christian Amos, Jos Jimoh, Chulin Jiang, Marco Brander, Berin Seta, Jinoop Arackal Narayanan. *Understanding the Mechanical Behaviour of Carbon Fiber Composites after Hydrogen Exposure*. Presented at ISSMART 2025, 1 Dec 2025, UK. ISBN: 978-1-0369-6269-2.
3. Marco Brander, Chulin Jiang, Berin Seta, Jinoop Arackal Narayanan. *Resilient Hydrogen Storage for the Arctic Through On-Site Additive Manufacturing*. Arctic Science Summit Week (ASSW) 2026, 25 March – 1 April 2026 (Abstract accepted).

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Funding:
FCDO

Research Location/s:
Sisimiut, Sarfannguit, Kangerlussuaq & Nuuk.

Together for Resilient Air and Climate Engagement (TRACE)

Overview:

Climate warming is driving rapid and widespread environmental change, particularly across high-latitude systems such as Kalaallit Nunaat (Greenland). These changes affect local communities in diverse ways, influencing infrastructure, health and livelihoods. One example, highlighted by local people, are fluctuations in the number of high-latitude dust (HLD) events they are subjected to, and how these will alter with retreating glaciers, drying permafrost ground or new infrastructure.

The TRACE project focused on building collaborations with local communities to gather observations, co-develop methods and implement monitoring networks to assess the impact of environmental change on people. Low-cost air quality instruments were developed and installed to monitor air quality and HLD events, alongside trail cameras to assess activity across a new ATV road development between Sisimiut and Kangerlussuaq. A range of community and local municipality meetings were held to share data insights to date, and to identify common concerns amongst local community members.

Highlights:

- **Low-cost air quality and trail camera instruments:** We have begun deployment of new air quality sensors across the important UNESCO World Heritage Site. Combining data from the network, we will begin modelling sources of HLDs to assess the impact of different environmental or development stressors.
- **Networking and community links:** Community workshops were held in Sisimiut, Sarfannguit and Kangerlussuaq to gather diverse insights into how climate change is affecting local life. This will support future proposals and network design.
- **Common concerns:** Changing precipitation patterns were consistently highlighted as a major and persistent concern affecting travel routes, harvesting and coastal water conditions within all communities.

Next Steps:

We continue to foster partnerships we have developed with the Qeqqata Kommunia municipality, UNESCO chairs, and Arctic Circle Trail Businesses. A follow up proposal to Nunatsinni Ilisimatusarnermik Siunnersuisoqatigiit (Greenland Research Council) has been submitted to foster community-based stream and lake water monitoring across the Qeqqata Kommunia.

Photos: Dr Paul Mann, Northumbria University

Mapping whale watching activities in Arctic waters II

Principal Investigator:
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CoIs/Team Members:
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Aberdeen University

International Partners:
Drummond Fraser, Transport Canada and Hjalti Hreinsson, PAME, Iceland

Funding:
FCDO

Research Locations:
Pan-Arctic

Overview:

Shipboard visitors to the Arctic routinely encounter whales. However, careful management and dedicated research are required to ensure that growth in Arctic marine tourism does not inadvertently harm northern whales, many of which are currently facing climate driven changes to their habitats. While many Arctic nations are now working to mitigate the impacts of shipping traffic on whales, far less focus has been placed on developing responsible marine wildlife watching measures and there is not yet a clear understanding of the extent of whale watching within Arctic waters. This new PAME working group project delivered by Canada and the UK will progress our ability to quantify and map whale watching activity across the Arctic, explores which stocks and populations are being routinely observed and improve our understanding of the data needs for monitoring and managing whale watching activity in the Arctic. While boat-based tourism can potentially impact whales, responsible tourism can also make a substantial contribution to local Arctic economies and whale conservation, therefore it's important that this industry develops in a sustainable and well managed manner guided by research and best available data.

Highlights:

- Analysis of the spatio-temporal trends in Arctic maritime tourism based on information in the ASTD system, including supplementary information with respect to the number of passengers and polar class. Statistical analysis of time vessels spend in EEZ's in relation to MPA's.
- Identification of Arctic Ports and Harbours where commercial whale watching operations take place and an inventory of operators and their fleet for each along with vessel passenger capacities and target species.
- Review of whale watching guidelines and regulations across the Arctic States and subsequent recommendation for increased clarity and alignment with the goal of improving compliance and adoption.

Next steps:

- The bursary has contributed to the PI securing an RSE fellowship, providing further capacity to undertake at sea surveys to provide additional data for use in this PAME project.
- The PI and Co-I are now undertaking a separate ASTD analysis for PAME looking at longer term trends in the data for working group report to be produce later this year.
- The PI is now undertaking work as part of a related project with WWF Arctic mapping whale migrations in collaboration with colleagues from CAFF.
- This summer in collaboration with industry partners HX Expeditions and Seiche we will be placing an infrared camera onboard an expedition ship to capture data on whales encountered, this will be the first time trialling this technology in polar waters and the results will be used to help inform future management and mitigation measures for vessels operating in the high north.

Publications:

There are 3 publications currently in preparation for submission related to this work; Tourist Vessels in the Arctic, Mapping the movements of Arctic whales, How are we managing whale watching in the Arctic, it is estimated that these will all be submitted for publication in 2026.

Photos: Dr Lauren McWhinnie, Heriot-Watt University

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CoIs/Team Members:
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International Partners:
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Funding:
FCDO

Research Location:
Finnish Meteorological Institute
Arctic Space Centre (FMI-ARC),
Sodankylä, Finland

InSnowLation (A study of the effect of snow on roofs)

Overview:

The Arctic Council states that the Arctic is home to almost four million people, and all of them need heated accommodation. Transporting building materials and fuel is expensive, particularly for remote communities, and understanding the thermal properties of buildings in cold environments is important for sustainable development. The structural and thermal properties of snow have been well known to Indigenous Peoples for millennia, and snow is still used for temporary or emergency shelters on the land. Scientific research and building regulations relating to interactions between snow and permanent structures, however, have focussed on snow loading on roofs; studies of the thermal properties of snow-covered roofs are severely lacking. Likewise, there have been far more studies of the insulating effect of snow on the ground than on roofs. Thermal conductivity is determined by snow microstructure that evolves over the winter due to effects of compaction, wind, temperature, vapour exchange and liquid water. Snow structure on roofs also depends on roof height, slope, aspect, materials and building use, and differs from snow on the surrounding ground. This project combines expertise in building and snow measurement for a field experiment to enable modelling of the thermal performance of Arctic housing and network building.

Highlights:

- Instrumentation installed inside and outside two buildings of contrasting construction and use
- Data available via ftp for analysis in near-real-time
- Poster presentations accepted for Comfort at the Extremes (CATE+) conference and UArctic Assembly in May 2026

Next steps:

With automatic instrumentation installed and running reliably, we will be able to extend the study to summer heat in Arctic buildings and snow insulation again next winter.

Above: Temperature and snow depth sensors installed above a roof.

Right: Rich Fitton (l) and Grant Henshaw (r) installing heat flux sensors on the ceiling of a building.

Photos: Prof. Richard Essery, University of Edinburgh

Feeding biology with glacial flour

Principal Investigator:
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kathen@bas.ac.uk

International Partners:
Dr Beatriz Gill Olivas, Aarhus,
Prof. Jemma Wadham, UiT

Funding:
FCDO

Research Locations:
Cambridge, UK (with visits to Aarhus and UiT)

Overview:

Glaciers were once thought to be inert environments, too cold for biology or for chemical reactions to occur. It's only in the last two decades that we've discovered that glacial environments are "hot spots" for biogeochemical processes that release biologically important elements. As glaciers flow, they crush the underlying rock into very fine "flour". When this material reacts with water flowing beneath glaciers and ice sheets, the unusual chemical conditions allow new, solid materials to form. These very fine particles are highly reactive and can release elements and compounds into the environment. Glacial flour is an important source of critical nutrients for coastal marine environments and has attracted substantial interest as a fertiliser for crops but also has the potential to harbour toxic metals. Different groups in the UK, Norway and Denmark are working on disentangling how different elements are released as these particles flow downstream and how they interact with each other. The aim of this project is to bring scientists together from these different laboratories for knowledge exchange and networking, and to produce a horizon scan of the key gaps in our understanding of how glacial flour feeds biology in marine and terrestrial systems.

