# NERC ARCTIC RESEARCH STATION SCIENCE SUMMARIES

## 2019 SEASON

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

Arctic Office
NATURAL ENVIRONMENT RESEARCH COUNCIL

UKRI Natural Environment Research Council

# THE NERC ARCTIC RESEARCH STATION

Established in 1991, the UK's Arctic Research Station in Svalbard is funded by the Natural Environment Research Council (NERC) as part of a broad network of research facilities to support excellent environmental science. It is managed and operated by the British Antarctic Survey.

The Station is available to support UK-based researchers and international collaborators across a wide range of fields, including: ecology, glacial/periglacial geomorphology, chemistry, and marine research.

Priority use of the station is given to researchers funded by United Kingdom Research and Innovation (UKRI). The station also welcomes those supported directly by universities and research centres or funded from other routes, such as the Leverhulme Trust and similar sources. Researchers funded by the European Union Horizon 2020 INTERACT programme - eu-interact.org – are eligible to apply and warmly encouraged.

The Station provides an extremely effective and safe platform for Arctic field research. Comprising 440m$^2$ of laboratory, office, workshop, storage, garage, sitting room and bedroom space. All users of the station receive comprehensive briefings and appropriate training. Safety support is provided during their stay. The Station's Polarcirkel workboat provides access to field locations throughout the fjord coastline. There is also access to snowmobiles and a wide range of field support equipment. The Station is extremely well-connected via a fibre optic web link and telephone system. However, in order to prevent interference with sensitive instruments at a Geodetic Earth Observatory in Ny-Ålesund there is no mobile telephone network.

The Station is normally open to support researchers from early March through to early September. Expressions of interest in using the Station are welcome at any time but it is best to apply as early as possible.

For further information about the Station, the application process and who to contact, as well as detail on Ny-Ålesund itself, please visit the NERC Arctic Office website: www.arctic.ac.uk

# NERC Arctic Station Laboratory:

During the early part of the 2019 season, the Station laboratory underwent a major upgrade. This multipurpose facility comprises four separate laboratory spaces:

- Large main laboratory with wide benching and double sink. Suitable for use as laboratory or electronics workshop
- Annex chemical laboratory with recirculating fume hood, Class II biological safety cabinet and oven
- Wet laboratory with ultra pure water system, sink and benching
- Dry laboratory with benching (balances and microscopes)
- Associated office space and store of general laboratory consumables


The new laboratory equipment available for sample preparation, preservation and basic analysis now includes:

- Spark free laboratory fridges and chest freezers
- Balances (2 d.p. and 4 d.p.)
- Vacuum pumps
- Oven and vacuum concentrator
- Microscopes (multiple light field, including blue light)
- BioSpectrometer (200-830nm; with µCuvette)
- pH meter
- Centrifuges, heat block mixer and vortex (for 1.5ml, 15ml & 50ml tubes)
- Autoclave, steriliser, and microwave
- Web ports available in the laboratory

Further information is available from the Station pages on the Arctic Office website: www.arctic.ac.uk or contact Elaine Fitzcharles, emfi@bas.ac.uk

# THE NY-ÅLESUND INTERNATIONAL RESEARCH COMMUNITY

Scientific research in Ny-Ålesund began in 1966. The Norwegian Polar Institute established a research station in 1968. The Cambridge Arctic Shelf Programme operated a busy summer field base from 1972 – 1992 overlapping with the NERC Arctic Research Station, which opened in 1991. There are now 14 research stations operated by 10 nations: Norway, UK, Germany, France, Japan, Italy, China, Netherlands, South Korea and India. There is strong collaboration between the various international partners within the Ny-Ålesund research community.

There are a number of other affiliated organisations including the University of Svalbard (UNIS). The Ny-Ålesund Science Managers Committee (NySMAC) includes representatives from each station. They discuss project details, promote international collaboration, science quality and help ensure protection of the local natural environment. The committee also organises research seminars held in the countries represented in the community.

*Photo: Ed King, BAS*

# AN INTRODUCTION TO SVALBARD

The Svalbard archipelago lies between 74°- 81° North and 10°- 35° East. Discovered in 1596 by the Dutch explorer Willhem Barentz the archipelago was initially named Spitsbergen ('the land of pointed peaks'). It remained a "No Man's Land" until 1920 when the Spitsbergen Treaty was signed in Paris. Now known as the Svalbard Treaty, it recognised the islands as part of the Kingdom of Norway. There were 14 original signatory nations, including the UK; today that number has risen to 46.

