

UNITED KINGDOM AND ICELAND ARCTIC SCIENCE PARTNERSHIP SCHEME 2024–25



Project Summaries



Photo: Mariana García Criado



Ministry for Foreign Affairs



BACKGROUND

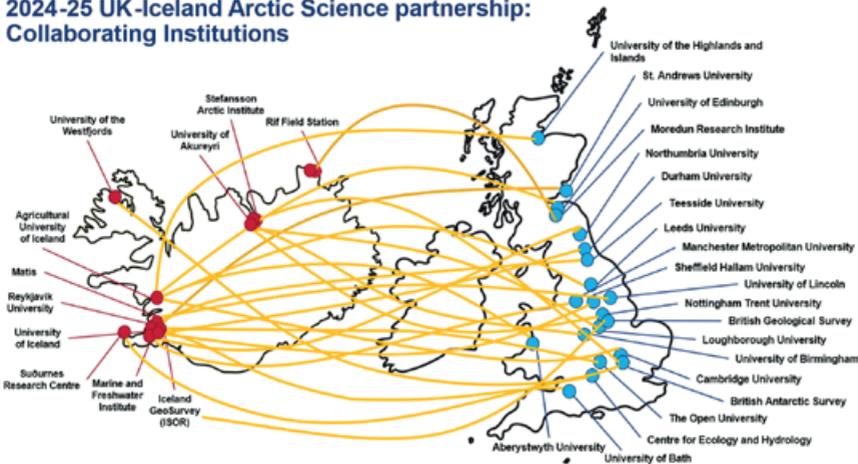
This publication shares details of new work from UK-based research teams working with Iceland-based researchers in 2024–25, funded by the UK Government and Rannís – The Icelandic Centre for Research.

Researchers in the UK and Iceland are well-placed to develop important new science partnerships that address pressing research questions, drawing on strong bilateral relations with foundations in the UK and Iceland’s Joint Vision for 2030. These research partnerships support the development of skill- and knowledge-based networks to strengthen both communities; foster the creation of positive, respectful and empowering partnerships; and create lasting research connections. The potential is also for broader benefit to each country, with innovation and new technologies driving economic growth and solving everyday challenges.

The ‘UK and Iceland Arctic Science Partnerships Scheme’ supported UK and Iceland-based researchers working in partnership in Iceland in 2024–25, with funding from the United Kingdom’s Department for Science, Innovation and Technology and Rannís – The Icelandic Centre for Research, working with the British Embassy in Reykjavik, the UK Science and Technology Network and the NERC Arctic Office, together with the Ministry of Foreign Affairs in Iceland.

The outcomes of the science partnerships scheme are supporting and further developing lasting research and collaboration links between researchers in the UK and Iceland; and providing new access opportunities for researchers to work with new partners and develop ideas for future international projects. 21 projects from a broad range of topics have been funded through this scheme. This booklet provides a summary of each of these projects.

2024-25 UK-Iceland Arctic Science partnership: Collaborating Institutions



Project Summaries:		
PI Name	PI Institution	Project Title
Dr Tariq Ahmed	Teesside University	Compatibility of polymeric materials for 100% hydrogen transportation in Iceland and the UK
Dr Catherine Howarth	Aberystwyth University	Island Oats
Dr Eleanor Watson	Moredun Research Institute	Nanopore sequencing approaches for ecosystem monitoring in the Arctic
Dr Iestyn Barr	Manchester Metropolitan University	Lake drainage events recorded in sediments (LAERS)
Prof Joanna Bullard	Loughborough University	Particulate contributions to air quality in Akureyri
Dr Nicola Dakin	British Geological Survey	Offshore and coastal region Geological and Geomorphological Assessment: Icelandic Windfarm Suitability (OGGA-IWS)
Dr Jenny Jenkins	Durham University	Seismic Network in Underexplored Central Iceland - SNUCI
Dr Gbotemi Adediran	UK Centre for Ecology and Hydrology	ArcticNanoCon: A consortium for the investigation of colloidal matter in the Arctic by advanced nanoscopy
Prof Robert Jackson	University of Birmingham	Dog lichens and their associated microbiota as indicators of climate warming
Dr Girish Beedessee	Northumbria University	Employing metatranscriptomics to survey functional diversity of eukaryotic phytoplankton around Iceland marine environment
Dr Mike Coffey	Nottingham Trent University	Holistic evaluation of sewage pollution at Akureyri, Iceland
Prof Benjamin Murray	University of Leeds	Aerial sampling of ice-nucleating dust plumes over Iceland (DustDrone)
Dr Robert Storrar	Sheffield Hallam University	A Hub for Understanding Glacial and Environmental change in ICEland (HUGE ICE)
Prof John Chew	University of Bath	Microplastic fibres in Arctic wastewater: Focusing on transport behaviours in membrane-based treatment processes
Dr Mariana Garcia Criado	University of Edinburgh	Plant borealization across a rapidly warming Arctic
Dr Craig Smeaton	University of St Andrews	The role of Iceland sedimentary environments in climate regulation (RISER)
Prof Ulf Buentgen	University of Cambridge	Combining dendrochronological and wood anatomical data and techniques to better understand the composition and behaviour of Iceland's dwarf shrub communities under climate change (DAIS)
Luke Talbot	National Centre for Food Manufacturing, University of Lincoln	Industry and society benefits of enhanced fish co-product utilisation: exploring future opportunities via collaborative partnership
Dr Lucy Stephenson	British Antarctic Survey	SKILLSET: Scientific uK:Icelandic coLLaboration aboard the SDA through Early-career-researcher Training and networking
Dr Tamara Lopez	The Open University	Sociotechnical modelling of resilient Arctic communities
Dr Karen Marshall	University of the Highlands and Islands Inverness	Strengthening ties - exploring collaborative educational and research initiatives between Agricultural University of Iceland (AU), the University of Highlands and Islands - Inverness (UHI Inverness)

Compatibility of polymeric materials for 100% hydrogen transportation in Iceland and the UK

Principal Investigator: Dr Tariq Ahmed, Teesside University

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UK and Iceland-based

Co-Investigator/Team members:

Dr David Finger, Reykjavik University

Dr Jinoop Arackal Narayanan, Teesside University

Dr Bjarnhedinn Gudlaugsson, Reykjavik University

Research location: Teesside University and Reykjavik University

Project overview:

Hydrogen is emerging as a key clean energy carrier, driving the need for robust infrastructure to support its safe transport and storage. This research investigates the compatibility and durability of Polyamide Nylon, High-Density Polyethylene (HDPE), and Polytetrafluoroethylene (PTFE) for 100% hydrogen transportation under different conditions at Teesside University. Design of Experiments (DOE) was used to assess hydrogen's impact on the mechanical properties of these materials under varying temperatures, pressures, and exposure times. Nylon exhibits enhanced ductility and toughness, making it suitable for flexible hydrogen transport, though reduced stiffness may limit high-load applications. HDPE demonstrates improved flexibility and toughness, though reinforcement may be needed for structural reliability. PTFE retains strong bending properties but shows significant stiffness reduction, making it more suitable for non-structural applications. Further research is underway to ensure long-term material reliability. Beyond material performance, this study evaluates the environmental impact of

hydrogen transportation through Life Cycle Assessment (LCA). Geothermal and hydropower resources in Iceland enable high full load hours (FLH), ensuring cost-effective hydrogen production. Excess renewable electricity from seasonal geothermal activity allows for competitive pricing, potentially lowering costs below fossil-based alternatives. These insights support sustainable hydrogen distribution networks and the clean energy transition.

Project highlights:

- **Development of a Decision Support Tool for Material Selection and System Design:** By the end of this project, we aim to develop a comprehensive decision support tool that guides the selection of polymeric materials for 100% hydrogen transportation. This tool will enable persons of interest including policymakers, engineers, and industry leaders to easily assess the environmental footprint of various hydrogen transportation options. This tool will provide a systematic evaluation framework, integrating life cycle assessment (LCA) data, techno-economic analysis, and long-term sustainability metrics to support informed decision-making.
- **Experimental Validation of Polymeric Materials under Hydrogen Exposure:** The project will generate critical experimental data on how different polymeric materials behave under prolonged exposure to hydrogen in different temperature and pressure conditions. Through assessing mechanical performance, this research will provide essential guidelines for selecting durable materials, ensuring long-term safety and efficiency in hydrogen transport systems.

- **Strengthening UK-Iceland Collaboration in Hydrogen Research:** This project establishes a strategic partnership between UK and Icelandic researchers, combining expertise in material science, experimental analysis, and life cycle assessment. Both research teams have already visited each other, delivering talks on energy decarbonisation and energy system modelling, fostering deeper collaboration and knowledge exchange. This partnership not only advances hydrogen transportation research but also contributes to global renewable energy initiatives.