Highlights:

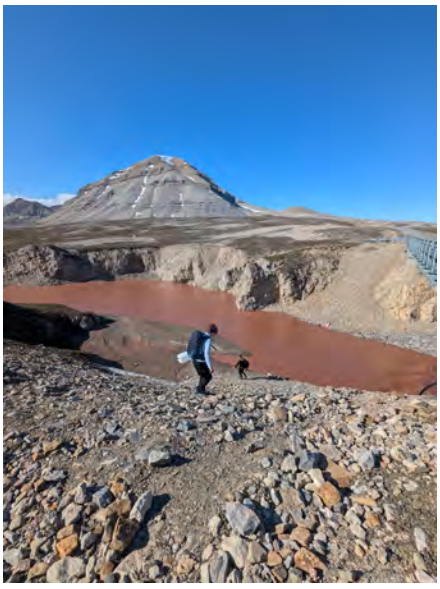
1. **Knowledge exchange**
   PI Hendry attended the UK Arctic Conference at Northumbria University in September 2025, participated in an early career researcher (ECR) discussion event, and presented a poster on glacial flour as a source of nutrients. She also undertook a visit to the University of Aarhus (Risø) in November 2025, to support planning for the project workshop and to give a seminar, and to Tromsø in February 2026 to meet with project collaborators (and attend a side event at Arctic Frontiers).

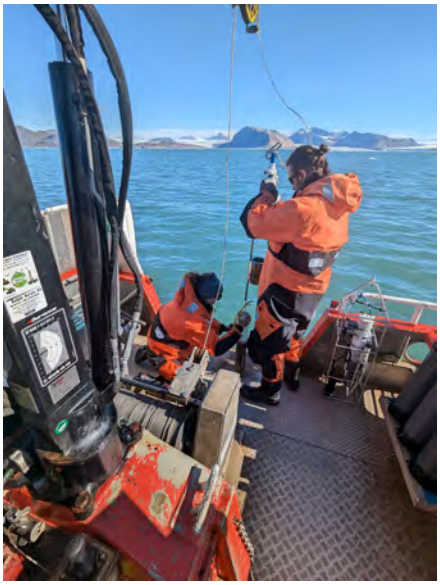
2. **Laboratory experiments and analyses**
   PhD student, Silje Waaler (UiT) carried out several sediment incubation experiments using samples of glacially derived sediments from Svalbard. The samples were analysed for dissolved silicon (DSi) as part of this project in the BAS Cambridge Labs in January 2026. The results show the clear role played by both geology and water salinity in driving nutrient release from glacial flour. Porewater samples from sediment cores from Svalbard were analysed for DSi in January 2026. The results demonstrate that there is an along-fjord gradient in sediment fluxes of DSi, increasing towards the mouth of the fjord, likely driven by differences in biological activity and glacial sedimentation.

3. **Workshop planning**
   Planning is well underway for the project workshop on glacial flour as a source of nutrients, to be held in BAS Cambridge in March 2026. We have approximately twenty attendees registered, including ECRs from Europe and the US, with interest from attendees engaged with stakeholders from industry. ECRs from UiT and Aarhus will be visiting to attend the workshop and also carry out further experiments in the BAS Cambridge Labs.

Next steps:

We will be holding the project workshop and hosting ECRs from Norway and Denmark in March 2026. The planned outcomes of this workshop include a horizon scanning report and potential outline plans for a proposal for further funding.





Photos: Prof. Kate Hendry, British Antarctic Survey

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CoIs/Team Members:
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Funding:
DSIT

Research Locations:
Ny-Ålesund, Svalbard

Arctic radiometer deployment to validate satellite-derived surface temperatures for climate services

Overview:

Land surface temperature (LST) is an essential climate variable because it characterises key aspects of the climate system. It is measured primarily using satellite remote sensing of emitted thermal infrared radiation from the surface, quantifying the 'skin' temperature. LST influences the global energy balance and drives heat exchange between the land surface and the atmosphere, making it critically important for understanding weather and climate processes.

To ensure confidence in satellite-derived climate datasets, validation against ground-truth measurements is required to assess accuracy, uncertainty and long-term stability of climate data records. In support of this, the surface temperature research group has installed the first dedicated LST radiometer at the NERC research station. The system measures upwelling and downwelling thermal radiation over a relatively homogeneous area. Measurements are taken every second and aggregated to one-minute intervals. The in-situ station will record surface temperature throughout the year, enabling monitoring of seasonal transitions across surface types such as bare ground, snow and ice.

Given Arctic amplification, with the region warming around four times faster than the global average, capturing detailed surface temperature change is essential for comparison with satellite observations and for robust assessment of Arctic climate trends.

Photos: Dr Abigail Waring, University of Leicester

Highlights:

1. Milestone Success

A major milestone was the successful deployment of the first dedicated LST radiometer at the NERC Arctic Research Station in Svalbard. This installation establishes a long-term, traceable reference site for validating satellite-derived LST climate data records (as seen in Figure 1).

The deployment demonstrated the feasibility of operating precision radiometric instrumentation in a harsh Arctic environment, including snow, ice and transitional surfaces through the seasons. The success of this campaign has directly enabled plans to expand the observing network, including a further deployment in Greenland in March 2026. Longer term, we aim to collaborate again with BAS to build a distributed Arctic LST validation network to strengthen confidence in satellite climate products

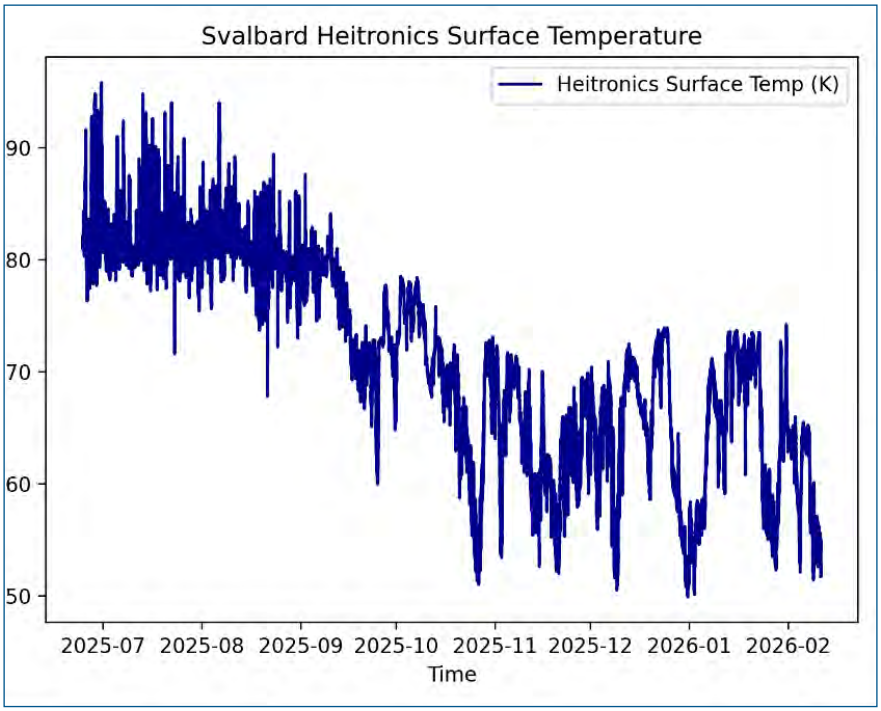

Figure 1: *Time series of surface temperature measured by the Heitronics infrared radiometer at the Svalbard validation site. The data are recorded at 1-minute temporal resolution and expressed in Kelvin, showing the diurnal variability of radiometric surface temperature over the observation period.*

2. High-Impact Media Recognition
   An in-depth blog detailing the Arctic deployment was published on the NCEO and NERC Arctic Office websites, communicating both the scientific objectives and the operational challenges of establishing a polar validation site. The piece was subsequently picked up for a BBC television special, significantly broadening the audience beyond the academic community.
   This media exposure amplified the visibility of satellite climate validation work and highlighted the importance of in-situ measurements in understanding Arctic amplification. It demonstrated tangible societal impact, translating technically complex Earth observation research into accessible public-facing content.
   The experience strengthened engagement between scientists, communications teams and broadcasters, and provided a platform to showcase the role of UK Earth observation research in addressing climate change. Continued outreach will remain a priority as the Arctic instrument network expands.