Svalbard has a land area of 61,000 km$^2$, 60 per cent of which is glaciated. The sun is permanently in the sky from mid-April to late August and lies below the horizon mid-October to late February, showing above the mountains near Ny-Ålesund (79°North), in early March. The west coasts of Svalbard experience the last remnants of the North Atlantic Drift. From mid-June to early September the coastline is largely snow free with areas of alluvial plain and tundra, which support plant life. The archipelago is at the forefront of Arctic climate change, with annual average temperatures having risen by 4°C in the last 50 years, with even more pronounced changes in the winter (7°C since 1971).

The Ny-Ålesund area is home to the polar bear, reindeer, arctic fox, ringed, harbour and bearded seals, walrus and whales including beluga, humpback and minke. Blue and finn whales are becoming quite common. Birds make use of the perpetual summer sunlight to nest. They include puffins, Brunnich's guillemots, phalaropes, fulmars, ivory gulls, little auks and ptarmigan. Barnacle geese return in the summer having spent the winter on the shores of the Solway Firth. Terns rear their young before returning to Antarctica in the autumn.

# STATION SUMMARIES

| | NERC Arctic Research Station Projects 2019 | | | | | |
|---|---|---|---|---|---|---|
| | Project PI / Leader | Institute | Email Address | Project Title | Dates | Funding source |
| 1 | Dr Geoffrey Evatt | University of Manchester | Geoffrey.Evatt@manchester.ac.uk | Lost Meteorites of Antarctica | 8 – 18 March | Leverhulme Trust |
| 2 | Professor Nick Wright | Newcastle University | Nick.Wright@ncl.ac.uk | Arctic Flight Tests of SeaDrone | 11 – 18 March | ESPRC and Innovate UK Grants |
| 3 | Jamie Buchanan-Dunlop, Dr Helen Findlay and Dr Ceri Lewis | Digital Explorer, Plymouth Marine Laboratory and University of Exeter | jamie@encounteredu.com<br>hefi@pml.ac.uk<br>C.N.Lewis@exeter.ac.uk | Arctic Live 2019 | 29 – 9 April | XL Group plc |
| 4 | Cecilie Mielec and Michael Nielsen | Aarhus University | | BITCue | 20 – 24 June | H2020 EU Funded – INTERACT Transnational Access Programme |
| 5 | Dr Kevin Newsham | British Antarctic Survey | kne@bas.ac.uk | REMUS - Soil Warming Project | 24 June – 4 July and 26 August – 5 September | British Antarctic Survey – core funds |
| 6 | Guy Tallentire | Loughborough University | G.D.Tallentire@lboro.ac.uk | Fjord meltwater and sediment delivery in a fast changing high Arctic environment | 27 June to 22 July | PhD funded by NERC through the Central England NERC Training Alliance (CENTA) |
| 7 | Amy Gray | Loughborough University | v.a.gray@lboro.ac.uk | Glacial contribution to lacustrine ecological, geophysical and chemical yields in the High Arctic (LEGACY) | 4 – 22 July | PhD funded by NERC through the Central England NERC Training Alliance (CENTA)<br>Fieldwork funded by Arctic Field Grant |
| 8 | Dr Angela Gallego-Sala | Exeter University | A.Gallego-Sala@exeter.ac.uk | ICAAP: Increasing Carbon Accumulation in Arctic Peatlands | 1 – 8 August | NERC |
| 9 | Professor Mark Inall | Scottish Association for Marine Science | Mark.inall@sams.ac.uk | Where AUV's Dare: Sub-glacial discharge plumes | 8 – 19 August | NERC 'NEXUSS' CDT studentship<br>SAMS Scottish Marine Robotics Facility<br>Norwegian Fram Centre "fjords" flagship programme |
| 10 | Dr Alistair Crame | British Antarctic Survey | jacr@bas.ac.uk | PhD Student Course. Safe & Effective Fieldwork in the Polar Regions | 27 August – 2 September | Funded by course participants and British Antarctic Survey |