Next steps:

We are actively pursuing funding to expand our research in hydrogen transportation and renewable energy. We have applied for the EU Horizon project "Efficient Conversion of Biogas via Novel Tri-reforming for Methanol Synthesis (ECONOVA)" - (€7.6M) to develop tri-reforming technologies for efficient biogas-to-methanol conversion, supporting sustainable fuel solutions. Additionally, we plan to apply for the Ecological Citizenship Fund (£50,000) for the "Renewable Energy and Ecological Citizenship in Remote Communities (BREEZE)" project, which explores renewable energy adoption and ecological citizenship in remote communities. To strengthen collaboration, we are exploring a summer visit for our Icelandic partners at Teesside University. This will include a Life Cycle Assessment (LCA) workshop and discussions on expanding our partnership through ERASMUS-funded initiatives. These efforts will enhance knowledge exchange, refine joint research strategies, and drive future collaborations in hydrogen infrastructure and sustainable energy transitions.

Publications:

We have actively disseminated our research findings through high-profile conferences and are progressing towards academic publications. In October 2024, we presented a paper titled "Developing Green Hydrogen from the Arctic and Repurposing UK Gas Infrastructure for a Carbon-Free Future" at the Arctic Circle Assembly in Iceland, highlighting the potential for hydrogen transport between Iceland and the UK. Additionally, we are scheduled to present two papers at the EGU2025 Conference in Austria in April 2025. The first, "Experimental Assessment of Polymeric Materials for 100% Hydrogen Transportation and Distribution," explores the performance of polymeric materials under hydrogen exposure. The second, "Green Hydrogen Export from Iceland to Teesside as a Key to Industrial Decarbonization," examines the feasibility of hydrogen export and its industrial impact. Furthermore, we are preparing two journal articles—one reviewing materials for hydrogen transportation and another presenting experimental and life cycle assessment (LCA) results from the project.

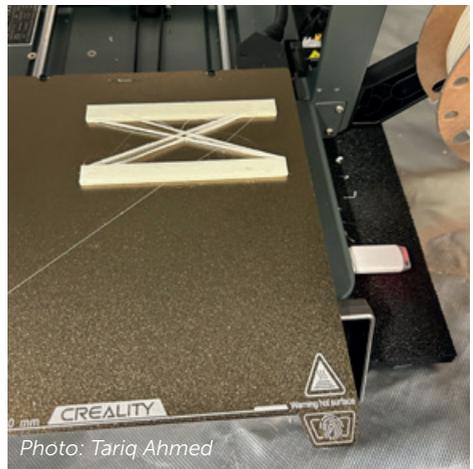


Photo: Tariq Ahmed

Island Oats

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UK and Iceland-based

Co-Investigator/Team members:

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Dr Sara Tudor

Agricultural University of Iceland (AUI):

Hrannar Smári Hilmarsson, head of
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Research location: Aberystwyth and Soil
Restoration Headquarters, Hella, Iceland

Project overview:

Island Oats brings together complementary expertise of oat scientists in Iceland and the UK to conduct field and genetical studies to understand photoperiod and stress factors affecting oat flowering time, grain yield and nutritional quality. Multi-locational testing of oat germplasm across Iceland and Wales resulted in a greater understanding of the impact of both the environment and genotype on these important agronomic traits. AUI trialled oats from ABER in official oat yield trials in 2024 and ABER simultaneously assessed high performing oat varieties identified from the AUI collection in the field in the UK. Testing UK varieties in Iceland provided valuable information for the development of climate resilient varieties for the future in this time of climate change. These reciprocal experiments will reveal whether there is any genetic basis for yield stability in the UK versus Iceland and this will serve to broaden our understanding on the agronomic performance of oat varieties and to strengthen the collaboration between the two countries. In addition,

the field trials acted as a focal point for in-person network and stakeholder meetings where UK and Icelandic scientists observed at first hand familiar oat varieties in a more extreme Icelandic or temperate UK climates.

Project highlights:

- Attendance at Oat Frontiers stakeholder workshop in Iceland. The purpose of the workshop was to introduce oat cultivars in Iceland and inspire oat production by sharing lessons learned from previous cereal cultivation and oat experiences and projects from Northern areas including Aberystwyth and Iceland.
- Successful completion of field trials in both Iceland and Aberystwyth, collection of data on plant development, grain yield and grain quality and identification and characterization of pre-breeding material for use both for research and by breeding companies targeting the UK and Iceland.
- Establishment of UK- Iceland oat network to identify joint opportunities and challenges of Iceland and the UK in the cultivation of oats.

Next steps:

Yes, further field trials are planned in both Aberystwyth and Iceland along with trials in Norway, Sweden, Finland and Ireland. All these countries, apart from the U.K. are eligible for Interreg funding and are part of the Oat Frontiers project led by Juho Hautsalo, Natural Resources Institute Finland. We will continue the field trials conducted in 2024 in the coming growing season in 2025 to provide robust data on the resilience of oat varieties to Northern climates.

Nanopore sequencing approaches for ecosystem monitoring in the Arctic

Principal Investigator: Dr Eleanor Watson, Moredun Research Institute

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UK and Iceland-based

Co-Investigator/Team members:

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Scott Hamilton,

Moredun Research Institute

Nuno Silva, Moredun Research Institute

Emma Cunningham,

University of Edinburgh

Nick Schurch,

Biomathematics and Statistics Scotland,

James Hutton Institute

Research location: The Rif Field Station, Raufarhöfn, Melrakkaslétta peninsula

field and therefore has particular utility for sampling of remote sites. The aim of this project is to employ and assess Nanopore sequencing for ecosystem monitoring within Melrakkaslétta, an important subarctic site for bird conservation, especially for migratory birds on their way to Greenland and Arctic Canada.

Project highlights:

- Nanopore long-read sequence data was successfully generated from a range of sample types and sites within the northeast coast of the Melrakkaslétta peninsula in Northeast Iceland
- Data analysis enabled the identification of bacterial species within samples, indicating that the method can be used as a tool for ecosystem monitoring for microbial pollution within these remote sites
- The bursary was also used to set up a DNA extraction station at the Rif Field station to support further ecosystem monitoring projects with the Moredun team and remote access for other international collaborators.

Next steps:

The team are developing ideas for projects focussing on the spread of zoonotic disease and antimicrobial resistance by migratory birds.

Project overview:

The spread of microbial pathogens and antimicrobial resistant bacteria within ecosystems is a global problem with significant implications for both human and animal health. Survival, reproduction and distribution of pathogens can be influenced by climate driven changes such as increased water temperatures and extreme weather events. Climate also influences disease vectors including shifts to migratory patterns of wild birds, which are well established carriers and disseminators of microbial threats. Risks vary depending on ecosystem type and the wildlife species that circulate within them, and environmental monitoring, particularly through analysis of water and soil samples, can act as an early warning system for disease threats. Nanopore sequencing has emerged as a technology that offers rapid and comprehensive analysis of samples. The method uses intact DNA, which can be stabilised in the



Lake drainage events recorded in sediments (LAERS)

Principal Investigator: Dr Iestyn Barr,
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UK and Iceland-based

Co-Investigator/Team members:

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University of Iceland, project planning,
analysis and fieldwork.

Dr Kathryn Adamson,
Manchester metropolitan University,
project planning, analysis and fieldwork.

Dr Ívar Örn Benediktsson,
University of Iceland, project planning,
analysis and fieldwork

Research location: SE Iceland



(GLOFs), have on sediments. GLOFs are common in glacierised regions globally (including across the Arctic) and understanding and recognising their sedimentological impacts has important implications for studies which aim to reconstruct palaeoenvironments from lake sediment records. This project investigates the impact of glacial lake floods on the landscape of SE Iceland. Specifically, we have extracted sediment cores from the bed of a lake and will investigate the geochemistry of these sediments to search for evidence of past floods.

Project highlights:

- Upon concluding this project, sediment records from proglacial lakes will be better understood in relation to how past flood events are recorded.
- Findings will allow us to contextualise the apparent recent global proliferation GLOFs.

Next steps:

We hope to co-supervise a postgraduate student in the near future.



Photos: Iestyn Barr

Project overview:

Sediments trapped at the bed of glacial lakes are often used as key indicators of past environmental change. In turn, these sediments, and the environmental records they preserve allow recent climate change to be contextualised. Despite this importance, there are several factors about lake sediments which remain poorly known. One key unknown is the impact that large-scale lake drainage events, often referred to as 'glacial lake outburst floods'

Particulate contributions to air quality in Akureyri

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UK and Iceland-based

Co-Investigator/Team members:

Dr Marcello Di Bonito,
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Dr Audrey Matthews,
University of Akureyri

Dr Asta Asmundsdottir,
University of Akureyri

Research location: Akureyri, Iceland

mineral particles and anthropogenic particles such as textiles (e.g. cotton) and plastics. Analysis of samples is ongoing.

Project highlights:

- Installation and testing of atmospheric deposition samplers in a harsh environment (strong winds, snow). We have identified some modifications that will improve the effectiveness of the samplers. Initial analysis of samples highlights the variability in particulate matter, for example there is a higher frequency of organic matter in the samples from summer months closer to sea level.

Project overview:

This project is exploring the relative importance of different contributors to particulate air pollution in Akureyri, Iceland's second largest urban area. Akureyri has very variable air pollution which originates from a combination of natural sources, including wind erosion of soils and re-entrainment of volcanic material, and anthropogenic sources such as the use of studded car tyres in winter and tourist activities in summer. The potential sources include particles <math><10\ \mu\text{m}</math> in size (PM10s) that are small enough to affect human health.