3. Advancing Arctic Climate Data Records
   The project provides a critical step forward in validating satellite-derived LST climate data records in a region warming approximately four times faster than the global average. Continuous in-situ measurements across seasonal transitions, including snow-covered, mixed and snow-free conditions, allow detailed assessment of satellite accuracy, uncertainty and stability under extreme environmental variability.
   This work supports improved quantification of uncertainty budgets within LST climate data records, strengthening their suitability for long-term climate trend analysis and operational applications. Establishing a sustained Arctic validation framework will enhance confidence in global LST datasets used by research, policy and operational climate services.

Next Steps:

The instrument will need swapping after two years to re-calibrate, meaning we would need to return to continue the project. The success of this deployment has directly led to a new deployment in Greenland in 2026.

Photos: Dr Abigail Waring, University of Leicester

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International Partners:
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University Centre in Svalbard

Funding:
FCDO

Research Location:
Svalbard

Midnight feast: what drives migration variability in a keystone Arctic species?

Overview:

This project will focus on variability in the migratory behaviour of a keystone Arctic marine species – *Calanus finmarchicus*. Calanus populations undertake extensive vertical migrations every day with huge consequences for carbon flux and predation rates. We know a lot about migration variability between species (i.e. the differences in timing and depth of vertical migrations between Calanus and krill), but almost nothing about the way that individual variability (e.g. hunger, diet, morphology (size and colour, and therefore visibility to predators), lipid reserves) drives migration differences within one species. These individual characteristics are all changing with warming oceans with the potential to disrupt migration patterns with knock-on effects for carbon flux and higher trophic levels. In this project, PI Hobbs will determine which aspects of individual variability govern migration timings by running repeated zooplankton sampling campaigns during known migration times (sunrise and sunset) in the high Arctic. These observations will be analysed in the context of projected environmental changes to evaluate how shifts in this fundamental and widespread behaviour could influence Arctic ecosystems.

In September 2025, the PI spent two weeks working in Ny-Ålesund alongside as part of a team working on the Norwegian project "OpKROP". For the Midnight Feast project, the team undertook a specific morning field sampling campaign with the aim of catching migrating zooplankton as they descended at sunrise.

The team used a pumped system to sample zooplankton continuously from 30m, and filtered these through zooplankton nets, switching sampling containers every 30 minutes. In parallel, they took three depth-resolved WP2 zooplankton nets every hour. By being stationed at KB3, we were near to our long-term mooring station enabling us to compare our data to bioacoustic records once we collect the instruments in summer 2026.

Back in the lab, we identified, weighed, and photographed our samples. Some Calanus copepods were incubated for 48h to collect faecal pellets, which I weighed to estimate gut fullness. A subset was preserved for future DNA analysis to look at the stomach contents.

Working under red light at night.

Photos: Laura Hobbs, SAMS

Highlights:

- Capturing the migration
- Initial microscopy work suggests that we caught some size variation in the migration, exactly what we hoped for! These are still preliminary results, but we are hoping to dive into them more this spring.

Next steps:

Midnight Feast was designed as a pilot study, and we intend to use these results to apply for a bigger funding pot and carry out the sampling on wider timescales and different locations.

A collection of zooplankton ready for weighing.

Calanus, our target catch.

Marine Plastics in the Arctic (MaPinA)

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CoIs/Team Members:
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Funding:
FCDO

Research Location:
Uummannaq, Greenland

Overview:

Uummannaq is a small coastal town in northwestern Greenland (population ~1000-1200). It sits on Uummannaq Island, about 590 km north of Nuuk. The island is about 12 km^2 and the town occupies the southern tip. Because of its remote location, it is reachable by helicopter or boat from Qaarsut, which has the nearest airport. The community is closely-knit and traditional Arctic livelihoods are still the main employment. These include:

- Fishing (mainly for halibut)
- Hunting seals, whales and other marine animals
- Dog sledding in winter
- Small-scale tourism (a few cruise ships in summer)

There is very limited waste management infrastructure. Due to the expense of exporting waste and importing materials, any waste which may prove useful in the future is stockpiled in the environment - creating a kind of island circular economy.

This project provides a networking and scoping visit to build strong relationships with the community in Uummannaq and to identify community concerns and research priorities when living in a remote location with strong traditional Inuit customs and a rapidly changing environment. The team was hosted by Ann Andreasen, the director of the Uummannaq Children's Home and founder of the Polar Institute, who facilitated introductions to many prominent people within the community.

Photo: Courtesy of Project Team

Highlights:

- Workshop with the children of Uummannaq Children's home to explore their experience of living in Uummannaq and how climate change and plastics are affecting their day to day life.
- Meeting with researchers from Uummannaq Polar Institute and potential co- developed citizen science projects.
- Meeting with Hunters and Fishers co-operatives- discussion on co-developing a project to understand the status of the halibut fishery and plastics in higher predators.
- Discussions for collaborations with University of Versailles and other international partners

Next steps:

- Arctic Plastics Discourse: hosted by the Revolution Plastics Institute, University of Portsmouth. Open to individuals from both academia and other organisations (e.g. Civic, NGO, SMEs)
- Systematic review of current information on plastics, climate change and indigenous knowledge in Greenland (this will feed into a large grant application crossing the interface between social science, art, environmental and ecological science, with partners in Uummannaq and International academic partners)
- Co-develop a large-scale community driven research project on the issues raised during community meetings and seek funding from UKRI/Horizon Europe or other funders.

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Funding:
FCDO

Research Locations:
Northwest Territories,
Yukon, Nunavut

Navigating Online Risks for Trusted Health Emergency Response in the North – Strengthening Health Infrastructure and Emergency Literacy for Disaster readiness (NORTHERN SHIELD)

Overview:

This project examines information integrity as a core component of health security in the context of the accelerating securitisation of the Arctic. Drawing on a review of scientific literature, policy documentation and targeted engagement across northern Canada, it develops a context-informed framework for understanding how health-related misinformation and disinformation circulate within Arctic governance environments.

Fieldwork in Inuvik (Northwest Territories), Whitehorse (Yukon), and Iqaluit (Nunavut), focused on sites central to Canada's evolving security and health infrastructure. These locations illustrate how defence expansion, public health systems, and indigenous governance intersect in shaping community resilience.

The research connects pan-Arctic and national strategies with grounded analyses of local information ecosystems. Particular attention is given to how health-related misinformation affects trust, resource allocation, emergency preparedness, and the implementation of the Emergency Prevention, Preparedness and Response (EPPR) framework. This project aims to generate policy-relevant recommendations for embedding local knowledge systems and community-led resilience strategies within EPPR-aligned planning in Arctic contexts.

The Legislative Assembly of Nunavut, February 2026.

Photo: Dr Filippa Lentzos, King's College London

Highlights:

- **Network-Building and Strategic Policy Access:**
  We expanded and consolidated a cross-sector Arctic health security network spanning territorial and federal health policy, frontline clinicians, defence stakeholders, digital infrastructure specialists and media actors. Engagement was structured to ensure co-creation of research priorities grounded in operational realities across northern communities.
  This positioning has enhanced the project's policy traction. Dr Lentzos was appointed to Health Emergency Readiness Canada's (HERC) Life Sciences Expert Advisory Council, a special operating agency within Innovation, Science and Economic Development Canada. HERC leads Canada's industrial policy response to health emergencies and supports life sciences capacity-building aligned with national security objectives. The advisory role includes providing input to the Deputy Minister of Industry on industrial health preparedness in the Arctic and High North, embedding insights from this project directly into federal-level strategic discussions.