# The Lost Meteorites of Antarctica

**Research in Svalbard database number:** 10883

**Date of visit:** 8 to 18 March

**Principal investigator:** Dr Geoffrey Evatt, University of Manchester

**Email:** Geoffrey.Evatt@manchester.ac.uk

The Lost Meteorites of Antarctica team spent ten days in Svalbard during March 2019, testing, refining and re-testing equipment for their Antarctica mission (December 2019) to detect and retrieve sub-surface iron meteorites. The equipment comprised of a wide array metal detector, constructed out of large flat plastic panels with embedded metal coils. This work built upon trials they conducted in Ny-Ålesund the year before and in Antarctica two months prior. Combining the internal facilities of the work-station (e.g. laboratory, workbenches, tools, excellent internet access) with the broad field equipment (e.g. skidoos, markers, ropes etc) and the close proximity of glacial field sites, enabled the team to make rapid advances. On the whole the weather held out, if a bit chilly when temperatures dropped to the low -20s, and thus ensured that a thorough field testing of the equipment could be made with relative ease.

The station was full during our visit, including a BBC radio contingent, but we all got on well and it added a pleasant novelty to matters. We are grateful to all of the exceptional help we received from the two station managers (Nick & Nick) and the Kings Bay Company. Their help and the existence of the UK base hugely helped our project. If only there was a lost layer of meteorites in Svalbard!

*Photo: Lost Meteorites of Antarctica Team*

# Arctic Flight Tests of SeaDrone

**Research in Svalbard database number:** 10983

**Date of visit:** 11 to 18 March

**Principal investigator:** Professor Nick Wright, Newcastle University

**Email:** Nick.Wright@ncl.ac.uk

The SeaDrone is a highly novel type of drone that can both fly and go underwater. It is designed to assist scientists collecting data in Arctic conditions. Sea trials were conducted landing on the sea and then submerging to a set depth. Extensive development work on surface manoeuvrability also took place indicating that the rotatable motor design enables the craft to navigate very efficiently through the sea ice. Anti-ice coatings and naturally derived polymer materials for the craft structure were also investigated.

*Photo: Nick Wright, Newcastle University*

# AXA XL Arctic Live Research Expedition 2019

**Research in Svalbard database number:** 11185

**Date of visit:** 1 to 8 May

**Principal investigators:** Jamie Buchanan-Dunlop, Encounter Edu, Dr Ceri Lewis, Exeter University, Dr Helen Findlay, Plymouth Marine Laboratory

**Email:** jamie@encounteredu.com

Encounter Edu's AXA XL Arctic Live is the most northerly education programme delivering polar education for schools following research conducted from the NERC Arctic Research Station. Running for its sixth year, in 2019, AXA XL Arctic Live brought to life microplastics and ocean acidification research by University of Exeter and Plymouth Marine Laboratory to 15,200 students in 21 countries.

The Encounter Edu team set up a 'broadcast studio' in the station garage / storeroom and live streamed 25 broadcasts to schools. These ranged from live investigations, experiments that students watching could follow, to expert interviews with resident field researchers and the station manager. Students are always amazed with the view from behind the station stretching over 30km on a clear day to the Tre Kroner, the pyramidal peaks at the head of the fjord.


In addition to the education outreach work, Arctic Live 2019 saw the second year of a long-term marine monitoring programme, investigating the abundance and partitioning of marine microplastics in Kongsfjorden and the impact of ocean acidification on marine invertebrate settlement. This data will help build a picture of how human activity is having an impact on the marine environment around the NERC Arctic Station.

AXA Arctic Live is supported by AXA XL, BAS, University of Exeter and PML and implemented by Encounter Edu. Further information is available at https://encounteredu.com/live/arctic-live-2019.

*Photos: Arctic Live Team*

# Biotic interactions tracked by computer vision (BITCue)

**Research in Svalbard database number:** 11236

**Date of visit:** 20 to 24 June

**PI:** Toke Thomas Hoye, Aarhus University

**Fieldworkers:** Cecilie Mielec and Michael Straarup Nielsen

Investigating the impact of climate change on the interaction between Arctic plant phenology and pollinating insects is not always an easy job. To be able to monitor detailed changes in flower stages and visiting pollinators new methods need to be developed. By using surveillance cameras mounted towards flower pads, automatic image recognition and artificial intelligence in the means of machine learning, it is possible to get a massive dataset of insect pollinators at the species level and when they visit different flowers.