In consultation with the local community, passive deposition samplers have been installed on the roofs of buildings throughout the urban area. These include at sea level near the cruise ship terminal; the Hof cultural centre at sea level; the Glerártorg shopping centre c. 20 m asl and at the University of Akureyri c. 65 m asl.

Samples are being retrieved regularly and retained for analysis. Initial examination of samples collected in summer 2024 highlights the variability of material from the 4 sites in terms of both quantity and the balance between organic matter,

Next steps:

We are modifying and refining the design of samplers to be more robust through the Icelandic winter and intend to keep the samplers deployed beyond the end of the funding periods.

We are seeking funding for a student internship to assist with analysis of the filter papers.

The team also presented an overview of the project at the 2024 UK Windy Day Conference (University of Liverpool). We are also giving a talk and poster about the project at the 5th Sustainability Conference to be held at the University of Akureyri on 11 April, 2025.



Photo: Joanna Bullard

Offshore and coastal region Geological and Geomorphological Assessment: Icelandic Windfarm Suitability (OGGA-IWS)

Principal Investigator: Dr Nicola Dakin, British Geological Survey, BGS

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UK and Iceland-based

Co-Investigator/Team members:

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Ögmundur Erendsson,

Iceland GeoSurvey ÍSOR – Reykjavik.

Árni Magnússon, ÍSOR.

Steinunn Hauksdóttir,

Mapping and Exploration, ÍSOR.

Sigurður Friðleifsson,

Orkustofnun, Energy Agency, Iceland.

Andrew Finlayson, BGS

Dayton Dove, BGS

Duncan Stevenson, BGS

Research location:

5-day fieldtrip across southwest

Iceland, led by Anett Blischke

<https://storymaps.arcgis.com/stories/d4ca948211d8444c9301d670d3b256e6>

4-day workshop and fieldtrip across south and east Scotland (workshops at BGS Edinburgh office, Fife, Aberdeen, Glasgow), led by Nicola Dakin

Blischke, alongside workshops engaging key stakeholders on windfarm policy and regulatory requirements. BGS partners shared insights on how the seabed and near subsurface impacts windfarm development, including mapping of geomorphological features that have potential engineering constraints at and near the seabed. In the UK, a boat trip to a working offshore windfarm (Aberdeen Bay, operated by Vattenfall), the 7MW Levenmouth Demonstration Turbine (operated by ORE Catapult), and an onshore windfarm at Whitelee, provided first hand experience to policymakers and partners of turbine scale, design, manufacturing, installation and maintenance requirements. A field excursion across southwest Iceland, including Skeiðarársandur - the largest glacial outwash plain in the world, provided onshore analogues for understanding sediment heterogeneity and the impact on engineering constraints. This collaboration fostered knowledge exchange, supporting Iceland's potential pathway to offshore wind.

Project overview:

Offshore wind is a key energy source, driving progress towards Net Zero targets. As Iceland seeks to expand its energy mix beyond harnessing geothermal activity, the possibility of offshore wind must be explored to accommodate future energy needs. The UK is considered a world leader in offshore wind with ~14.7GW of wind power installed. The partnership between BGS and ÍSOR facilitated two fieldtrips led by Nicola Dakin and Anett



Photo: BGS, UKRI

Project highlights:

- An invitation to the British Embassy based in Reykjavik provided ÍSOR and BGS the opportunity to present fieldtrip and workshop plans in Iceland and the UK as part of the bursary, initiating discussions with policy makers in attendance.
- A comprehensive presentation from The Crown Estate providing an overview on UK policy and regulatory settings for the private sector. A key component also included an outline to the UK marine environment, including the protection of birds, mammals, fish and seabed habitats. This included a discussion on the evidence of change knowledge hub <https://owekh.com/home>, a portal to assimilate data and information knowledge tools.
- A total of two-week field trips across southwest Iceland and Scotland showcasing the scale and extent of windfarms and identifying key geological constraints on windfarm development.

Next steps:

We are actively seeking future proposals to build on our partnership and drive continued collaboration. In the interim, BGS and ÍSOR are partners as part of European projects (EMODnet and the Geological Service for Europe, GSEU), and this bursary has been an incredible opportunity to consolidate links between our institutes.

Publications:

- <https://www.bgs.ac.uk/news/bgs-awarded-research-grant-to-support-potential-offshore-wind-development-in-iceland/>
- <https://www.bgs.ac.uk/news/bgs-collaborates-with-icelandic-colleagues-to-assess-windfarm-suitability/>
- A detailed Icelandic field guide is presented here: <https://storymaps.arcgis.com/stories/d4ca948211d8444c9301d670d3b256e6>



Photo: BGS, UKRI

Seismic Network in Underexplored Central Iceland – SNUCI

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UK and Iceland-based

Co-Investigator/Team members:

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Elias Rafn Heisson,
University of Iceland

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University of Iceland

Egill Árni Guðnason, Iceland Geosurvey

Dr Þorbjörg Ágústsdóttir,
Iceland Geosurvey

Research location: Central Icelandic
Highlands (around Hofsjökull and
Langjökull glaciers)

Project overview:

A new network of 15 seismometers were deployed using UK/Iceland Arctic Science Partnership Scheme funding in July 2024 in the central Icelandic Highlands. A little studied area that contains several volcanic and geothermal systems. The seismometers will collect data on ground motion for 2 years, allowing analysis of both small local earthquakes and large distant earthquakes from around the world. Exploration of the causes of local seismicity will provide new insight into the activity of the volcanic and geothermal systems. Analysis of global earthquakes will allow us to generate subsurface imaging down to 30km depth, exploring the structure of the crust and distribution of subsurface fluids.

Photos: Jenny Jenkins





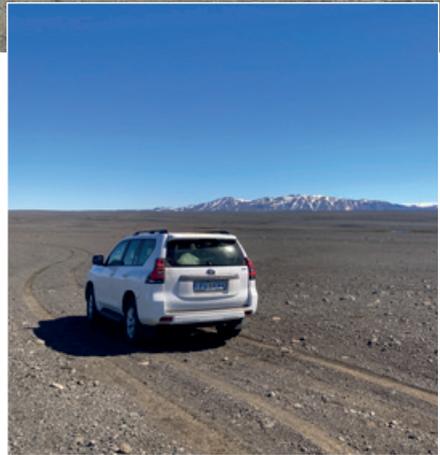
Project highlights:

- Deploy the first network of seismometers in central Iceland to monitor local earthquakes
- Explore activity levels of little studied volcanic systems
- Image subsurface structure throughout the crust to study presence of fluids (magma/geothermal) and crustal formation processes

Next steps:

Seismic activity in the region over the last year has been particularly high, drawing large amounts of national interest. We hope to extend the period of the seismic deployment beyond the planned initial 2 years to continue to explore this.

International collaborative plans for a nationwide deployment of seismometers both onshore and offshore of Iceland are currently being led by collaborators in Germany – we hope that an extension of this network can fold into and contribute to these large scale plans if future funding is secured.



Publications:

Jenkins, J., Johnson, B. A., Valentine, K., & Lynn, K. J. (2024). Considerations and perspectives on pregnancy and fieldwork. *Nature Reviews Earth & Environment*, 1-2.

The PI was 7 months pregnant during the deployment in July 2024, this inspired the following perspective piece that was recently published, using collected perspectives from numerous scientists who had carried out fieldwork while pregnant.

ArcticNanoCon: A consortium for the investigation of colloidal matter in the Arctic by advanced nanoscopy

Principal Investigator:

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UK and Iceland-based

Co-Investigator/Team members:

Dr Halldór Pálmar Halldórsson,
The University of Iceland, Co-investigator

Dr Hermann Dreki Guls,
The University of Iceland, Co-investigator

Sandra Dögg Georgsdóttir,
The University of Iceland, Co-investigator

Research location:

