

# Annual report 2024



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# Words from the Directors

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Since the establishment of iC3 in July 2023, we can reflect on an exciting period marked by increasing activity within the Centre.

During this time of significant growth, it has been both inspiring and motivating to see the development of a supportive and stimulating research culture among our diverse team of scientists and across iC3's partnership of UiT The Arctic University of Norway, the Norwegian Polar Institute and NORCE.

We have been delighted to welcome a growing body of iC3 early career researchers (ECRs), including our first cohort of iC3-funded PhDs. ECRs play a vital role in iC3's scientific endeavours, as well as in fostering a strong sense of community and identity. Setting up mechanisms to encourage and holistically support their progress has been a key priority during this initial phase of the Centre.

Since its launch, iC3 has achieved considerable funding success through

projects officially affiliated with the Centre; including an EU Synergy Grant (Into the Blue: PI Knies) and four Norwegian Research Council projects (METALLICA: PI Wadham, iCryme: PI Moreau, METHANICE/ GLASIGAS: PI/ Co-I PI Kalenitchenko). We have also established a new laboratory facility, Polar MAGIC, to serve iC3 science, focused on biogeochemical cycling in polar environments, along with the appointment of a full-time lab manager.

We are fortunate to be located in Tromsø which provides an exceptional setting for our research, and we are maximizing the opportunity to train students and ECRs on our doorstep in the Arctic. In 2024 we held the first iC3 Field School, "Ice to Ocean Biogeochemical Cycling in a Changing Arctic," in the Lyngen Alps near Tromsø. This course offered PhD students the chance to study biogeochemical cycling in polar environments across the full ice-to-ocean spectrum.

Through iC3's important partnership, we have excellent access to high Polar environments for our research via three research vessels, the Norwegian

Polar Institute's infrastructure in Svalbard and Antarctica, and Earth System Modelling capability via NORCE. We have undertaken field campaigns on land and at sea in mainland Norway, Svalbard, Greenland and Antarctica, yielding invaluable empirical datasets for iC3's core mission. Such datasets are also crucial to iC3's work in development and application of novel technologies to polar cryospheric research. Here notable progress has been made, such as advancements towards implementing dynamic ice sheets in the Norwegian Earth System Model and the development of sensor technology for glacial water systems.

We would like to extend our thanks to all within the iC3 community, iC3's partners and host institution who have contributed so much to our achievements thus far. As we look forward to the coming year, we are excited to advance our research and to continue fostering an environment of collaboration and innovation.



**iC3 Director**  
Jemma Wadham

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**Assistant Director**  
Monica Winsborrow

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*Unless otherwise stated this report was written  
by Jemma Wadham, Monica Winsborrow, Terri  
Souster and Till Bruckner*

# About iC3

# iC3 Vision and objectives

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## Vision

*iC3 produces ground-breaking insights into how links between ice sheets, carbon cycles and ocean ecosystems impact life on earth.*

## Centre Objectives

*The centre identifies a single primary objective, to be met by six secondary objectives, as follows:*

### **Primary Objective:**

To deliver a step change in current understanding of the impact of changing ice sheets on Earth's carbon cycle and ocean ecosystems, suitable for integration to IPCC and policy frameworks.

### **Secondary Objectives:**

**To develop** the first robust inventory of carbon stored beneath present-day ice sheets and determine its future sensitivity to climate-driven release via clean drilling, innovative geophysics and modelling.