- **Federal Investment and Strategic Alignment:**
  During the fieldwork period, several federal announcements underscored the growing strategic significance of Arctic security and information integrity. In Whitehorse, we attended the announcement of over $350,000 to the Council of Yukon First Nations through the Regional Defence Investment Initiative to advance Arctic security and economic development. Canada also released its first Defence Industrial Strategy, outlining multi-billion-dollar investment to reinforce the defence industrial base, including in the High North. Public Safety Canada committed C$14 million to modernise Arctic ground search-and-rescue capacity, enhancing resilience in remote communities.
  Concurrently, the appointment of Dr Joss Reimer as Chief Public Health Officer (20 February 2026) signalled renewed federal attention to health misinformation and rebuilding public trust.
  These developments directly reinforce the project's core argument: that expanding defence and security infrastructures must be matched by strengthened information integrity and community-centred health governance. The research provides analytic lens for integrating these domains rather than treating them as parallel policy tracks.
  The bursary has enabled direct engagement with Arctic governance actors at a critical inflection point in Canada's defence and health policy development, ensuring that information integrity considerations are incorporated into emerging security architectures.

The team travelling between meetings in Iqaluit, February 2026.

Photo: Dr Fawzia Fall, King's College London

Next Steps:

We will submit evidence to the House of Commons Defence Committee inquiry on Defence in the High North (25 March 2026), drawing directly on findings from our fieldwork and policy analysis.

We will present project findings to academic and practitioner audiences, including a poster presentation at the Global Health Security conference (Malaysia, June 2026), to facilitate cross-regional comparison and knowledge exchange.

We are also developing follow-on funding proposals to extend the research geographically to Greenland and Norway and substantively to comparative Arctic information ecosystem strengthening the project's pan-Arctic relevance

Publications:

A manuscript for the *British Medical Journal (BMJ)* examining Arctic health security through three interrelated dimensions: the civilian–military nexus in health systems; the public health implications of expanding security infrastructures; and governance mechanisms for safeguarding information integrity.

A manuscript for *International Affairs* analysing how the securitisation if Arctic governance is reshaping scientific cooperation and diplomacy, generating structural vulnerabilities to mis/disinformation and foreign information manipulation and interference (FIMI).

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Funding:
DSIT

Research Locations:
Ny- Ålesund and Longyearbyen

POLARSENSE+: airborne nano and microplastic sensing across Svalbard

Overview:

Micro- and nanoplastics (MNPs) are increasingly detected in polar and other remote environments, highlighting the global scale of plastic pollution. Due to their small size (<5 mm), these particles can be transported over long distances through atmosphere. As a result, even relatively pristine Arctic area receives plastic contamination originating far beyond the region. In addition to long-range transport, local human activities such as tourism, shipping, and research infrastructure may also contribute to plastic pollution in Svalbard.

Building on the earlier POLARSENSE project, this work focuses on improving automated sampling technology for monitoring airborne MNPs. Existing sampling systems are improved, and a redesigned smaller, more compact instrument has been deployed in remote environments. These improvements allow easier deployment and more consistent sampling.

Alongside ongoing monitoring in Ny-Ålesund, the project expands the research area to Longyearbyen to investigate local sources and transport pathways of plastic particles within Svalbard. By combining improved sampling technology with expanded geographic coverage, the project aims to better understand how plastic pollution moves through Arctic environments and contributes to long-term monitoring efforts.

Highlights:

Project outputs focus on the development of new sampling technology and the generation of datasets to improve understanding of airborne MNPs in the Arctic.

1. Development of a compact automated atmospheric sampler capable of operating continuously for up to one month. The system incorporates a NanoTank wet scrubber collection bottle and improved controller hardware designed for reliable Arctic deployment.
2. Completion of three field deployments in Svalbard, producing atmospheric particulate samples for laboratory analysis and expanding monitoring of airborne pollution across multiple locations.
3. Preparation of scientific outputs based on collected datasets, including a methods paper describing the sampler design and modelling of NanoTank sampling performance. Following laboratory analysis, the project is expected to deliver three manuscripts examining MNP transport pathways, atmospheric particulate composition, and potential aerospace-derived metal tracers in Arctic air samples.

Photos: Dr Iain Rudkin, British Antarctic Survey

Future plans:

Longer term funding through NERC funding schemes.

Outputs:

Manuscripts are in preparation but not published. Outreach related included field site videos (2 on YouTube), presentations (4 on the project) and posters (1 at EGU).

Leveraging sub-meter satellite imagery to support management of West Greenland's heritage and natural systems

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Funding:
FCDO

Research Locations:
Aasivissuit–Nipisat UNESCO World Heritage Site, Qeqqata Kommunia, West Greenland, including the Arctic Circle Track corridor between Kangerlussuaq and Sisimiut.

Overview:

This project supports the management of the Aasivissuit–Nipisat UNESCO World Heritage Site (>400,000 ha) in West Greenland through the acquisition and analysis of sub-meter satellite imagery. Working in close partnership with Qeqqata Kommunia and the Greenland Institute for Nature Resources (GINR), the project addresses emerging land-use pressures associated with the recently completed Arctic Circle Track, an ATV-accessible route linking Kangerlussuaq and Sisimiut.

Using very high-resolution imagery combined with machine learning and computer vision approaches, we will detect and map ATV incursions and wildlife trails, generate land cover and vegetation classifications, and integrate outputs with GINR's wildlife telemetry datasets (caribou and muskox).

The project includes co-development of visual materials and a collaborative workshop in Kangerlussuaq (Winter/Spring 2026) to support evidence-based planning, conservation, and outreach. Through methodological innovation and close stakeholder engagement, the project strengthens local capacity for landscape monitoring and contributes to Arctic Council goals on biodiversity, sustainable development, and science-policy integration.

Highlights:

1. **Collaborative Workshop in Kangerlussuaq (March 10–17, 2026):** a central milestone of the project is a co-creative workshop in Kangerlussuaq bringing together researchers from Cambridge, representatives from Qeqqata Kommunia, collaborators from GINR, and local stakeholders. The workshop will present imagery products, automated mappings of ATV and wildlife tracks, and draft land cover classifications. It will provide a structured forum to review findings, refine analytical priorities, and co-develop a strategy for long-term imagery-based monitoring across the UNESCO site and surrounding areas. Beyond scientific exchange, the workshop is designed to support local capacity building and ensure that outputs are directly usable in municipal planning documents, heritage communication, and emerging management strategies, including those linked to the proposed West Greenland National Park.
2. **Acquisition and Analysis of Sub-Meter Satellite Imagery:** we have purchased very high-resolution (sub-metre) multi-band satellite imagery from Maxar's WorldView constellation covering the UNESCO site during the first summer following the opening of the Arctic Circle Track. These data are being mosaicked and ortho-rectified, then analysed using a machine learning-based computer vision framework to detect and classify ATV incursions and wildlife trail networks ahead of the Kangerlussuaq workshop.
3. **Integration into Local Governance and Future Planning (during and after the workshop):** project outputs will be designed for direct application in Qeqqata Kommunia's planning processes, including management documents for the UNESCO site and strategies associated with the potential West Greenland National Park. High-resolution maps, 3D visualisations, and simplified spatial products will be co-developed for use in signage, school programmes, public presentations, and events such as the annual World Heritage Festival.

By integrating remote sensing, ecological monitoring, and stakeholder-defined needs, the project advances a transferable model of science-informed, locally embedded governance. The work strengthens links between UK and Greenlandic institutions while supporting sustainable tourism, biodiversity monitoring, and heritage protection within a rapidly changing Arctic context.

Next Steps:

The project lays the foundation for continued collaboration with Qeqqata Kommunia and GINR on imagery-based monitoring of vegetation, wildlife movement, and land-use impacts across the UNESCO site and in relation to the proposed West Greenland National Park.

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Funding:
DSIT

Research Locations:
Ny-Ålesund, Svalbard

Arctic snowfall

Overview:

Snowfall is the primary driver of the Arctic hydrological cycle, the supplier of virtually all mass to Arctic glaciers and the Greenland Ice Sheet, a primary control on freezing and thawing of the region's soils and sea ice, and is at the frontline of climate change. It is also very poorly observed and therefore poorly modelled; hence its future is uncertain. This project aims to enable a major expansion in the scale of Arctic snowfall measurements in support of the Arctic Council's climate measuring and monitoring goals. It will adapt for Arctic conditions a new, award-winning method that allows snowfall to be measured accurately, in near real time, on a scale order of magnitude greater than previously possible, and potentially across the surface of the Greenland Ice Sheet where no comparable measurements exist. We will trial these adaptations in northern Svalbard, and once hardened against animal attack, long winter darkness and summer flooding, our autonomous sensors will allow us to collect the benchmark data we need to improve operational weather forecasting and future climate projections of snowfall.