Fieldwork in Iceland and advanced laboratory analysis in the UK

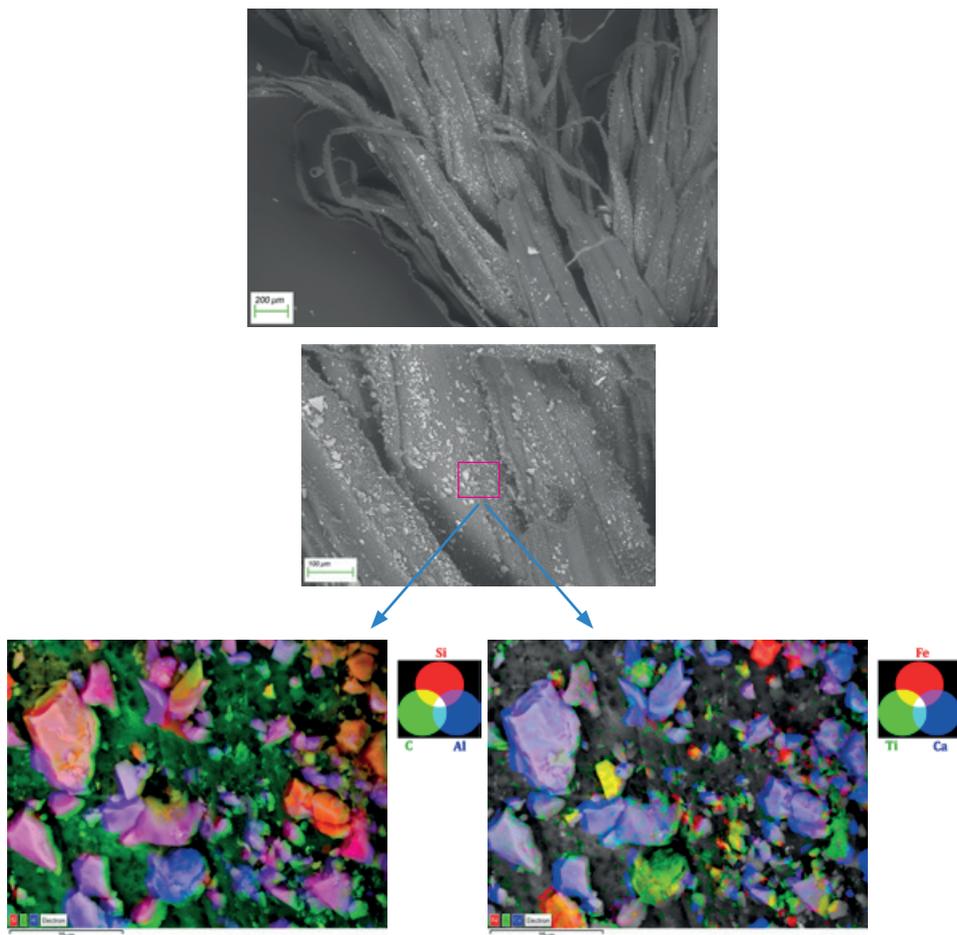
Correlative Microscopy and Spectroscopy, ArcticNanoCon will establish a micro-spectroscopic workflow from field sampling to data interpretation. This **Iceland-UK partnership** will advance fundamental research on colloidal matter's role in climate regulation, nutrient cycling, and toxic substance accumulation. By driving innovation in Arctic science, ArcticNanoCon will enhance predictive climate and pollution models, inform policy, and foster interdisciplinary collaboration.

Project highlights:

- **Establish a new international analytical capability** – ArcticNanoCon will develop advanced nanoscale techniques for detecting and analysing colloidal matter in Arctic ice cores, air, soil, water, and biota, leveraging recent NERC investments in multimodal Correlative Microscopy and Spectroscopy.
- **Develop a micro-spectroscopic analytical workflow** – The project will create a standardized workflow, from field sampling to data interpretation, enabling more precise research into colloidal matter transport, deposition, and interactions in the Arctic environment.
- **Strengthen international collaboration and research impact.** ArcticNanoCon will drive innovative research and educational initiatives through the Iceland-UK partnership, enhancing our understanding of colloidal matter's role in climate systems, nutrient cycling, and toxic substance accumulation.

Project overview:

Colloidal matter (particles $<1\mu\text{m}$) is a fundamental yet poorly understood component of Arctic ecosystems, playing a critical role in processes such as contaminant transport, deposition, cloud formation, ice nucleation, and stabilisation. However, its study has been hindered by significant analytical limitations. The **Consortium for the Investigation of Colloidal Matter in the Arctic by Advanced Nanoscopy (ArcticNanoCon)** aims to bridge this gap by developing an international analytical capability for nanoscale detection and characterization of colloidal matter across environmental matrices, including ice cores, air, soil, water, and biota. Building upon recent NERC investments in multimodal



High-resolution imaging of colloidal deposits on moss near an active volcanic site in Grindavik, coupled with microscopic compositional analysis, reveals the spatial distribution and colocalization of the most abundant elements (C, Si, Al, Fe, Ca, and Ti) within the colloidal matrix.

Next steps:

Building on the initial findings, there are plans to expand the project to investigate multiple episodes of volcanic eruptions, providing a broader understanding of their impact on colloidal matter transport and deposition in Arctic environments.

Additionally, the project will serve as a foundation for developing MSc and PhD research opportunities, fostering advanced scientific inquiry and training the next generation of researchers in nanoscale environmental analysis.

Dog lichens and their associated microbiota as indicators of climate warming

Principal Investigator:

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UK and Iceland-based

Co-Investigator/Team members:

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Dr Nathan Christmas,
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Iceland:

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The University of Akureyri

Dr M. Auður Sigurbjörnsdóttir,
The University of Akureyri

International partners:

Dr Natalia Ramirez Carrera,
Swedish University of Agricultural
Sciences, Alnarp, Sweden

Research location: Northern Iceland
and UK (Scotland and Cumbria)

Photos: Robert Jackson



Project overview:

Lichens of the genus *Peltigera* ('dog lichens') are prominent and important components of terricolous vegetation in Arctic and sub-arctic biotopes. Like other lichens, they are symbiotic associations of fungi, algae and a host of associated microorganisms that thrive within the lichen thallus and contribute to its health and functionality. The ongoing climate warming raises concerns about the fate of these organisms and their role in sub-arctic ecology. A cross-ecosystem approach facilitated by collaboration between researchers operating in both temperate and Arctic habits is essential to better understand the effects of climate warming

on dog lichens. We have sampled a range of *Peltigera* lichens from similar biotopes in heathlands and other habitat types in Iceland, Scotland and England. In Iceland and the UK and created a small biobank of these to provide base samples for future studies. We are currently comparing the microbiomes and metabolomic profiles of these lichens. In March 2025 we will be bringing together expert researchers in the field for a two-day workshop expected to yield research grant proposals to national and international funding agencies to tackle this important topic in boreal and Arctic cryptogam ecology.

Project highlights:

- The field trips yielded a total of 55 samples of 12 *Peltigera* species from 14 sampling sites in Iceland, Scotland and Cumbria. Each sample was taken in quadruplicate for amplicon-based metabarcoding of the associated microbiota, LC/MS-based metabolomics analysis, targeted culturing of specific groups of endolithic bacteria, and one replicate as a taxonomic voucher to be stored at the Icelandic Institute of Natural History. An unexpected highlight was the abundance of diseased lichen thalli, showing clear symptoms of fungal infections, at two of the sampling sites in Scotland. This inspired us to broaden the scope of our interests to include pathogens of lichens, their biogeography and likely effects of climate thereon. This has also led to currently ongoing work at the University of Akureyri on culturing and characterising chitinolytic bacteria from both diseased and healthy lichen thalli.



- The metabolic profiles of the collected samples were acquired for the entire dataset by mass spectrometry. Preliminary analysis indicates that the lichen species is the major driver of the differences in the chemical profile of the evaluated *Peltigera* individuals. Moreover, the metabolic profile of some species, such as *P. membranacea* and *P. leucophlebia*, varies according to sampling location, with differences observed between samples from Iceland vs UK (*P. membranacea*, *P. leucophlebia*) or even in different locations of the same country (*P. leucophlebia*). Furthermore, within the UK dataset, discrimination of 'diseased' lichens from healthy individuals collected at the same locations was possible. The differences in these samples, and the ones correlated with different locations (same species) or between species, are associated with a subset of metabolites (features) that are currently being annotated and evaluated individually.
- The planned workshop at the University of Birmingham has provided the opportunity to assemble a consortium of leading European scientists who will build on the present project to write highly competitive research proposals on lichens, their biogeography and the impact of a warming climate thereon, for submission to national and international research funds. We will include a discussion on lichen pathogens in the upcoming workshop.

Next steps:

The team will hold a workshop on lichens and microbiomes at the University of Birmingham, March 27-28, which will bring about 20 scientists from around Europe to discuss the state-of-the-art as well as present outcomes from this project. It is hoped that a future funding scheme can be identified to progress future studies.

Employing metatranscriptomics to survey functional diversity of eukaryotic phytoplankton around Iceland marine environment

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UK and Iceland-based

Co-Investigator/Team members:

Dr Sara Harðardóttir,
Marine and Freshwater Institute
(HAFRO International partners (name and institute): Marine and Freshwater Institute (HAFRO)

Research location: Marine stations around Iceland and sequencing in UK

nutrients. Insights from this study will allow us understand phytoplankton ecological and evolutionary innovations for extreme conditions as well as impact of climate change on marine food web.

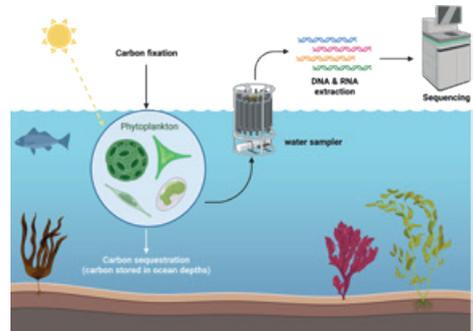


Figure was made by PI (Girish Beedessee) using a licenced version of BioRender

Project overview:

Our project employs metatranscriptomics to explore the metabolic and functional diversity of phytoplankton around Iceland. Phytoplankton are dominant primary producers in the ocean that can act as indicators of environmental change and changes in their functional diversity and abundance have major consequences on higher trophic levels.