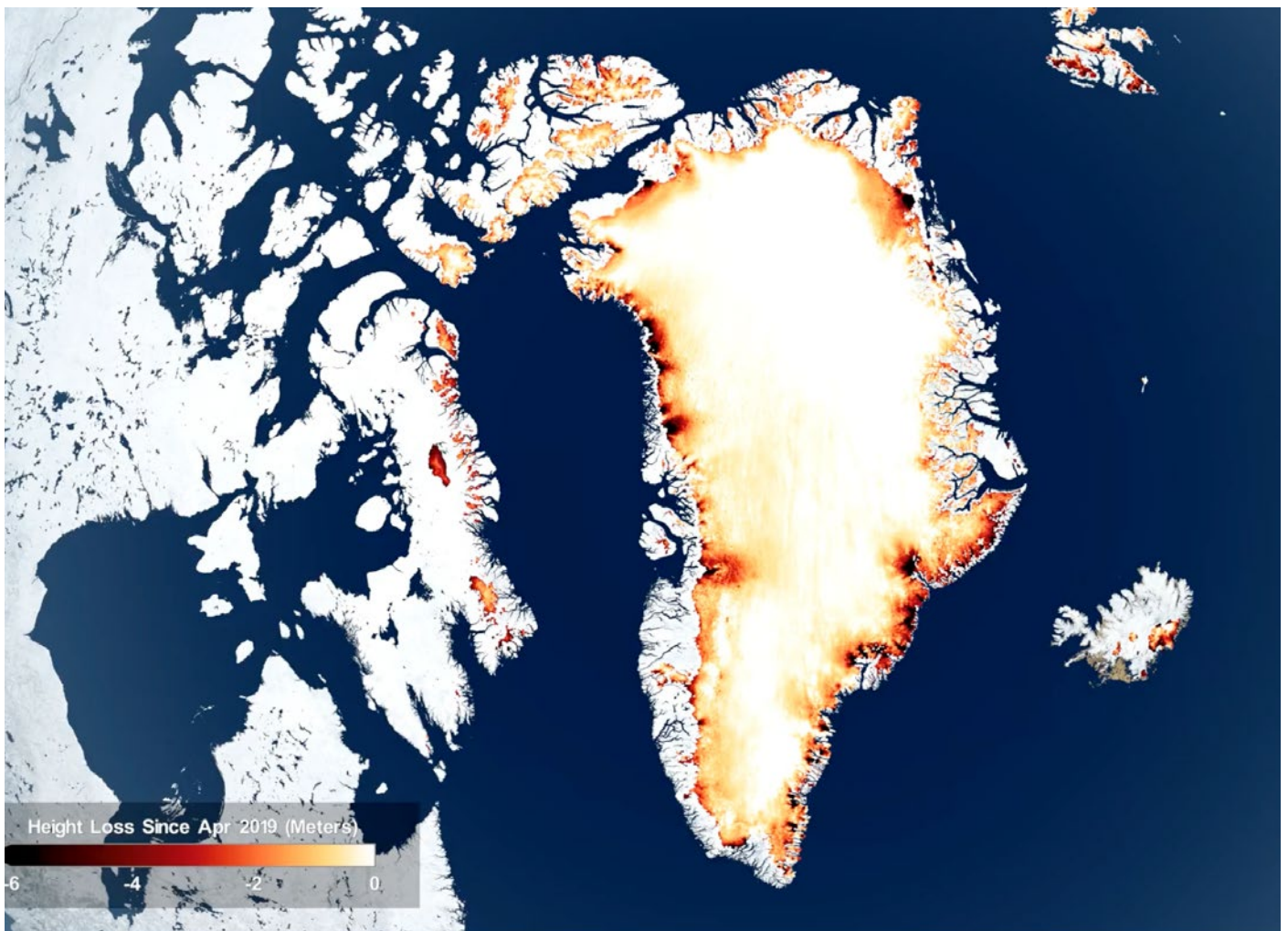
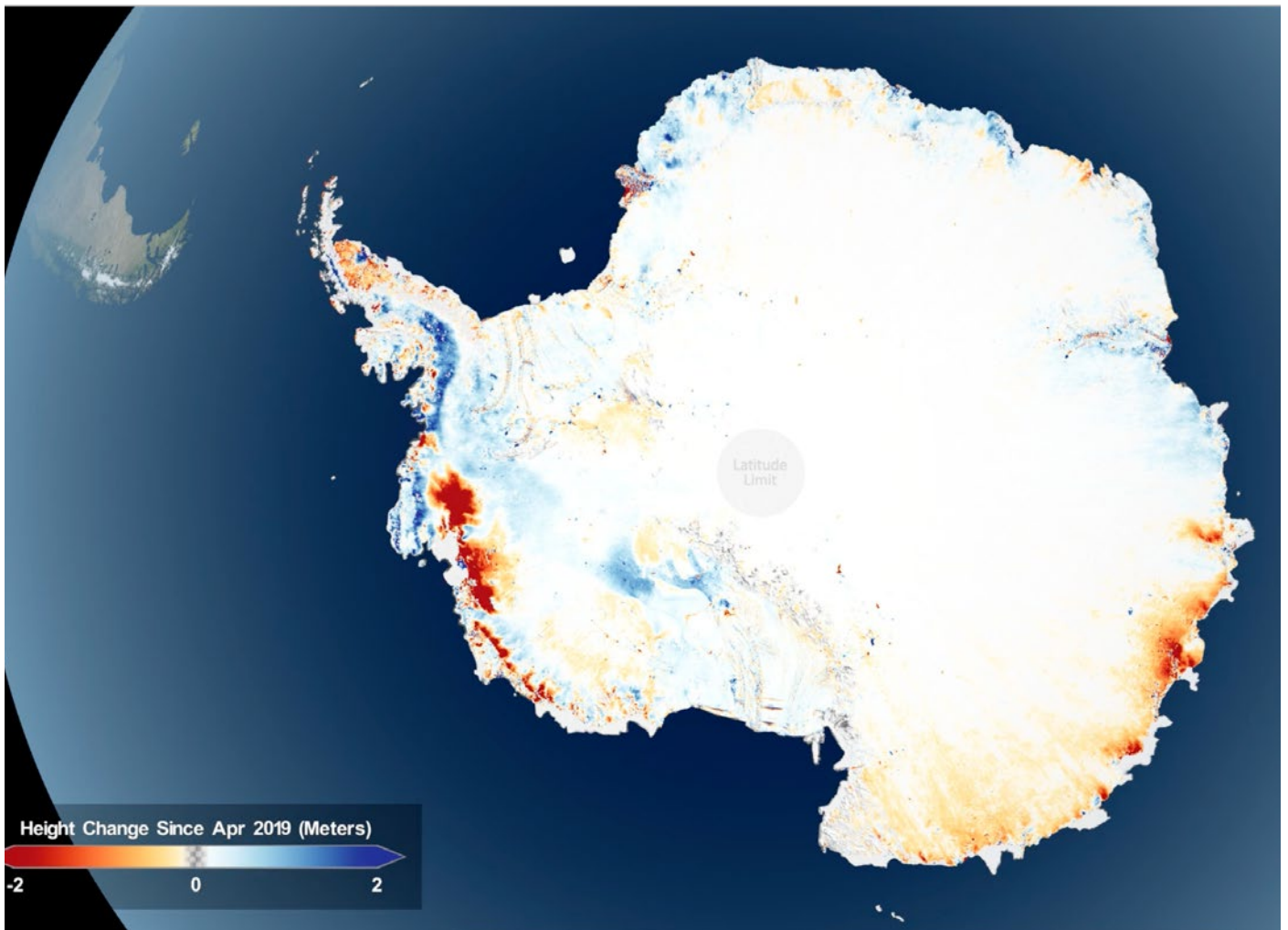
**To drive** major scientific breakthroughs in understanding the export and fate of ice sheet-sourced carbon and nutrients over ice-to-ocean gradients by integrated process study.