Expected Scientific Outcomes:

1. **Development and Field Testing of New Snowfall Instruments.**
   Two newly developed, ruggedised snowfall-measurement instrument variants will be field-tested for Arctic conditions. These systems will be ready for scaling into an autonomous, high-frequency observational array capable of capturing individual snowfall events in near-real time across potentially thousands of square kilometres of the Arctic. This will include the first direct snowfall measurements on the Greenland Ice Sheet, offering a transformative step forward in understanding this fundamental component of the Arctic climate system.

2. **Novel Svalbard Snowfall Observations and Model Assessment.**
   A full winter of new, high-resolution snowfall observations will be collected in Svalbard. These data will support a preliminary evaluation of the accuracy of AROME-Arctic high-latitude snowfall outputs in the region, improving our ability to assess and refine numerical weather and climate models.

3. **Knowledge Transfer and New Arctic Partnership.**
   Expertise in snowfall measurement techniques will be transferred from BAS to NPI, strengthening institutional capability. The project will also establish a new international partnership with colleagues in an Arctic state, enabling broader adoption and development of this innovative snowfall-measurement method.

Recce of Trautvatnet, the proposed field site.

Photo: Dr Iain Rudkin, British Antarctic Survey

Aquaculture & the Arctic carbon cycle (AC2)

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Funding:
DSIT

Research Locations:
Seyðisfjörður and Isafjarðardjúp,
Iceland

Overview:

AC2 is delivering the first comprehensive, process-based assessment of how industrial finfish aquaculture is altering organic carbon (OC) burial and long-term storage in Iceland's fjords. By combining high-resolution sediment coring with radionuclide dating, geochemical characterisation (C, N, $\delta^{13}C$, $\delta^{15}N$), thermal reactivity measurements, and metal analysis, the project is generating a new dataset on both natural and aquaculture-derived OC. Early findings indicate that Icelandic fjords accumulate less OC than global averages, increasing the relative influence of aquaculture-derived organic matter on sediment biogeochemistry. This work provides the first mechanistic understanding of how aquaculture inputs alter OC sources, lability, and burial efficiency information currently absent from Arctic carbon budgets. The resulting evidence will inform climate-relevant assessments of fjord ecosystem services across the North Atlantic and wider Arctic.

Highlights:

1. **First assessment of aquaculture impacts on Arctic fjord carbon storage.**
   AC2 is generating the first integrated dataset showing how finfish aquaculture alters the sources, lability, and burial of organic carbon in Icelandic fjords, using sediment cores, radionuclide dating, geochemical analysis, and reactivity measurements.
2. **Direct policy relevance for Arctic Council working groups**
   The project provides new evidence on aquaculture-derived organic matter and associated metal inputs, supporting AMAP climate assessments, informing ACAP pollution-prevention work, and contributing to PAME's ecosystem-based management approaches for Arctic coasts.
3. **Scalable modelling to estimate national carbon burial**
   Using Quantile Random Forest models combined with new and existing fjord datasets, AC2 will deliver the first Iceland-wide estimate of natural vs aquaculture-derived carbon burial, enabling national-scale evaluation of aquaculture's climate implications.

Photos: Dr Craig Smeaton, University of St Andrews

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International Partners:
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Arviat, Canada

Funding:
FCDO

Research Locations:
Arviat (Nunavut) and Hopedale (Nunatsiavut), Canada.

Community engagement in Arviat, Nunavut, Canada.

Photos: Dr Ishfaq Malik, University of Leeds

TRAILS – Tracking Risk Assessment and Indigenous-Led Strategies: ethnoclimatology of trail mobility in the Arctic

Overview:

The TRAILS project examines how rapid climate change is reshaping everyday mobility, safety, and access in Arctic communities by focusing on land-, ice-, and water-based travel routes (trails) that underpin livelihoods, social life, and wellbeing. Working in partnership with Inuit communities of Arviat and Hopedale in the Canadian Arctic, the project combines Indigenous knowledge with climate and environmental data to understand how changing ice conditions, weather variability, and seasonal transitions affect travel decisions and risk. TRAILS moves beyond infrastructure-centric adaptation by centring mobility as a critical but under-recognised dimension of climate resilience. The project generates policy-relevant insights for adaptation planning, emergency preparedness, and climate risk governance, while producing community-accessible outputs that support locally grounded decision-making.

Highlights:

1. **Co-produced travel safety insights**
   A core achievement of the TRAILS project is the co-production of travel-safety insights with Inuit community members. Using interviews and participatory mapping during a two-month fieldwork in the Canadian Arctic, the project documented context-specific criteria for safe travel across water, land, and ice. These insights reflect how multiple environmental variables interact in everyday decision-making rather than abstract technical standards. Indigenous knowledge was translated into an operational form without loss of context, forming the analytical foundation of the project and providing a transferable, bottom-up approach to climate risk assessment focused on mobility.

2. **Advancing mobility-focused climate adaptation**
   TRAILS advances climate adaptation thinking by centring climate justice, everyday mobility and access rather than infrastructure alone. The project demonstrates how changing trail conditions shape food security, emergency response, and cultural practices. Findings highlight that adaptation strategies which overlook trails risk exacerbating vulnerability. Project outputs are being translated into policy-relevant insights and community-accessible summaries to support locally grounded adaptation planning. By foregrounding Indigenous knowledge as integral to climate risk governance, TRAILS provides a practical framework for incorporating mobility into adaptation decision-making in Arctic and other climate-vulnerable regions.

3. **Contributions through publications:**
   The project has resulted in three significant publications:

   Political ecology of climate change adaptation in the Arctic: Insights from Nunatsiavut, Canada (Nature - Humanities and Social Sciences Communications) https://www.nature.com/articles/s41599-025-06058-2

   A critique of climate objectivity in the context of global injustice (Environmental Research Letters) https://iopscience.iop.org/article/10.1088/1748-9326/ae301b/meta

   Political ecology: past, present, and future (Discover Sustainability) https://link.springer.com/article/10.1007/s43621-026-02707-x

Next steps:

The bursary has directly enabled the development of a transferable methodological framework that will be extended in future research. Planned next steps include developing trail access insights on Arctic in the form publications. The work also feeds into larger interdisciplinary funding applications focused on mobility, climate justice, and Indigenous knowledge co-production, ensuring the bursary's impact extends well beyond the life of the initial project.

Traditions of care: Gaelic and Indigenous knowledge for rural mental wellbeing

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International partners:
Informal engagement with partners in Canada with expertise in land-based, community-led approaches to mental health.

Funding:
FCDO

Research Locations:
Scotland (Gaelic-speaking communities, primarily rural and island contexts).

Overview:

Gaelic Traditions of Care: Cultural Knowledge and Rural Wellbeing explores how traditions of care embedded in Gaelic language, culture, and relationships to land continue to shape wellbeing in rural Scotland. While rural mental health is increasingly recognised as a public health priority, cultural resources that communities draw on - such as communal storytelling, coimhearsnachd (community as shared responsibility), and duthchas (deep belonging and connection to place) - remain largely invisible within health systems and the education of health professionals. This project will work with Gaelic speakers, particularly elders and cultural practitioners, to record oral histories and explore how cultural concepts and practices have supported people through hardship and distress. It will also consider concepts such as cianalas (a complex longing for place and kin) and the historical role of local figures who provided practical and emotional support. Alongside Scotland-based work, the project is preparing the ground for respectful dialogue with Indigenous partners in Canada around land-based, community-led approaches to mental health - without making direct comparisons at this stage.

Highlights:

1. **Reframing rural wellbeing through Gaelic cultural knowledge**
   A key development so far has been establishing a clear project focus on cultural traditions of care as a missing layer in how rural mental health is commonly framed. The project foregrounds Gaelic concepts that reflect lived, community-rooted approaches to wellbeing - particularly coimhearsnachd (care as shared responsibility) and duthchas (place-based belonging). This reframing matters because it offers a way to think about rural mental health that goes beyond service access alone, recognising that communities often sustain wellbeing through cultural practices, intergenerational ties, language, and land. The project positions these traditions as valuable resources that have been under-recognised in contemporary systems and professional education, even in areas where Gaelic continues to shape everyday life.