This is done by collecting seawater samples together with environmental data to look at shifts in phytoplankton dynamics since Iceland is a key area for the meeting of different water masses namely the cold polar and Arctic water from the north and warm, saline Atlantic Water from the south. Metatranscriptome sequencing can inform us of the genes that are expressed by the community as a whole, determine species functional activity and reveal differential expression of genes under specific environmental conditions. Such an analysis can address resource partitioning in microbial communities, harmful algal bloom profiling and phytoplankton response to

Project highlights:

- Generate preliminary data from the project so as to conduct regular sampling during other seasons (autumn) as well as in coming years. This will provide different seasonal dimension to phytoplankton dynamics
- There is limited genomic data about harmful algal blooms associated organisms such as diatoms and dinoflagellates around Iceland. This project will be useful to establish species responsible for blooms.
- Implement our metatranscriptomic method around other Arctic regions to understand role of waves and nutrients.

Next steps:

Exchange visits between institutions, training and data analysis workshop, scientific publication.

Microplastic fibres in Arctic wastewater: Focusing on transport behaviours in membrane-based treatment processes

Principal Investigator: Prof John Chew, University of Bath

Email: jc604@bath.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Dr Garyfalia Zoumpouli, University of Bath

Prof Bing Wu, University of Iceland

Research location: Department of Chemical Engineering, University of Bath and Faculty of Civil and Environmental Engineering, University of Iceland

Project overview:

The UK and EU are key contributors of plastic pollution, with vulnerable coastal communities who subsist on the impacted ecosystem. This project investigates the transport and fouling behaviour of micron-scale plastic fibres (microfibers) during membrane filtration of wastewater and their effects on separation performance by using experimental and numerical methods. Microplastic pollution in the Arctic has attracted increasing attention because of its negative impact on the Arctic food web and global climate change. The release of microplastics from wastewater to the Arctic marine environments is one of microplastic pollution sources. In particular, the anthropogenic microfibers that are derived from greywater or industrial wastewater, have been identified as the majority of marine microplastics. This collaboration involves research team led by Prof John Chew from the Department of Chemical Engineering, University of Bath (UoB, UK), and research team led by Prof Bing Wu from the Faculty of Civil and Environmental Engineering, University of Iceland (UoI, Iceland). The team at

Bath focused on developing 3D printed composite membranes that have anti-fouling properties, and numerical models in elucidate the transport behaviour of microfibers in the membrane systems. The team at Iceland focused on testing of the 3D printed membranes by using Arctic wastewater.

Project highlights:

- Designed and constructed a bespoke cross-flow filtration system with in-situ visual observation via optical microscope – completed.
- Designed and scaled-up state-of-the-art 3D printed patterned membranes with anti-fouling properties – completed.
- Developed numerical model to elucidate the transport behaviour of microfibers on flat and wavy surface – on-going.

Next steps:

We are planning to continue our collaborations via student/research exchange. We have submitted a conference paper to *Fouling and Cleaning in Food Processing 2025*. The paper has been accepted as an oral presentation. We are also currently drafting an article for submission to *Chemical Engineering Journal*.



Delegation to University of Iceland: (from left to right) Prof Bing Wu, Prof John Chew, Dr Liana Zoumpouli

Holistic evaluation of sewage pollution at Akureyri, Iceland

Principal Investigator: Dr Mike Coffey,
Nottingham Trent University

Email: michael.coffey@ntu.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Dr Mike Coffey,
Nottingham Trent University

Dr Audrey Matthews,
University of Akureyri, Iceland
Ásta Margrét Ásmundsdóttir (UNAK)
(ÁMÁ)

Dr Marcello Di Bonito (NTU) (MDB)

Research location: Akureyri

Together we will sample sewage effluent and the immediately receiving surface coastal water for a range of nutrient, metal and microplastic pollutants. Dissolved constituents and those suspended in water will be determined. Data visualisation (GIS) techniques will be adopted, and computer modelling will be used to assess to bioavailability of metals.

Whilst some of these pollutants are currently investigated separately in studies, we propose a study that examines a wide range of potential contaminants of interest in this environment. Our study would provide a foundation for more extensive studies in the future, which would include microbiological and biological components for a holistic study.

Whilst a short-term and small-scale pilot study will provide only preliminary results, we would disseminate findings and scientific meetings but also locally to the public of Akureyri. Our proposal offers the opportunity for investigators to mutually develop skills and access analytical instrumentation to facilitate long-term collaboration.

Project overview:

The aim of this project is to conduct a pilot study investigating the impact of sewage effluent at Akureyri, a concern recently expressed both locally and more widely across Iceland. Two investigators from The University of Akureyri (Iceland) and two from Nottingham Trent University (UK) will collaborate for the first time.

Aerial sampling of ice-nucleating dust plumes over Iceland (DustDrone)

Principal Investigator: Prof Benjamin Murray, University of Leeds

Email: B.J.Murray@leeds.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Pavla Dagsson-Walhauserova,
Agricultural University of Iceland

Research location: Myrdalssandur,
Iceland

Project overview:

We propose a proof-of-principle field campaign in Iceland to study the icenucleating ability of airborne dust using a combination of a state-of-the-art weather drone (wxUAS) and miniaturised aerosol instrumentation. With our Icelandic partner, we intend to undertake a 5-day measurement campaign near Myrdalssandur, Iceland, during which we will fly vertical profiles to an altitude of 2 km whilst monitoring meteorological variables, measuring aerosol size

distribution, and collecting aerosol samples at specific altitudes. These measurements will allow us to investigate the vertical transport of airborne dust by comparing those taken at the surface to those at height.

Our long-term ambition is to fly in dust plumes, but in the absence of such events we will utilise the 5 days to provide evidence towards the successful integration of multiple instruments on a wxUAS drone. We will greatly benefit from the ongoing Copernicus Atmospheric Monitoring Service (CAMS) National Collaboration Programme (NCP) in Iceland. The NCP is combining ground based in-situ measurements with the High Latitude Dust (HLD) operational model, DREAM Iceland. We will utilise one of three permanent dust measurement stations as our drone take-off location, allowing for direct comparison between our measurements and ground based measurements.

A Hub for Understanding Glacial and Environmental change in ICEland (HUGE ICE)

Principal Investigator: Dr Robert Storrar,
Sheffield Hallam University

Email: r.storrar@shu.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

UK team:

Remy Veness,
Sheffield Hallam University.

Niall Gandy, Sheffield Hallam University

Naomi Holmes, University of York.

Iceland team:

Haukur Ingi Einarsson,
Glacier Adventure

Ívar Benediktsson, University of Iceland

Esther Guðmundsdóttir,
University of Iceland

Kieran Baxter, University of Iceland

International partners:

Tim Lane, formerly at Liverpool John
Moore's University (now at Aarhus,
Denmark)

Research locations: The climate centre is based at Glacier Adventure, a family run business at Hali in SE Iceland. Much of the work is based here. The DRUMIce project has fieldwork at Hofsjökull in the Icelandic highlands.

Project overview:

The project aims to develop a hub for understanding glacial and environmental change in SE Iceland. This is based around a family run business, Glacier Adventure, that operates glacier tours at Breiðamerkurjökull. Glacier Adventure has an ambition to establish a climate centre that enables: (1) scientists to conduct research; (2) educate tourists on climate change and sustainability issues and (3) facilitate outreach to members of the local community and tourists. This project aims



Photo: Robert Storrar

Haukur Ingi Einarsson (CEO of Glacier Adventure) trying out the VR glacier experience developed by Kieran Baxter

to kickstart this climate centre by seeding four science projects, as well as an outreach initiative based around the novel use of immersive virtual reality technology to help tourists and the public understand and visualise the striking changes happening in the local area. The science projects are diverse, and themed around glacial and environmental change. They investigate (1) subglacial hydrology using drones; (2) environmental change over the last 10,000 years using lake coring; (3) what lies underneath ice and how this impacts ice flow, using ground penetrating radar; and (4) how the Icelandic Ice Sheet behaved 20,000 years ago. The outreach part builds capacity for science communication at Hali using an immersive virtual reality experience, and has included the inaugural Hali climate conference, which took place in August 2024.

Project highlights:

- A highlight so far has been meeting many of the project team at the inaugural climate conference in Hali in August 2024. Rob Storrar and Niall Gandy from the UK team met with Haukur Ingi Einarsson and Kieran Baxter from the Iceland team, along with delegates from the local area, as well as from further afield, including the USA. There is a growing list of people interested in collaborating on the project and we are excited to see where it leads.
- The summer 2024 fieldwork took place in August, with Rob Storrar and Niall Gandy conducting UAV surveys of Breiðamerkurjökull and Skálafellsjökull, hosted by Haukur Ingi Einarsson. Each location was successfully surveyed three times in a day, allowing us to calculate sub-daily changes in the glacier surface. The summer fieldwork also included a guest lecture at the University of Iceland by Niall Gandy on his numerical simulations of the Icelandic Ice Sheet during the Last Glacial Maximum.
- Plans are under way for the winter fieldwork, which comprises two trips taking place in March. The first will conduct Ground Penetrating Radar surveys of part of the Hofsjökull ice cap using super jeeps. The second will conduct sediment coring of the (hopefully frozen) lake Kárvatn, which we hope will yield a core revealing climate changes over the last (up to) 10,000 years.