**To unlock** new geological records as past analogues of future warm climates and ice sheet-carbon cycle feedbacks.

**To quantify** future global carbon cycle sensitivity to ice sheet change by advancing Norwegian modelling capability.

**To develop and apply** novel technologies for polar cryospheric research.

**To train** a new generation of interdisciplinary cryosphere-carbon-climate scientists in Norway.





# Centre organisation

iC3 is a partnership between UiT The Arctic University of Norway (UiT), the Norwegian Polar Institute (NPI) and NORCE. It is hosted by the Department of Geosciences at UiT, where both directors hold positions.

iC3 studies the full spectrum of ice sheet-carbon-climate feedbacks over an ice-to-ocean domain, including land and marine-terminating glaciers, glacier forefields, fjords, coasts and oceans in the Arctic and Antarctic (see infographic). It addresses its central hypothesis via five connected, interdisciplinary Research Units (RUs). Two Impact Themes cross-cut RUs and will: a) invest in new technologies (IT1); and b) mentor and train early career researchers (ECRs) (IT2) within iC3's broad remit. Each research unit has a Lead, Assistant Lead(s) and a network of international/national collaborators.

- RU1:** How much carbon exists beneath ice sheets and how vulnerable is it to release?
- RU2:** How are methane, nutrient and organic carbon exported from ice sheets?
- RU3:** How do ice sheet changes impact marine carbon cycles and ecosystems?
- RU4:** How did past changes in ice sheets affect the global carbon cycle and marine ecosystems?
- RU5:** What is the sensitivity of Earth's carbon cycle to shrinking ice sheets?

**IT1:** Innovation and Technology

**IT2:** Training the next generation



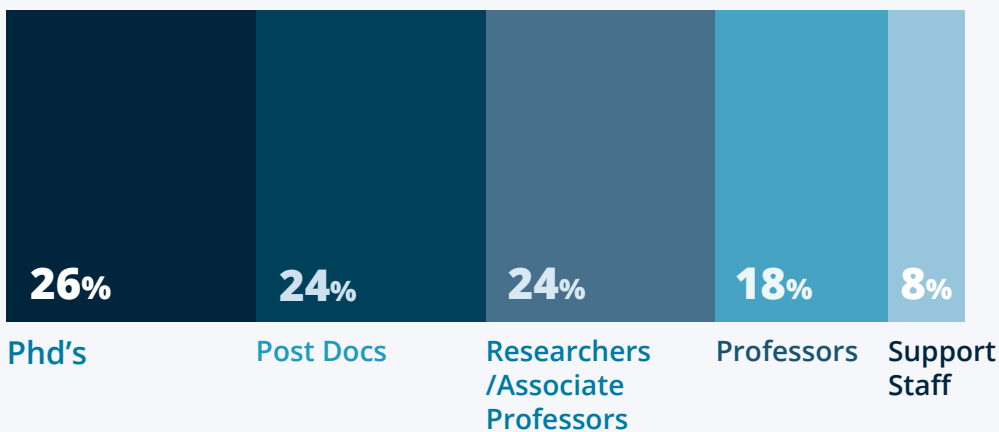
*Illustration: Frida Cnossen*

# Who we are

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iC3 currently hosts 46 scientists of which 25 are ECRs. Across the centre 38% of the team are women, whilst among the ECRs this increases to 50%.

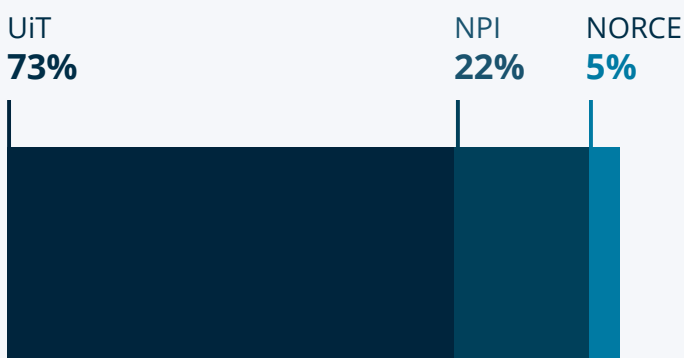
## iC3 Centre Configuration



## Research council funding

iC3 received 155m NOK from the Research Council of Norway through its Centres of Excellence scheme. This is matched by significant in-kind support from the partners (>180m NOK), which includes in-kind PhD students, a full-time technician to manage iC3's new Polar MAGIC laboratory and field infrastructure support. Distribution of Research Council of Norway funds amount the iC3 Partnership is shown below.

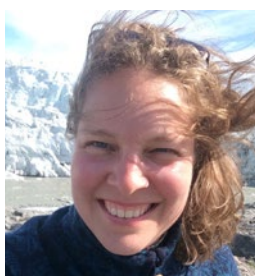
### Funding plan



# iC3 Adjunct members

iC3's adjunct members bring essential skills needed to tackle the biggest questions in polar science.