We went to set up eight surveillance cameras in Ny-Ålesund monitoring flower pads of Dryas octopetala. All cameras were installed to take pictures once every minute from before budding initiated until the flowers had withered and the season had come to an end. Cameras were mounted on a heavy metal rack able to withstand wind and extreme weather. The legs were buried deeply in the ground to avoid reindeers tipping them over, as the animals frequently forage in the area. Once every week memory cards and batteries were exchanged with new ones and data was sent back to Denmark for analysis.

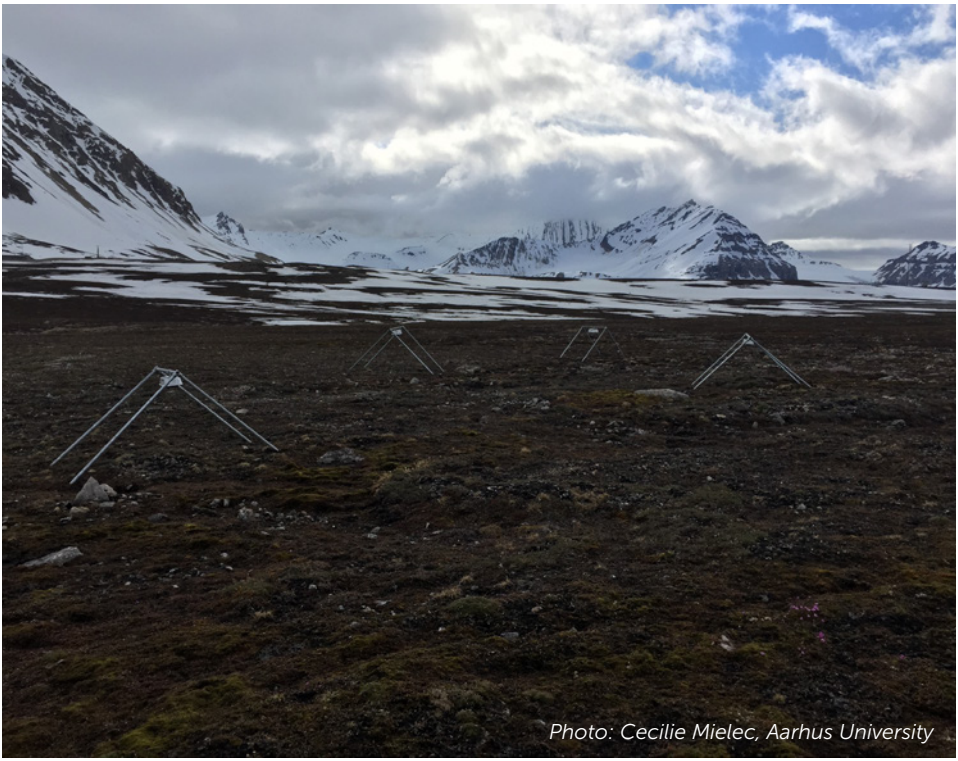


*Photo: Cecilie Mielec, Aarhus University*

# REMUS: Responses of Microbes in Upper Soil Horizons to Environmental Manipulations

**Research in Svalbard database number:** 6921

**Date of visit:** 24 June to 4 July and 26 August to 5 September

**PI:** Dr Kevin Newsham, British Antarctic Survey

**Email:** kne@bas.ac.uk

In September 2014, REMUS, a long-term soil warming experiment, was set up at Kvadehuken on the Brøggerhalvøya Peninsula. Forty eight plots in three blocks were established over frost boils. The boils were colonised by Salix polaris, Bistorta vivipara and Saxifraga oppositifolia, and by microbial soil crusts. Twenty-four ITEX chambers (1.2 m basal diameter, 0.75 m aperture diameter, 400 mm height, each held down with ropes) were deployed over frost boils to increase mean annual soil surface temperatures by c. 1 degrees Celsius.

Twice during summer 2019 (in mid-June and late August), one litre of deionised water was applied factorially to 24 of the boils, resulting in four treatments (-OTC/-water, -OTC/+water, +OTC/-water and +OTC/+water). Initial observations with collaborators at the Korean Polar Research Institute and the University of Copenhagen indicate that OTCs influence the taxa of bacteria present in soil and the fluxes of greenhouse gases to and from soil. Samples were gathered in late August 2019 to investigate the effects of warming on lichen ecophysiology, and an application is underway with the University of Cambridge to extend the observations to analyses of plant cover.