Next steps:

A collaboration at SHU with a Psychologist has resulted in a PhD studentship that is about to be advertised, looking at whether experiencing glacier change through a glacier walk and VR experience can impact the behaviour of tourists with respect to sustainability.

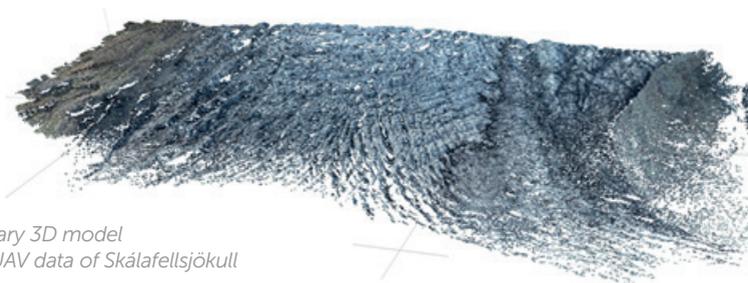
The UAV work is being used to validate a method that has been deployed on a NERC-funded project in Greenland. The Icelandic data provide valuable ground-truth data on ice-free areas which was not possible in Greenland.

We plan to use the sediment core from Kárvatn for MSc research projects to conduct some preliminary analysis. It may then be used to develop an external funding application for more detailed analysis.

The Hali conference generated discussion around a potential research project investigating glacier outburst floods (Jökulhlaups) that have been observed in ice caves where tourists are often taken. We aim to submit at least one proposal to study this potential hazard to help inform local stakeholders.

The LGM numerical modelling of Iceland is currently being written up for publication, and has been submitted as an abstract for EGU.

Remy Veness has submitted an application to the RGS for follow-on funding for the DRUMIce project.



A preliminary 3D model from the UAV data of Skálafellsjökull

Plant borealization across a rapidly warming Arctic

Principal Investigator: Dr Mariana García Criado, University of Edinburgh

Email: mariana.garcia.criado@ed.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Dr Mariana García Criado,
University of Edinburgh

Prof Isabel C. Barrio,
Agricultural University of Iceland (AUI)

International partners:

Prof James Speed,
Norwegian University of Science and
Technology (Norway)

Dr Anne Bjorkman,
University of Gothenburg (Sweden).

Prof Isla Myers-Smith, University of
British Columbia (Canada).

33 members of the International Tundra
Experiment network from 34 institutions

Research location: Pan-Arctic

Specifically, we measure to which extent borealization has already occurred, assess the main biogeographic, climatic and local drivers of plant borealization, and identify which plant species and their traits are more likely to drive borealization patterns. This project entails a macroecological data synthesis with a pan-Arctic scope, institutional visits to Scotland and Iceland, participation at the the Arctic Circle Assembly in Reykjavík (Iceland), including a presentation of preliminary results, and a scoping visit to a field site in the lowlands of Iceland to set up future projects.

Project highlights:

- **Scientific outputs.** This project broadens our understanding of the previously poorly understood process of plant borealization across the Arctic. We found that borealization has occurred in around half of our studied tundra sites, and particularly in Eurasia, at sites closer to the treeline, at higher elevations, in warmer and wetter regions, in sites that had undergone limited climate change, and with lower initial abundance of boreal species. Additionally, borealization was driven by boreal-tundra species, rather than boreal specialists. Finally, colonisations by boreal species were more likely to be from shorter species, and from shrubs and graminoids. These findings indicate that borealization is mainly driven by the spread of already established species in the tundra, and suggest that future changes to Arctic ecosystems might not involve rapid, widespread replacement of Arctic species by boreal species, but rather a slower displacement of the boreal-tundra ecotone.

Project overview:

Tundra ecosystems are changing fast in response to ongoing climate change and increased human pressures linked to land use changes. One derived phenomenon from these impacts is the northward distributional shift into the tundra of southern boreal species, a process known as borealization. While borealization trends have long been recognized in marine Arctic ecosystems, few local studies have investigated parallel trends in terrestrial plant communities, and to date there are no assessments of biome-scale plant borealization. Using existing plot-level vegetation data from the International Tundra Experiment (ITEX+) network, this project quantifies plant borealization at a pan-Arctic scale and identifies the main drivers contributing to this process.

- **Institutional visits.** During this project, Prof Barrio visited the University of Edinburgh and Dr García Criado visited the Agricultural University of Iceland. These visits focused on project work, particularly on the main parts of the analyses and manuscript writing undertaken by the two Co-Is. Additionally, these visits served to prepare follow-up projects, to strengthen networking opportunities across the two different institutions, and to engage with members of the policy-making community.
- **Outreach.** During the institutional visits, Prof Barrio delivered a seminar the Biosphere sessions of the School of Geosciences (University of Edinburgh) and Dr García Criado delivered a public lecture at the Fræðslukaffi of the Agricultural University of Iceland. Additionally, this work has been presented at multiple seminars and conferences, including: InterArctic Knowledges conference (Durham University, UK), Global Change Symposium (University of Edinburgh, UK), Seminar series on Climate Change and Sustainability (Society of Spanish Researchers in the UK), International Tundra Experiment meeting (Vancouver, Canada), Arctic Circle Assembly (Reykjavík, Iceland), CHARTER annual general meeting (University of Lapland, Finland), the Ecosystem Services Partnership Europe Conference (Wagenigen, Netherlands) and the Functional Trait Ecology seminar (online). The project has also been promoted on the [NordBorN website](#) and results will be advertised in social media as appropriate (e.g., BlueSky).

Next steps:

This project contributes to the NordBorN research network led by AUI and funded by NordForsk, which will ensure continuation of the collaboration for at least the next five years. This project has also identified some questions to be prioritized in future research, including for example the need to conduct targeted studies at the ecotone between the boreal forest and the tundra. Thus, next summer a field-based project will be set up in Finnish Lapland at the boreal-tundra ecotone. An additional visit between the Co-PIs will take place to plan for future steps and potential joint funding applications.

Publications:

The resulting publication has been submitted and is currently under review at an international peer-reviewed journal, and expected to be published in 2025. A pre-print of the scientific article is available at: García Criado, Barrio *et al.* (2025) Plant community borealization in the Arctic is driven by boreal tundra boundary species. *EcoEvoRxiv*. <https://doi.org/10.32942/X2534Q>

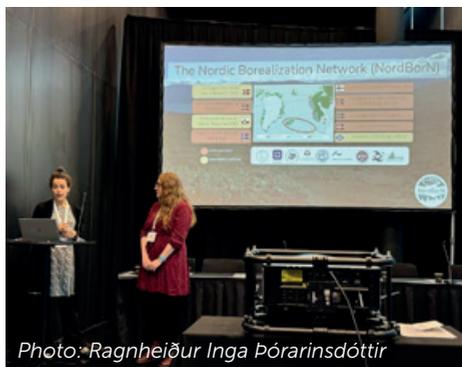


Photo: Ragnheiður Inga Þórarinsdóttir

The role of Iceland sedimentary environments in climate regulation (RISER)

Principal Investigator:

Dr Craig Smeaton,
School of Geography and Sustainable
Development, University of St Andrews

Email: cs244@st-andrews.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Hildur Magnúsdóttir,
Marine and Freshwater Research
Institute, Research Assistant

Research location: Iceland, Arnarfjörður

Project overview:

The RISER project brings together expertise from the United Kingdom and Iceland to undertake the first comprehensive research study to understand and quantify the processes that govern the climate regulation service(s) provided by the organic carbon stored in the marine sediments of Iceland's Westfjords.

The project has:

- Collected sediment cores from the Westfjords of Iceland.
- Characterised key the sedimentological (grain size) and geochemical (OC/N, $\delta^{13}\text{C}$, $\delta^{15}\text{N}$, OM thermal reactivity, metals) attributes of the sediments.



Photo: Hildur Magnúsdóttir

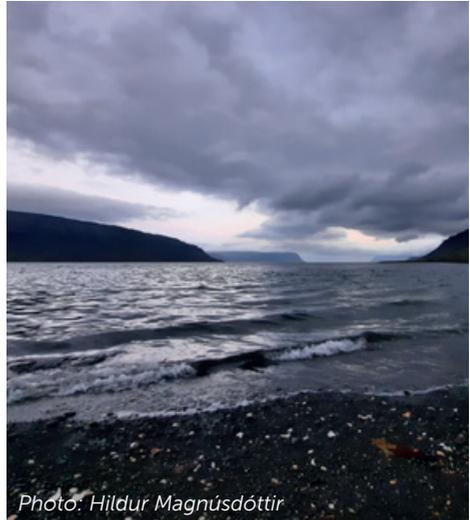


Photo: Hildur Magnúsdóttir

- Ongoing research is focused on quantifying the accumulation rates using radionuclide dating techniques (^{210}Pb , ^{137}Cs , ^{241}Am).