Four top scientists from the United States, the United Kingdom, Belgium and Norway have joined iC3, boosting its efforts to discover how the links between ice sheets, carbon cycles and ocean ecosystems will impact life on earth.



**Dr. Petra Langebroek** (NORCE), Assistant Lead RU5 and NORCE senior representative in the iC3 Leadership Team. Petra has expertise in Earth System modelling, in particular the Norwegian Earth System Model (NorESM).



**Dr. Fanny Monteiro** (U. Bristol), Lead RU5 (from September 2024), ocean modeller.



**Dr. Jon Hawkings** (U. Pennsylvania), Assistant Lead RU2, with expertise in glacial biogeochemistry.



**Prof. Sandra Arndt** (Free University of Brussels), biogeochemical modeller contributing to RU5.

"Right now, nobody knows how much carbon is stored beneath the world's polar ice sheets, how much will be released as the ice melts, and how that is going to affect global climate and life in the oceans. Solving this urgent puzzle requires collaboration between scientists from many different disciplines, so I'm delighted that four world-class scientists are joining our team."

– *Dr Monica Winsborrow, iC3 Assistant Director*

"This vote of confidence in iC3 by globally leading scientists builds our reputation as a global hub of excellence in polar research. We look forward to attracting even more top scientific talent to Tromsø over the coming months and years."

– *Dr Terri Souter, iC3*

# Collaboration

iC3 has a wide network of national and international collaborators (see figure), and we are continuously working to deepen and expand these connections. Stimulating and enabling international collaboration is a key ambition of iC3 and the launch of our International Fellowship Programme in 2025 will facilitate this further.



# MSCA postdoctoral researchers

iC3 has successfully used the European Marie Skłodowska-Curie Actions (MSCA) funding scheme to attract top talent to Tromsø. Three MSCA postdoctoral researchers recently joined iC3.



## **Laura Rasmussen**

will quantify the impact of Arctic glacier forefield exposure on soil nitrogen cycling and export to coastal marine environments. Her research will inform future ecosystem management policies across the Arctic region.



## **Jan Viljanen**

will develop an optical measurement technique to monitor and quantify dissolved iron in glacial meltwaters. This will enable fast reagent-free online monitoring of dissolved iron in glacial meltwaters.



## **Aurélie Labarre**

will research the fate of bioavailable nutrients, trace metals and carbon on phytoplankton productivity and their impact on the biological carbon pump in the Southern Ocean.

To attract strong candidates, iC3 actively promoted fellowship opportunities on its website and social media channels. To help them succeed, iC3 launched a dedicated funding support programme that helps early career researchers to develop winning MSCA research proposals.

Seven researchers applied in 2024 and are currently waiting for a funding decision. These efforts will continue during 2025, in coordination with the Arctic MSCA program run at UiT.

# Affiliated projects

Securing external funding is essential for iC3's growth and legacy. We have achieved high success so far, including projects funded by the Research Council of Norway (RCN), Tromsø Research Foundation (TFS) and the EU. We have been putting in mechanisms to support future bids, and to ensure that iC3 is positioned to provide the stimulating, support environment necessary to continue our success in this area. Here we highlight some of the externally funded projects awarded since iC3 started, a full list of affiliated projects is found in the appendix.

## **Into The Blue (i2B)**

Funded with €12.5M by a European Research Council (ERC) Synergy Grant, the Into the Blue (i2B) project will deliver a ground-breaking, synergistic framework to address: "Why and what were the global ramifications of a "blue" (ice-free) Arctic during past warmer-than-present-climates?". Led by Jochen Knies leader of iC3 RU4 (UiT), Gerrit Lohmann (Alfred Wegner Institute), and Stijn De Schepper (NORCE), i2B unites world-leading Arctic climate experts who will work together to investigate past warm Arctic climates and their impact on ecosystems and society, using cutting-edge geological records and numerical models.