2. **In-Depth Qualitative Approach**
   The project is progressing an in-depth qualitative approach, working with Gaelic speakers to discuss how they feel traditions of care continue to shape wellbeing today. This includes exploring cultural concepts such as cianalas, and the historic roles of local support figures who offered practical and emotional care within communities. The emphasis is on respectfully recovering and valuing knowledge that has historically been excluded from healthcare practice and professional training. By capturing oral histories and culturally grounded accounts of care, the project is building a foundation for future knowledge exchange that can inform how rural services and education can better recognise and engage with culture, language, and place.

3. **Building an international dialogue pathway**
   A further highlight is the early-stage relationship-building that will support future international dialogue. The project is engaging informally with partners in Canada and other countries who have developed land-based, community-led approaches to mental health. At this stage, the intention is not to draw direct comparisons, but to prepare the ground for respectful exchange and learning across rural contexts where culture, land, and identity are central to wellbeing. Looking ahead, planned outputs include an online knowledge-sharing webinar in 2026, which will bring together collaborators and interested colleagues to share learning and shape the next phase of work,

Image: Courtesy of Project Team

Next Steps:

Planned next steps include a knowledge-sharing webinar in 2026, with the aim of building a wider network of collaborators and shaping further work focused on culturally grounded rural mental health and wellbeing approaches that takes a co-production approach.

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Funding:
FCDO

Research location:
Pan-arctic synthesis

Borealisation of the Arctic: understanding region- and ecosystem-specific ecological and societal impacts through research synthesis

Overview:

As the Arctic rapidly warms, species expanding their range and densities into the Arctic are likely to have substantial ecosystemic and societal consequences. The movement of boreal species in the Arctic is known as borealisation and is increasingly documented across many Arctic marine, terrestrial and freshwater environments. Building on previous work to establish a database of literature documenting ecological and societal implications of borealisation, we are investigating core thematic areas of societal implications of borealisaton.

We are also using interview-based research with borealisation researchers to understand their perceptions of the likelihood and magnitude of societal implications from the ecological impacts of borealisation in their study systems. This will help both horizon-scan for future risks from borealisation and document those impacts that are currently occurring but are poorly documented.

Finally, Dr Wheeler is collaborating on a rapid review of climate adaptation projects led by the Norwegian co-investigator.

Dr Wheeler is working directly with Tromsø-based leads of the AMAP/CAFF Societal Implications of Climate Change in the Arctic report and CAFF Climate Change Impacts on Ecosystems and Associated Climate Feedbacks reports to integrate findings into the reports.

Photos: Project Team

Highlights:

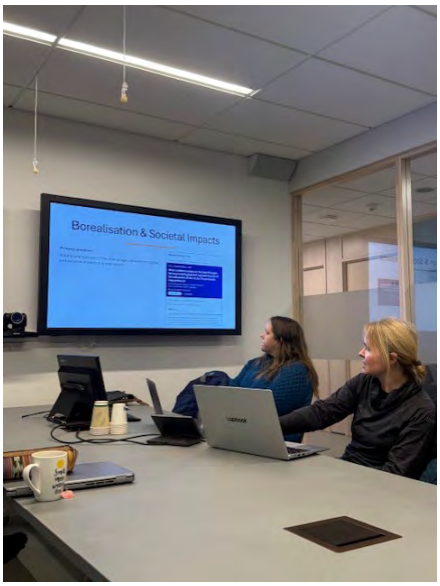
- Of 90,131 articles returned by our search strings, 5,705 pertained to borealisaton of which only 242 referred to societal implications of borealisation, demonstrating that the majority of the literature regarding borealisation has an ecological focus. Of these 2,767 pertained to marine environments, 549 to coast, 792 to freshwater and 3,309 to terrestrial (noting that some pertained to multiple ecosystem types).
- Analysis of the borealisation database using topic modelling, has identified some core recurrent themes in literature related to societal implications of borealisation of the Arctic. Dominant themes related to reindeer husbandry and caribou, parasites (particularly ticks) and disease, fish and fisheries and berries. Core societal thematic areas included health, adaptive capacity, vulnerability and infrastructure, surveillance, knowledge, subsistence and harvest. We are currently further investigating these themes within the database and the interlinkages between ecological and societal implications of borealisation. We are mapping the location of studies to understand where studies of borealisation are undertaken relative to key predictors of rapid environmental change to understand how the geographic distribution of studies might affect our interpretation of the impacts of borealisation.
- We are analysing 15 interviews with terrestrial borealisation researchers to understand the perceived interlinkages between ecological and societal implications of borealisation in terrestrial environments. A cognitive mapping approach was used to look at the perceived linkages between environmental change and societal impacts.
- Helen Wheeler has been contributing to the AMAP Societal Implications of Climate Change in the Arctic report, in particular through collaborating on an analysis of community climate adaptation projects.

Next steps:

We are investigating opportunities with the Nordic Borealisation Network to make further use of the database to investigate ecological aspects of borealisation across different environments. We hope the borealisation database provides ongoing opportunities for research synthesis in this area.

Publications:

Baker, K., Hausner, V. H., Ramsay, J., & Wheeler, H. C. (2025). What evidence exists on the interlinkages between ecological and societal impacts of borealisation of the Arctic? A systematic map protocol. *Environmental Evidence, 14*(1), 15.



Photos: Project Team

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Funding:
FCDO

Research Location:
Tromsø, Norway

Photos: Prof. Philip Steinberg, Durham University

Developing a legal assessment of Arctic geoengineering to support AMAP's scoping exercise

Overview:

To address a rapidly warming climate, scientists, funders, and policy makers have been drawn to geoengineering, with a particular focus on the Arctic. In response, the Arctic Council's Arctic Monitoring and Assessment Program (AMAP) has begun processes to develop a mechanism for assessing the impact of geoengineering (climate intervention) initiatives for Arctic ecosystems and peoples. To date, however, little of this effort has explored geoengineering's legal or ethical implications. To rectify this gap and to begin providing a focus for AMAP's efforts, the research team used funding from this scheme to convene 23 thought leaders for a two-day workshop in Tromsø, Norway. Experts in law, governance, environmental ethics, Indigenous representation, and climate policy engaged in a series of exercises to identify key criteria, standards, and processes that could be applied to assess the viability and desirability of proposed Arctic geoengineering initiatives. Over the coming months, the research team will transform workshop outputs into a document that will be passed on to AMAP for potential integration into its scoping exercise. The long-term aim is to develop a standard of assessment for ensuring that geoengineering, in addition to being scientifically sound, is cognisant of the needs of Indigenous peoples, future generations, non-human species, and others with a vested interest in the future of the Arctic.

Highlights:

1. The research team affirmed that assessment guidelines for proposed geoengineering initiatives, in addition to accounting for impacts on climate processes, must also account for impacts, which might be positive or negative, on habitats and biodiversity, livelihood options (including food security), institutional structures (including structures that underpin fundamental principles of sovereignty), physical infrastructure, and the self determination of the Arctic region's Indigenous peoples. Furthermore, the team affirmed that the selection of standards for assessing impacts across each of these domains itself reflects embedded values, and that this must be acknowledged within the guidelines.

2. The research team affirmed that assessment guidelines should be process-based. Different levels of assessment should be implemented at different stages, as a geoengineering initiative proceeds from conceptualisation (i.e., the research design itself) to exploratory research to implementation; as the spatial scale of impact extends from the laboratory to the community to the geosphere; as the temporal scale extends from isolated moments of conceptualisation to the long-term impacts that are sought by the climate modification initiative's proponents; and as the universe of interested parties extends from the community of scientists to human and non-human inhabitants of the spaces where the initiative is implemented to the global population (including future generations) that will ultimately be impacted by the geoengineering initiative's climate transformations. Additionally, the team affirmed that the guidelines will require a flexibility that reflects how these stages are neither necessarily linear nor proceeding in parallel with each other.

3. The research team affirmed that assessment guidelines should identify existing institutions, legal bodies, and declarations that have been developed for the governance of spaces that exceed national jurisdiction (e.g. UNCLOS, BBNJ), transboundary processes (e.g. CBD, IPCCC), the Arctic region (e.g. Arctic Council, CAOFA), and Indigenous peoples (e.g. UNDRIP), as well as being guided by the various guidelines and policy documents that have been produced, or are being produced, by other initiatives that have sought, or are seeking, to develop standards for assessing climate interventions. This engagement with existing institutions, legal bodies, and declarations will both associate the guidelines with pre-existing structures that have established conditions of legitimacy and permit the team to learn from and adapt these mechanisms to establish a novel assessment framework.