Project highlights:

- By the end of the project the RISER project will provide a new understanding of the mechanisms that govern the accumulation, preservation, and storage of OC in the sediments of Iceland's Westfjords.

● Current research highlights (still in progress):

The organic carbon held in the fjords is largely derived from the marine sources, which differs from the other North Atlantic systems.

The organic carbon in the sediments of the Westfjords is less reactive than other fjord systems.

Next steps:

We plan to present the results of the study at a session at the AGU Ocean Science Meeting in Glasgow in February 2026.

Combining dendrochronological and wood anatomical data and techniques to better understand the composition and behaviour of Iceland's dwarf shrub communities under climate change (DAIS)

Principal Investigator: Prof Ulf Buntgen, Department of Geography at the University of Cambridge

Email: ub223@cam.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Dr Ólafur Eggertsson, Agricultural University of Iceland
Miss Audrey Palosse (PhD student), Department of Geography at the University of Cambridge

Research location: Isholsvatn (Northeast Iceland), and Breiðdalsheiði (Eastern Iceland)

uncovering valuable insights into how Arctic ecosystems are responding to recent climate shifts. This includes identifying key thresholds and tipping points that affect the productivity and function of dwarf shrub species and communities. Our results will contribute essential information for conservation and management efforts in Iceland and other Arctic regions.

Project highlights:

- **First network of species-specific shrub-ring chronologies for Iceland**
Through a series of wood anatomical analyses, annual shrub rings will be counted and measured. Through this, the site- and species-specific age structure of shrub communities in Iceland will be established and the impact of climate on growth rings can be determined.
- **First analysis of shrub recruitment pulses for Iceland**
From age measurements, germination timings can be inferred and thus recruitment pulses and their drivers will be examined, providing insight on the impact of climate (or other factors) on the future establishment of shrub communities in Iceland.
- **First analysis of cell wall lignification of Icelandic shrubs**
A double-staining technique will be applied to thin cross-sections of collected shrubs to determine whether a change in site and/or elevation impacts the deposition of lignin in secondary cell walls, as a means to investigate the impact of temperature on shrub growth beyond annual rings.

Project overview:

The Arctic is experiencing rapid environmental transformation driven by human-induced climate change, with air temperatures in northern latitudes rising at twice the global average rate (Previdi et al. 2021). These increasing temperatures have already altered vegetation patterns, including a significant expansion and intensification of Arctic shrub growth (Wang et al. 2019; Berna et al. 2020; Mekonnen et al. 2021). This phenomenon, known as "Arctic Greening," has the potential to significantly impact terrestrial ecosystems through complex interactions between vegetation, climate, carbon and nutrient cycles, permafrost thawing, changes in albedo, and shifts in species diversity (Myers-Smith et al. 2020). The aim of this project is to explore the biotic and abiotic factors that influence the distribution, composition, expansion, age structure, and growth of Iceland's dominant dwarf shrub species. By combining dendrochronology, wood anatomy, and global change ecology, we anticipate

Industry and society benefits of enhanced fish co-product utilisation: Exploring future opportunities via collaborative partnership

Principal Investigator: Luke Talbot,
National Centre for Food Manufacturing
– Grimsby, University of Lincoln

Email: LukeTalbot@lincoln.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Luke Talbot, NCFM – UoL
Edward Hammond, NCFM – UoL,
Sæmundur Elíasson, MATIS, Iceland,
Cecile Dargentolle, MATIS, Iceland,
Anna Þóra Hrólfsdóttir, MATIS, Iceland
Alexandra Leeper, Iceland Ocean
Cluster, Iceland

Research location: Lincolnshire, UK
and Iceland (mostly Reykjavik region
and Akureyri)

Project overview:

The aim of this project is to strategically analyse opportunities for the UK Seafood Sector to adopt higher value by-product utilisation as exhibited by the significant work undertaken for cod in Iceland, to look for markets in both countries that would benefit from this further utilisation, and to build onward collaboration between MATIS, Iceland, the Iceland Ocean Cluster, and The National Centre for Food Manufacturing at the University of Lincoln in this valorisation space.

This project provides opportunity for the institutions to visit each other, the associated sectors in each country, and to exchange knowledge around how by-product utilisation is approached in each country, what can be learned from each other's experiences, and how the outreach of these opportunities could be increased on both sides of the equation. The aim is to highlight specific areas for collaboration in this space, building on innovative research to progress a theoretical model for by-product valorisation into something that is financially and technologically viable in both the UK and Icelandic contexts.



University of Lincoln and MATIS teams' visit to the Grimsby Fish Market

Project highlights:

- **Visits to Iceland** – This was (and is) a huge opportunity for knowledge exchange with business visits and laboratory experimentation taking place with UK by-products. Salmon was highlighted as a major collaborative opportunity for both the UK and Icelandic partners due to high or increasing by-product availability and only small, lab-scale research having taken place for this species so far. Other further opportunities were also highlighted in separate parts of the seafood supply chain between Iceland and Grimsby.
- **Icelandic visit to the UK** – This week created many opportunities for knowledge exchange between academics from MATIS and NCFM, four UK Seafood processors producing salmon products (and associated by-products), two by-product utilisers who are currently creating fish meal/oil and pet treats from salmon, and two other schools within the University of Lincoln who could aid with material analysis, to progress this agenda. These visits set the scene for the UK opportunities in this space with many collaborative projects and one-page project overviews being circulated throughout internal teams to look for onward funding.

Next steps:

Yes- there have been several large-scale collaborative opportunities identified between the institutions involved which are being developed into full proposals for submission into further funding schemes when appropriate, including but not limited to:

- UK and Iceland 100% Salmon Utilisation
 - Supercooling as an alternative to freezing or air freight to create higher value, lower carbon seafood and associated by-products.
 - Optimisation of Freezing and Thawing for down-stream quality control between UK and Icelandic Seafood Industries.
-

SKILLSET: Scientific uK:Icelandic coLLaboration aboard the SDA through Early-career-researcher Training and networking

Principal Investigator:

Lucy Stephenson, British Antarctic Survey

Email: lustep@bas.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Iceland Col: Dr Catherine Chambers,
University of Westfjords

Leadership team: Lucy Stephenson,
Floortje van den Heuval, Rachael
Sanders, Eleanor Maedbh Honan,
Gabi Stowasser

ECR participants: Megan Malpas,
Emily Pejic, Alessandra Schnider,
Einar Jonsson, Andrew McDonald,
Dylan Beard, James Lucas,
Phoebe Noble, Claire Penny

APECS Iceland

APECS Iceland leadership:

Babsi Neubarth (University of Iceland)
Jonathan Wood (University of Iceland)
Negar Ekrami (University of Iceland)

Iceland ECR participants:

Emily Pejic (University Center of the
Westfjords)

Alessandra Schnider (Hólar University
and the University of Iceland)

Einar Jonsson (University of Iceland/
Marine and Freshwater Institute)

Jonathan Wood (couldn't attend in the
end due to illness)

Urður Ýrr Brynjólfsdóttir (Marine and
Freshwater Institute, Iceland) (couldn't
attend in the end due to bereavement)

Dr Catharine Chambers (University
Center of the Westfjords)

Research location:

Transit between Harwich and Madeira
aboard the RRS SDA

Project overview:

SKILLSET was a training cruise run by UK Polar Network and APECS Iceland which brought 9 early career researchers (ECRs) aboard the RRS Sir David Attenborough (BAS's research vessel), making use of spare berths. This was the first bespoke training cruise aboard the SDA, addressing the paucity of at-sea research training opportunities for ECRs. Participants gained experience using SDA science facilities including the uncontaminated seawater system, underway instrumentation, the aerosol lab and the observation deck. This knowledge was applied to interdisciplinary group projects using ship data, which had impressive outputs considering the time frame. The programme sought to provide a holistic suite of training beyond the practical science covering: cruise reports, remote sensing to support cruises, lab management, event logging, science communication, respectful relationships and cruise leadership. SKILLSET's other objective was to promote long-term collaboration between the UK and Iceland through networking. The leadership team and participants had the opportunity to share their scientific backgrounds with each other at the start of the cruise, encouraging an atmosphere of mutual knowledge exchange throughout. A collaboration road-mapping workshop helped us to link each other to colleagues, infrastructure, opportunities and funding; as well as develop future projects between UK Polar Network and APECS Iceland.

Project highlights:

- The experienced leadership team put together a 'the programme they wish they'd had', leveraging their ship based experience to create sessions which would benefit ECRs on scientific cruises in future. Getting to use the state of the art science infrastructure on the ship was extremely useful for ECR participants. SDA staff went out of their way to ensure we had access to the maximum amount of equipment we could. This included the aerosol lab which was on board set up ready for an upcoming cruise. It also included the underway water system - participants collected water which they could then practice filtering and using the salinometer. One of the sessions that got extremely positive feedback was a session using Python GIS to access remote sensing data of the waters we were travelling through, which could then be compared to in situ data collected by the ship. The ECRs also benefited from tours by other science staff on the ship - including the plankton imager being trialed by a zooplankton scientist, the acoustic equipment measuring bathymetry by the geophysical data manager and the experimental aquarium by the aquarium manager.
- A collaboration roadmapping session and a general culture of idea co-creation during the cruise lead to the development of several future scientific collaborations. This includes the use of a UK specialist lab by an Icelandic ECR to the application of AI by one UK ECR to the manual element of an Iceland ECR's fish PhD (see below for further details). This kind of small-scale project generation is very impactful for the career of ECRs, requires little future resource input and will lead to long-term collaboration between the UK and Iceland.
- Such positive feedback was received from the ECR participants showing that SKILLSET had been genuinely positive for their careers and personal development. 100% of SKILLSET participants said that the experience helped address barriers to fieldwork and prepared them for future at-sea fieldwork.