*Written by Mariana Esteves*



## **Metallica**

Funded by the RCN FRIPRO programme, METALLICA's primary objective is to deliver ground-breaking process understanding of the cycling, export and ecosystem impacts of heavy metals released from Arctic glaciers to fjords. Led by Jemma Wadham (iC3 Director), METALLICA carries out ice-to-ocean field campaigns across a trans-Arctic latitudinal domain, to determine glacial control on heavy metal release and develop a novel conceptual framework to support the future prediction and management of toxicity impacts on critical ecosystem services.

*Written by Sarah Tingey*



## **Methanice**

Funded by the RCN FRIPRO Researcher Project for Early Career Scientists programme, Methanice examines the role of methane-consuming microorganisms associated with terrestrial sub-permafrost methane springs. Led by ECR Dimitri Kalenitchenko, Methanice combines field campaigns (in situ monitoring and high temporal resolution sampling) with laboratory experiments to study and quantify the impact of methane-consuming microbial communities on greenhouse gas release from methane seeps in Svalbard. Under a collaboration with NASA's Jet Propulsion Laboratory, knowledge gained in the project is also providing insights relevant to future missions targeting icy moons.

*Written by Dimitri Kalenitchenko*

# Methanice

## **GlaciGas**

Funded by a RCN FRIPRO grant to Andrew Hodson (The University Centre in Svalbard), GlaciGas investigates climate-driven methane outgassing at terrestrial and marine-terminating glacier margins, and involves iC3 ECR's Dimitri Kalenitchenko and Gabrielle Kleber. The aim of GlaciGas is to understand how the retreat of Svalbard's land-based and marine terminating glaciers will influence methane emissions in the near-future. The project's year-round in-field observations are producing critical process insights at locations on Svalbard which are representative of important yet poorly understood glacierised sites elsewhere in the Arctic.

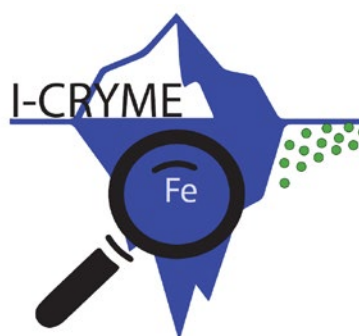
*Written by Gabrielle Kleber*

# GlaciGas

## **iCryme**

Funded by a RCN Research renewal grant to RU3 Assistant lead Sebastien Moreau (Norwegian Polar Institute), I-CRYME (Impact of CRYosphere Melting on Southern Ocean Ecosystems and biogeochemical cycles) investigates how the melting of the cryosphere is affecting the Southern Ocean physical dynamics and elemental cycles, and the marine ecosystems and their capacity to absorb the atmospheric CO<sub>2</sub> emitted by men. I-CRYME involves many others from iC3 including Jemma Wadham, Philipp Assmy, Tore Hattermann and PhD student Megan Lenss. I-CRYME combines field, laboratory and modelling activities that will generate novel datasets. The project utilizes the Research Vessel Kronprins Haakon, the Supply Vessel Silver Arctica that is commissioned annually by NPI to carry out research in the Southern Ocean; innovative technologies such as the TRIAXUS towed vehicle and long-term monitoring by deep-sea moorings in the area.

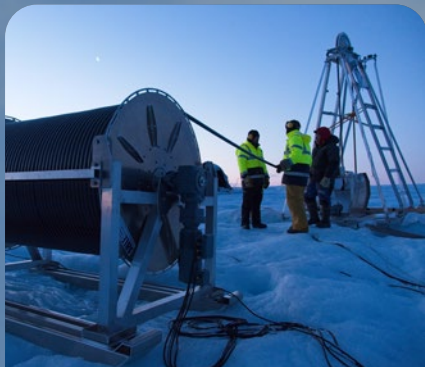
*Written by Sebastien Moreau*





# iC3 activities

# Highlights of 2023



## Marine and terrestrial field campaigns,

in Svalbard, Greenland (June – July), Antarctica, and the Southern Ocean (November – January)