*Photo: Marta Misiak*

# Fjord meltwater and sediment delivery in a fast changing high Arctic environment

**Research in Svalbard database number:** 11298

**Date of visit:** 27 June to 22 July

**PI:** Guy Tallentire, Loughborough University

**Email:** G.D.Tallentire@lboro.ac.uk

With the support of a CENTA NERC Studentship and funding from Loughborough University's Santander Mobility Award, PhD student Guy Tallentire alongside supervisor Dr Jeffrey Evans visited the UK Arctic Research Station June/July 2019 in Ny-Ålesund, Svalbard. The objective of the work was to study the transport of sediment and meltwater from the Austre and Vestre Brøggerbreen glaciers, through the Bayelva catchment where the river meets Kongsfjorden.

The work involved sediment sampling at many locations along the river, across the floodplain, and in the fjord. The team enjoyed (generally) fine and dry weather making it a productive few weeks.

Currently the project is developing relationships between suspended sediment concentration (SSC) and reflectance and SSC-turbidity, which will be used to calculate the variability of SSC in the Bayelva catchment and meltwater-laden sediment plume at various stages across the satellite era.

A second field season is planned in 2020, to collect more data across the melt season and to utilise time-lapse camera technology in order to analyse sub-daily changes in meltwater-laden sediment plume variability.

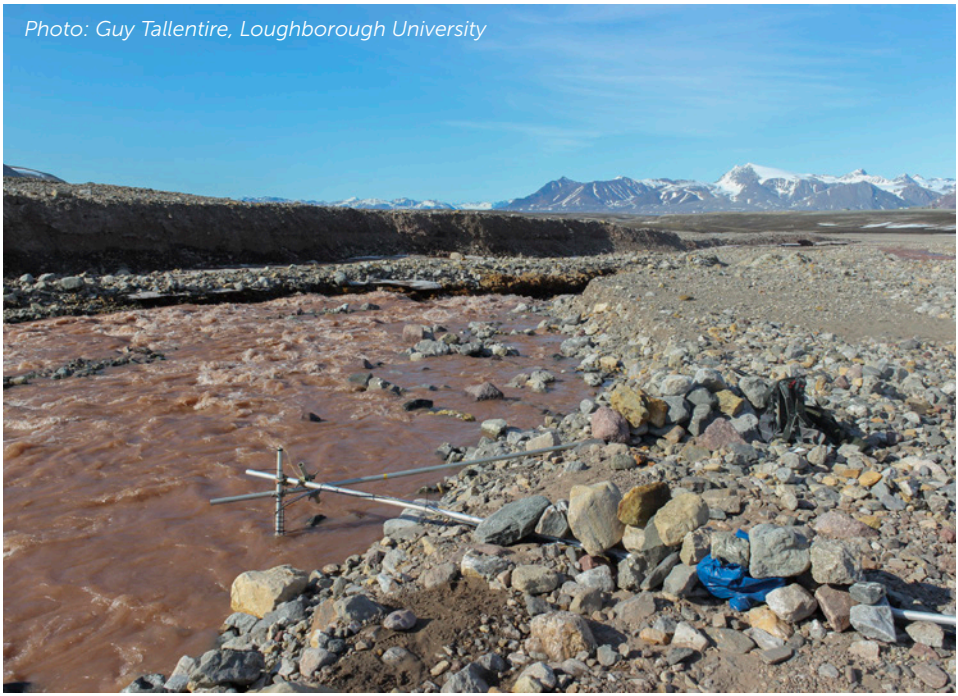


*Photo: Guy Tallentire, Loughborough University*

# Glacial contribution to lacustrine ecological, geophysical and chemical yields in the high Arctic (LEGACY)

**Research in Svalbard database number:** 11159

**Date of visit:** 4 to 22 July

**PI:** Amy Gray, Loughborough University

**Email:** v.a.gray@lboro.ac.uk

The Arctic is currently undergoing a profound climatic and environmental transformation, with the High Arctic experiencing rapid warming at a higher rate than the global average (Kaufman et al., 2009). But quantifying how these impacts might vary over time and understanding the influence of local-scale variability on this complex and interconnected Arctic system has been challenging to establish: not least due to the sparsity of high resolution, long-term data across the region.