Next steps:

Collaboration between UKPN and APECS Iceland will continue. Short-term plans include putting a session proposal in together at the Arctic Circle Assembly 2025. We will also collaborate on future seminars, public outreach and hopefully a similar at-sea training cruise, based on SKILLSET.

Individual ECR participants developed scientific collaboration ideas with other participants, their colleagues, infrastructure and funding. For example one specialised research facility in BAS may be used in future by one of the ECR participants. And a computer vision method one UK participant is proficient in may help one of the Icelandic ECR participants with an aspect of their biological PhD. One ECR participant from Iceland has since applied for a PhD with one of the SKILLSET leadership team. A UK participant developed a project idea with the help of a data manager on the ship, using imagery that the ship has collected previously. One participant managed to collect atmospheric data which may contribute to a chapter of their PhD.

We hope SKILLSET provides a template for future at-sea training courses to build on. We are in the process of writing a full report for UKPN (or another course). We have learnt a lot that would enable us to run a similar programme aboard the SDA on the same leg, or could be adapted easily for a different vessel/leg. We collected feedback from the participants which would help guide development of a future programme.

Sociotechnical modelling of resilient Arctic communities

Principal Investigator:

Dr Tamara Lopez, The Open University

Email: tamara.lopez@open.ac.uk

UK and Iceland-based

Co-Investigator/Team members:

Dr Tom Welsh The University of Iceland

International partners:

We have invited speakers from these international (Not UK/Iceland) institutions:

Marianne Lindroth,
Aalto University, Finland

Dr Sarah Robinson,
University of Cork, Ireland

Dr Faeq Alrimawi,
University of Limerick, Ireland

Dr Sigurður Emil Pálson,
NATO Cooperative Cyber Defence
Centre of Excellence (Estonia)

Research location:

Workshop 1 - Iceland - Cybersecurity culture - Eliciting Time and Trajectory (October 1-2, 2024, Iceland)

Workshop 2 - UK - Sociotechnical Modelling for Cybersecurity (25,26 March 2025, UK)

Q1: What are the cultural values of Icelanders with respect to security? How have these changed over time with the introduction of digital systems?

Q2: Which software engineering techniques and methods can be used to represent and ensure societal interests are present in cybersecurity solutions?

Within two workshops, the project is establishing a sustainable collaboration between Icelandic and UK researchers in resilient sociotechnical software systems engineering. The workshops are bringing together an international, multi-disciplinary group of researchers in cybersecurity, software engineering and the social sciences.

Project highlights:

At the first workshop held last October in Reykjavik, there was a thought-provoking and varied set of presentations across two days of discussions, interactions and sightseeing. There were many cross-disciplinary perspectives in the room, including software engineering, social sciences, education and the humanities. In addition, there were representatives from public and private organisations with particular insights and experiences to share. The workshop provided insights into the interplay and impact on resilience of several factors, including the relationship between island life and community, culture and identity, and the scale of issues along with a heightened awareness of the role of place and physical characteristics. The workshop drove home the broad nature of socio-technical resilience and made clear that its role in cybersecurity underpins the need for multi-disciplinary work in resilience research, and the importance of suitable training and education to support industry needs.

Project overview:

The Icelandic National Cybersecurity Strategy 2022-2037 (Government of Iceland, 2022) has identified a diverse set of issues impacting cybersecurity in Iceland and outlined a vision that requires cross-disciplinary effort. Cybersecurity solutions for Iceland must be engineered that reflect its unique resilience characteristics. We argue that in taking a sociotechnical approach to software engineering to identify established resilience characteristics within societies, it is possible to model and account for cultural aspects of resilience in engineering solutions. Toward this aim, we are considering the following guiding questions:

The main scientific output of this and the following workshop will be (1) the definition of a sociotechnical research agenda for aligning cybersecurity solutions with Icelandic values. (2) A longitudinal study will be designed to examine the social and cultural factors that contribute to resilience and shifts over time to social attitudes toward cybersecurity, including a comparison with attitudes in the UK and other island cultures. This will impact Iceland's cybersecurity strategy and the technical outputs of the research can be applied to other micro and island nations. (3) Additionally, the research agenda will include a programme for developing novel software engineering approaches to model, implement and verify the social and cultural aspects of resilience in software. This will address calls within the software engineering and social science communities to operationalise social concepts in software.

Next steps:

In the upcoming workshop in Milton Keynes, we hope to:

- begin drafting a New Ideas and Emerging Results paper for submission to the International Conference of Software Engineering (ICSE). Submission date: October, 2025.
- assemble a team that will collaborate on a bid (venue TBD).

Publications:

Lopez, T. (2025). Securing Code: A View on the Cultural Aspects of Resilience. *IEEE Security & Privacy*, 23(1), 76-78.

Stefánsson, B., M., Helgadóttir, Á., Nizon-Deladoeulle, Neukirchen, H., Welsh, T. (2024). Understanding Trust in Authentication Methods for Icelandic Digital Public Services. To appear: in *The 11th IEEE International Conference on Social Networks Analysis, Management and Security (SNAMS-2024)*

And two outreach activities:

- The Agile Business Consortium, a not-for-profit professional body in the UK will publish a report authored by Professor Helen Sharp presenting outcomes from the workshop held at the University of Iceland in October, 2024 and implications for the workplace. Provisionally entitled "Socio-technical resilience: how to recognise it and how to improve it", the post will appear on the Agile Research Network blog at: <https://www.agilebusiness.org/knowledge-base/blogs.html>
- Researchers in Iceland presented Gagnabær or "Datatown" which is a live running model of Iceland's critical infrastructure, in Lego at European Researchers Night (21. January 2025) and UTMessan (8th February 2025). When a cyberattack happens on one of the systems' honeypots, Gagnabær visualises this in real time. This supports discussion with the general public and other non-technical stakeholders around the societal implications of cybersecurity incidents.



Attendees from the October 2024 workshop at the University of Iceland.

Strengthening ties - exploring collaborative educational and research initiatives between Agricultural University of Iceland (AUI), the University of Highlands and Islands - Inverness (UHI Inverness)

Principal Investigator:

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UK and Iceland-based

Co-Investigator/Team members:

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Jóhannes Guðbrandsson,
Marine and Freshwater Research
Institute (HAFRO)

Prof Hlynur Óskarsson, AUI

Dr Hamish Moir,
IBFC Visiting Associate Research location:
Mýrar Peatland, Vesturland, Iceland

Research location: Mýrar Peatland,
Vesturland, Iceland

Project Overview:

This project fosters collaboration between partners to develop a meaningful pilot study for eDNA analysis in the Mýrar peatland, Vesturland. Samples were collected and analyzed to assess barriers in peatland water flow, focusing on invertebrates and fish. Students enrolled in our Level 8 module (Sustainable Development Approaches in an International Context) enhanced their understanding of the eDNA process through a guest lecture by Bernd Haenfling. Visiting the site in Iceland provided real-world context to the pilot study and strengthened institutional relationships between AUI and UHI Inverness. These collaborations will be further explored through an AUI delegation visit to UHI Inverness in March 2025. The goal is to develop a module that produces reusable and impactful content, fostering sustainability within pedagogy and research practices.



Photo: Karen Marshall



Project highlights:

- **Enriching Student Learning:** This experience has deepened our undergraduate students' understanding of sustainable development and its relevance to their future careers in the sciences. First-hand experiences of students have built positive relationships within their peer group and with AUI staff & researchers involved in the project. There is inspiration for future academic pathways and careers in the field of sustainable development from this project.
- **Institutional Collaboration and Knowledge Exchange:** Best practices shared between AUI and UHI Inverness leadership will foster mutual growth. Insights from observing teaching and research facilities will enhance educational strategies at both institutions. The visit will also facilitate networking among board members, faculty, and staff, creating a foundation for long-term collaboration and knowledge-sharing.
- **Engagement in Cutting Edge Research:** Cutting-edge research techniques have been integrated into our curriculum, promoting the exchange of knowledge and real-world applications. This pilot study has generated valuable educational content, enabling students to engage in ongoing institutional partnerships. UHI students have expressed enthusiasm for eDNA analysis outcomes and future interdisciplinary engagement.

Next steps:

Sustained Engagement and Research: This initiative will continue through the Sustainable Development Approaches in an International Context module, with annual fieldwork visits to Iceland. AUI will remain a host partner, and we aim to integrate further research activities across Vesturland. Ongoing engagement with the Mýrar peatland restoration progress will ensure long-term engagement in sustainable development initiatives. We would hope to build more links between peer groups across the institution, finding routes for creativity & research.



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