Establishing the origin of the invasive pink salmon, *Oncorhynchus gorbuscha*, spawning in Icelandic rivers

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Funding:
FCDO

Research locations:
Iceland, Laboratory work undertaken in UK and Norway

Overview:

2017 saw a massive intrusion of Pacific pink salmon into rivers around the North Atlantic, with the fish originating from deliberate introductions into rivers around the White Sea. Numbers have increased continuously since then. In their native North Pacific, pink salmon affect the whole oceanic food web, from phytoplankton to sea birds, sparking concerns about how far these invasive fish have spread and their impact on native fauna.

Our work has confirmed that pink salmon are breeding in Icelandic rivers. However, we don't know if these fish return to their natal Icelandic rivers. Fish otoliths (ear bones) preserve a life-long environmental record due to their incremental growth. Taking advantage of the unique geology of Iceland (strontium isotopes are determined by the age of local rocks), we use geochemical analysis ($^{87}Sr/^{86}Sr$) of otoliths from adult pink salmon caught in Icelandic rivers to determine if they are returning to their natal river, or if they are strays from outside of Iceland.

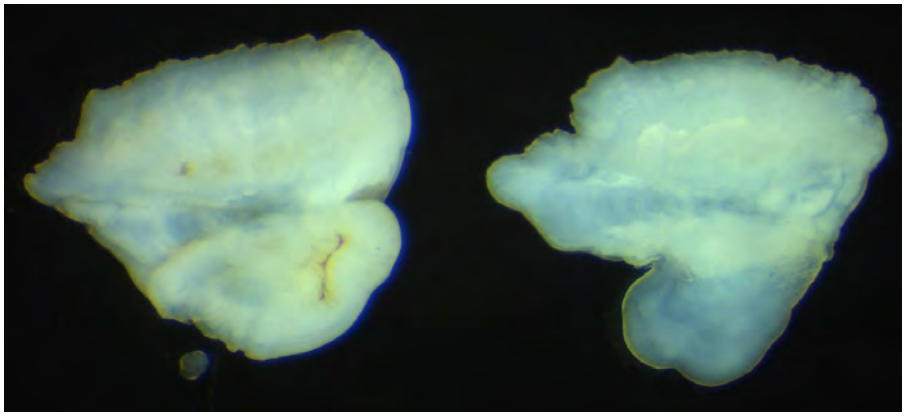
Return migration to Iceland would indicate the establishment of a self-sustaining population, rather than continued immigration from Barents/White Sea stocks. If true, we can no longer rely on control measures applied in Fennoscandia to contain the spread of this invasive species.

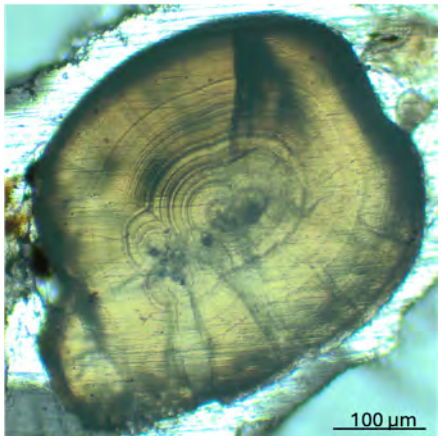
Highlights:

The cost of the measures being implemented in Norway to reduce pink salmon recruitment is substantial. The challenge will be far greater if self-sustaining populations are becoming established elsewhere: an international strategy will be needed.

Next steps:

We aim to use our findings to support further collaborative work to understand the spread and impact of this invasive species in the Arctic.





Above: Left and right sagittal otolith of an adult pink salmon recovered in an Icelandic river.

Left: Sagittal otolith of a juvenile pink salmon caught when leaving an Icelandic river. The otolith has been polished to show the core region (centre) and daily ring.

Images: Frode Pedersen, Norwegian Institute for Nature Research

Adult pink salmon caught after entering Icelandic rivers to breed.

Photo: Dr Guðni Guðbergsson Marine and Freshwater Research, Institute, Hafnarfjordur

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Dr Magnus Göransson, Natural
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Prof. Egill Erlendsson, University
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Linköping University, Sweden; and a
wider community of Icelandic
archaeologist and agronomists.

Funding:
DSIT

Research Locations:
Reykjavík, Iceland (sampling
archaeological plant remains)
and Durham, UK (aDNA analysis)

Sustainable agriculture in Iceland: archaeological and agricultural science knowledge-exchange and partnership-building

Overview:

This project has launched a new programme of cross-disciplinary knowledge-exchange, data-sharing and partnership-building between three groups that had been independently researching arable agriculture in the Northern Periphery Area: archaeologists studying Viking-age and medieval farms in Iceland where barley was successfully cultivated from AD 870-1400 during the Medieval Warm Period, plant aDNA specialists studying the evolution of Scandinavian barley landraces, and agronomists conducting modern barley breeding and field trial experiments. This interdisciplinary team has pooled data and expertise in a series of cross-disciplinary meetings and are collaborating on a new research project to extract and sequence aDNA from well-preserved barley grains recovered from a Viking-age site in Iceland. This research is generating a new dataset on the genotypes and specific genetic traits that evolved in Iceland, adapted to the Icelandic climate, wind-conditions, and soils, which made barley cultivation sustainable for over 500 years before the cooling climate of the Little Ice Age made arable farming unviable. This collaborative project will provide vital genomic data for the modern crop breeding programmes in Iceland, where barley cultivation is now possible again due to climate warming, but where barley breeding had start from scratch with modern Scandinavian and Orkadian cultivars in the 1980s.

Farm at Útskálar, Iceland, showing the modern farmhouse on a mound composed of earlier settlement remains. Where grass is grown today, there were barley fields in the Viking Age.

Photo: Dr Guðrún Alda Gísladóttir, Institute of Archaeology, Iceland

Viking-age house excavated at Útskálar, Iceland, in 2005, showing botanical remains on the floor preserved by anaerobic conditions.

Photo: Dr Guðrún Alda Gísladóttir, Institute of Archaeology, Iceland

Highlights:

1. **Cross-disciplinary team-building:** New collaborative relationships were forged in a series of meetings involving 13 archaeologists, archaeobotanists, aDNA specialists and modern plant geneticists, which took place in Reykjavík, Iceland, and Durham, UK, between October 2025 and January 2026. The knowledge and data exchanged have been pivotal to informing the team's approach to plant aDNA extraction and sequencing methods, and widened our understanding of the range of ways ancient genomic data could potentially be applied to modern barley breeding and farming practices in Iceland. These meetings also gave the environmental archaeologists on the team a new set of research questions informed by a better understanding of the challenges faced by farmers cultivating barley in the sub-Arctic today.
2. **Successful sampling of well-preserved Viking-age barley:** Archaeobotanical archives were visited and scanned at the University of Iceland and the Institute of Archaeology, Iceland. An extraordinarily well-preserved assemblage of plant remains from a Viking-age house floor that had been excavated at the farm of Útskálar, southwest Iceland, by the Institute of Archaeology, provided the project with over 50 samples of barley grains and other plant remains for aDNA analysis. Organic materials at Útskálar had not decomposed due to the clayey, anaerobic soil conditions, and the quantity and quality of aDNA preserved in these specimens will have a lasting impact on future excavation, sampling, treatment, storage, and analysis of archaeological plant remains in Iceland.
3. **Successful identification and 3D imaging of Viking-age barley prior to aDNA analysis:** The archaeological plant remains selected by the project team were formally identified by archaeobotanists at Durham University as six-row hulled barley and 3D imaged under a Keyence microscope. The interior structure of the barley is also being 3D imaged by X-ray computed tomography prior to aDNA analysis, which the team aims to complete before the conclusion of the project.

Prof. Karen Milek scanning archaeobotanical samples from Útskálar at the Institute of Archaeology, Iceland, to find tenth-century barley grains.

Photo: Dr Guðrún Alda Gísladóttir, Institute of Archaeology, Iceland

Viking-age barley grain from Útskálar, Iceland, prior to aDNA extraction and sequencing.