This project aims to overcome the challenges associated with the lack of high-resolution, long-term environmental monitoring in the Arctic by using information captured within marine and lacustrine sediment records to determine past climatic and environmental conditions. These multi-proxy archives hold details of palaeoecological, sedimentological, chemical and hydrological change which, with appropriate analyses and interpretation, enable determination of past conditions.

As such, a series of marine and lacustrine sediment cores will be collected from within a 20km radius of Ny-Ålesund, northwest Svalbard. Cores will be analysed using a multi-proxy approach at high temporal resolution to reconstruct changing environmental history, looking at sedimentological processes affecting the study sites, sediment chemistry profiles (including the presence of a selection of nutrients, POPs, mercury and lead) and ecological shifts in diatom assemblages (key primary producers in Arctic environments). This will provide a diverse spatial and historical overview of how changing climate and anthropogenic contamination in the Arctic affects physical and environmental processes, thereby putting the present observations into climatic context, and providing key data to develop models on the impacts of global warming in this important and rapidly changing region.

*Photos: Amy Gray, Loughborough University*

# ICAAP: Increasing Carbon Accumulation in Arctic Peatlands

**Research in Svalbard database number:** 11178

**Date:** 1 to 8 August

**PI:** Dr Angela Gallego-Sala, Exeter University

**Email:** A.Gallego-sala@exeter.ac.uk

The project's main aim is to study whether the Arctic peatland carbon sink is likely to increase in the future. Demonstration and quantification of an increasing C sink in arctic peatlands would represent a fundamental shift in our understanding of the role of the arctic terrestrial carbon store in mediating climate change.

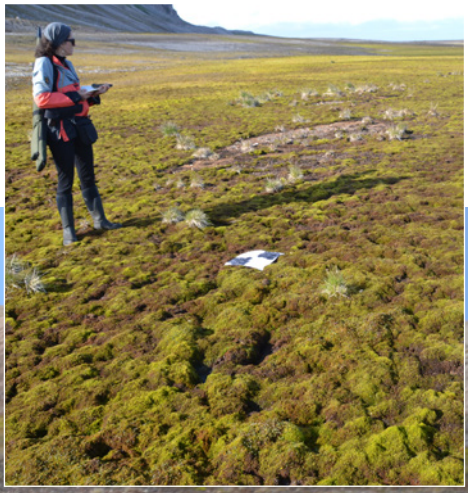
We will test three main hypothesis:

- H1 – Arctic peatland C accumulation rates increased in response to warmer past climates
- H2 – Arctic peatlands have expanded laterally due to increased temperature since the LIA, including post-industrial warming
- H3 - Future climate change will result in an increase of the Arctic peatland C store as a result of increased rates of C accumulation and increased potential for new peatland formation

We will do this with a mixture of palaeoecological and remote sensing methodologies to test dynamic global vegetation model (DGVM) simulations of peatland extent and accumulation rates over the circum-Arctic region for the last millennium, the last 150 years and the last c.30 years.

The ICAAP team (PI: Angela Gallego-Sala, Co-I: Dan Charman, Co-Res Matt Amesbury and Project Collaborator: Dave Beilman) spent a week at the NERC Arctic Research Station in Ny-Ålesund doing field work. The team, with wonderful support by Station Manager Nick Gillet, were able to sample the edges of nascent peatlands around the area (Bloomstrand, Stuphallet) to test for peatland expansion. At each of the two sites we also flew a drone to capture 3D images of different vegetation types to be used for ground-truthing of the satellite data.