Photo: Harvey Tew (Keyence), Durham University and Prof. Karen Milek, Durham University

Next steps:

The aDNA data generated by this project, including a detailed analysis of the genetic diversity of barley from a single Viking-age farm, and a comparison of ancient barley traits with historic and modern barley landraces in Scandinavia, will be published in a peer-reviewed paper, together with the team's evidence-based assessment of the value of aDNA data for modern crop breeding programmes in the Arctic. Building on this project, the team will apply for a grant for a new project that studies a larger barley aDNA dataset and integrates this with complementary research on the land-management practices and plant-soil nutrient cycling processes that made barley cultivation sustainable in Iceland for 500 years. In this way, the team aims to progress and expand their partnership to enable archaeological science data to inform research, policy, and best-practice in sustainable agriculture in Iceland.

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Funding:
FCDO

Research Locations:
Northern Norway

Designing for coexistence in the Arctic: urban kittiwake hotels

Overview:

Norway is home to twenty five percent of Europe's seabirds. Like many in the seabird family, black-legged kittiwakes (*Rissa tridactyla*) are vulnerable to extinction following significant population declines. Kittiwake numbers have grown steadily in towns and cities along the North East Atlantic coast, creating distinct challenges for urban life and planning across diverse areas of decision-making, with wide-ranging implications for conservation in the Arctic. The project builds on interdisciplinary research that has been running since 2018, which connects the North East of England with Northern Norway and has two aims 1) to examine how kittiwakes might be responding and adapting to environmental change 2) to understand the impacts for urban planning, coexistence and socio-environmental futures in the Arctic. The project focuses on the design, development and assessment of artificial nesting structures – 'kittiwake hotels' – involving work with architects, local councils, engineers, wildlife organisations, and local communities.

Photo: Prof. Helen Wilson, Durham University

Photo: Dr Tone K. Reiertsen, Norwegian Institute for Nature Research

Project highlights:

The completion of data analysis to support understanding of the value of artificial nesting structures for urban inhabitation and conservation

The ongoing development of stakeholder networks in Northern Norway to connect towns and cities that have nesting kittiwakes.

The development of a stakeholder report that outlines the knowledge gained from the hotels project; the local contexts, dynamics and communities that are critical to the projects; the mobility and adaptation of designs; and the interrelations with conservation policies.

Next steps:

The project will be continuing to build its stakeholder network and is preparing for a conference later in the year with local municipalities (funded by the ESRC). It is looking to develop further grants applications for impact.

Publications:

Wilson, H. F., Reiertsen, T. K., & Jacobsen, K.-O. (in press). Avian infrastructures: urban experiments and the makings of a seabird 'hotel'. *The Geographical Journal*. https://durham-repository.worktribe.com/output/4930908

The paper details how the first artificial nesting structures for kittiwakes were developed in Tromsø as a result of international collaboration that connected Newcastle Gateshead in the North East of England and Tromsø in Northern Norway.

Photos: Prof. Helen Wilson, Durham University

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Prof. Øyvind Breivik, UiB and Met Norway, Dr. Anna Oleynik, UiB

Funding:
DSIT

Research Location:
UCL Mechanical Engineering, UCL

HyAIce-Dr: a hybrid Hydrodynamic–AI framework for predicting ice floe drift in the Arctic marginal ice zone

Overview:

The increasing fragmentation and mobility of Arctic sea ice, driven by climate change, present growing challenges for environmental prediction and maritime safety. This project aims to develop a hybrid modelling framework to improve short-term forecasts of ice floe drift within the Marginal Ice Zone (MIZ). By integrating hydrodynamic theory with artificial intelligence, the model will capture complex wave–ice–current interactions while remaining physically interpretable. It will be trained using observational datasets, including GPS-based drift trajectories and wave spectra from OpenMetBuoy deployments, along with ERA5 wind and CMEMS/TOPAZ current reanalysis products. The work is structured around two core packages: hybrid model development and performance optimisation through data assimilation and sensitivity analysis. The outcome will be an open-access tool to support short-term ice drift forecasting in fragmented sea ice conditions, with potential applications in Arctic navigation planning, hazard warning, and environmental monitoring. This work could support the scientific priorities of Arctic Council Working Groups such as PAME (shipping safety) and AMAP (ice dynamics and climate indicators) and contributes to future UK-led engagement in Arctic operational research.

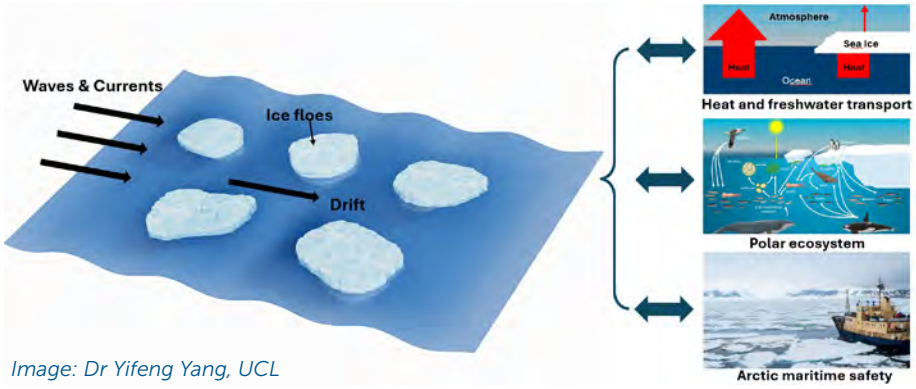

Image: Dr Yifeng Yang, UCL

Highlights:

1. **Development of a Wave–Ice–Current Theoretical Framework**
   A core achievement of the project is the further development and adaptation of a hydrodynamic wave–ice–current interaction model to describe ice floe drift in the Marginal Ice Zone (MIZ). The model captures the coupled effects of wave radiation, current advection, and wind forcing on fragmented sea ice. It builds on prior analytical and semi-analytical work by the PI and incorporates physically consistent representations of momentum exchange and external forcing. This theoretical foundation provides a mechanistic description of how wave-induced drift, Stokes transport, and current shear collectively influence floe trajectories. By establishing a physically grounded baseline model, the project ensures that subsequent predictive improvements are anchored in Arctic Ocean dynamics rather than purely empirical correlations.

2. **Data-Driven Modelling and Environmental Data Assimilation**
   The project integrates high-resolution observational and reanalysis datasets, including GPS-tracked ice floe trajectories, OpenMetBuoy wave spectra, ERA5 wind fields, and CMEMS/TOPAZ current products. A structured data assimilation framework is being developed to refine model initialisation and parameter estimation. Machine learning techniques are applied to identify nonlinear response patterns in fragmented ice under varying sea states. Sensitivity analysis quantifies the relative influence of waves, currents, and wind on drift prediction errors.

3. **Hybrid Physics-Informed Neural Network (PINN) Framework**
   The most innovative component of HyAIce-Dr is the integration of hydrodynamic theory with artificial intelligence through a physics-informed neural network (PINN) architecture. Rather than replacing physics with AI, the PINN embeds conservation laws and physically derived constraints directly into the learning process. This hybrid framework enables the model to capture nonlinear drift responses while maintaining physical consistency under extrapolation to unseen conditions. Early validation demonstrates improved short-term drift forecasting performance compared with purely physical or purely statistical approaches. The resulting model is designed to be interpretable, computationally efficient, and adaptable for future integration into operational Arctic forecasting systems.

Next steps:

The present project provides a strong foundation for future collaborative Arctic research. We plan to build on this work through joint UK–Norway proposals focused on operational sea-ice drift forecasting and wave–ice interaction modelling. The methodology developed under this bursary will support applications to larger international funding schemes, particularly those aligned with Arctic operational prediction, climate-risk assessment, and maritime safety. Continued collaboration with MET Norway and the University of Bergen will strengthen data-sharing and model validation efforts, with the long-term goal of integrating the hybrid framework into broader Arctic monitoring and forecasting initiatives.

Publications:

Yang, Yifeng, and Guoxiong Wu. Wave interaction with a large number of ice floes of arbitrary shapes. *Physical Review Fluids* 10.12 (2025): 124804.

Arctic Office

NATURAL ENVIRONMENT RESEARCH COUNCIL

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