*Photos: ICAAP Team*



# Where AUV's Dare: Sub-glacial discharge plumes

**Research in Svalbard database number:** 11282

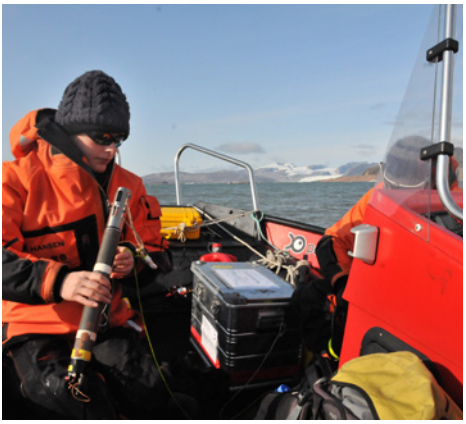
**Date:** 2 to 19 August

**PI:** Professor Mark Inall, SAMS/UHI

**Email:** Mark.inall@sams.ac.uk

Quantifying the dynamic hydrology of tidewater glaciers and the release of meltwater to Arctic fjords is an important step in the process of understanding glacier and ocean response to a warming climate. The presence of subglacial discharge plumes has long been noted at the snout of Kronebreen, a rapidly retreating surge type tidewater glacier in Kongsfjorden. This research campaign was led by scientists from the Scottish Association for Marine Science, with support from the Norwegian Polar Institute. The fieldwork focused on obtaining oceanographic measurements, from throughout the wider fjord to within hundreds of meters of the submerged vertical ice face, to explore the vertical and horizontal circulation invoked by the freshwater flux. The NERC Arctic Research Station provided a perfect field location to operate in this remote location.

*Photos: Mark Inall, SAMS*



Our methods utilised two Autonomous Underwater Vehicles (AUVs), a Hydroid REMUS 600 and a Planet Ocean ecoSUBμ, deployed from the NERC PolarCirkel workboat and the Kings Bay MS Teisten research vessel. Further to this, 66 CTD profiles and 79 Microstructure CTD profiles were conducted throughout the ford, and aerial imagery was obtained from a DJI Phantom drone. The deployment of AUVs offers a novel approach to capturing the three-dimensional structure of this elusive, dynamic regime and will shed light on the dominant oceanic driving mechanisms behind tidewater glacier retreat. The work was conducted under the UK-Norwegian partnership project 'Fjordic Freshwater Fluxes' with funding from the FRAM centre Fjord Kyst Flagship program and as part of the UKRI NEXUSS PhD studentship, 'Where AUVs Dare: Svalbard's subglacial discharge plumes', hosted at SAMS-UHI.

# Safe and effective fieldwork in the polar regions

**Research in Svalbard database number:** 10344

**Date:** 27 August to 2 September

**PI:** Dr Alistair Crame,
British Antarctic Survey

**Email:** jacr@bas.ac.uk

We ran our BAS Advanced Training Short Course for the fourth time from 21 August to 3 September. Ten PhD students from across the NERC community took part, and the course commenced with three days' intensive theoretical and practical work in the Aurora Innovation Centre. How do you plan a polar field season from the very beginning; how do you do this safely, keeping the costs down but making sure that you employ best practice and protect the environment? Hands-on practical sessions are very much to the fore, using BAS experts and real examples from both poles.

We then decamped to the NERC Arctic Station at Ny-Ålesund for a full week of field activities based around a geophysical survey of the Midrelovenbreen Glacier and a marine biological survey of Kongsfjord. No polar bears this year but several minke whales close to the harbour!

This course remains extremely popular and so far we have trained over 50 NERC PhD students on it. It represents a genuine collaboration between BAS Science, Operations, MAGIC and the Environment Office, and we would like to thank all the BAS staff who have freely given of their time to make it possible. We are already working on the 2020 course!

*Photos: Alistair Crame, BAS*

# BBC Radio 4 Today Programme, March 2019

The NERC Arctic Station is a wonderful resource for Arctic researchers, but we knew it was also a prime location from which to communicate cutting-edge stories of Arctic change and Arctic science.

Which is why at 7am local time with -20C plus wind chill outside and the light just beginning to come through the windows we were all crammed into the Arctic Station's office. With BBC presenter Martha Kearney, BBC science editor Tom Feilden and the production team, plus the Station Manager and researchers from Manchester, Newcastle and Aberystwyth who were all anxious to see whether our stories would make the cut on that morning's Radio 4 Today Programme – BBC Radio's flagship news and current affairs programme . Tension, anticipation and then relief - they did! All the planning and preparation for many months and weeks leading up to this point had been worth it. Over the course of the next six days there were daily BBC radio, online and news pieces on the effects of change in the Arctic, why it matters and the role of UK science in understanding and predicting that change.

Reaching out to the Today programme's six million listeners with a fantastically diverse range of stories on the warming Arctic, changes to shipping routes, the microbial life of glaciers and daily life at an Arctic research station amongst many others was a huge achievement and demonstrated UK researchers and operations experts at their best. Heartfelt thanks to everyone connected with the Station and the researchers themselves for making this such a productive and enjoyable experience.

Henry Burgess
Head, NERC Arctic Office

*Photo: Henry Burgess*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