Photo: Henry Patton



## iC3 Appointed a Project Manager Terri Souster

Photo: Iain Rudkin



## iC3 Monthly Science Board meetings started

## July

## Polar MAGIC

### Launch of Polar MAGIC lab

Polar Laboratory for Microbes and Geochemistry in Icy Climes at UiT



### Marie Skłodowska-Curie Actions

### MSCA

3 Marie Skłodowska-Curie Actions Postdoctoral fellowships funded within iC3



### iC3 recruited 4 adjunct positions



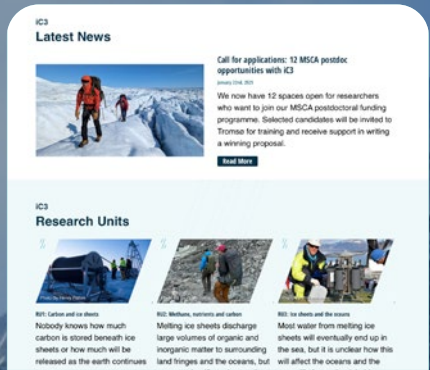
**iC3 Assistant Director and Project Manager delivered Fram Talks**

Photo: Mariana Esteves



**Recruited iC3 Communications advisor Till Bruckner**

Photo: Kai Mortensen



**iC3 website launched**

[ic3.uit.no/news-and-events](http://ic3.uit.no/news-and-events)

## December



**Media and outreach contributions**

BBC, Fram Forum, Barents Observer and The National Geographic

Photo: Mariana Esteves



**iC3 social events**

iC3 held several social events during our first year. Here pictured Autumn social at Holt community gardens on Tromsø island

Photo: Terri Souster



**Scientific Conference of Antarctic Research**

iC3 Leadership represented on the local organising committee for the SCAR Open Science Conference that will take place in Oslo in August 2026

# Highlights of 2024



**iC3 Official Launch,**  
and first iC3 Scientific  
Advisory Committee  
meeting

Photo: Terri Souster



**iC3 Side Event at  
Arctic Frontiers  
conference**

What do changing  
ice sheets mean for  
Earth's climate and  
life in our seas?

Photo: Till Bruckner



**iC3 Director Jemma  
Wadham invited  
to join Norwegian  
Academy of Science  
and Letters**

Photo: Tomas Rolland

## January



**iC3 leadership  
invited by NPI to visit  
Norwegian Antarctic  
Station, Troll**

Photo: Jenny Arthur

**ARCTIC  
FRONTIERS**

**Arctic Frontiers  
Science Session**

"Polar Fjords, Coasts and  
their interactions with  
glaciers" at Arctic Frontiers  
conference

**iT2**

**Launch of iC3  
Mentoring Scheme**



**iC3 hosted award-winning journalist Jacopo Pasotti for 3 months**

(ERC Frontiers Residency- funded)



**2 iC3 funded post-doctoral fellows recruited**



**First iC3 Field School**

on "Ice to Ocean biogeochemical cycling in a changing Arctic"

Photo: Jacopo Pasotti

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## December



**iC3's first cohort of 6 PhD students started**



**Launch of iC3-affiliated EU Synergy Grant i2B: Into the Blue**

Lead by RU4 Lead Jochen Knies



**UiT Young talent award**

iC3 RU4 Assistant lead Mohamed Ezat received UiT Young talent award

Photo: Jørn Berger Nyvoll

# Major iC3 science missions

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## Svalbard

With its ready access and world-leading research infrastructure, Svalbard represents a key focus for iC3 science missions across its ice-to-ocean domain.

Since start-up in July 2023, iC3 and affiliated projects have carried out multiple marine and terrestrial field campaigns, offering our team opportunities to collect world-leading datasets addressing how changing glaciers are impacting carbon cycling and marine ecosystems. Here we select three Svalbard science mission highlights from the Kongsfjorden Process Lab and two affiliated projects: Methanice and GlasiGas.



Photo: Gabrielle Kleber

### **Kongsfjorden Process Lab**

Kongsfjorden on the west coast of Svalbard constitutes a natural laboratory to test the impacts of accelerated glacier melting on carbon and nutrient cycling and marine life in Arctic fjords. Year-round access to the excellent research facilities of the Ny-Ålesund Research Station facilitates targeted process studies along the ice-to-ocean continuum and NPI's long-term environmental datasets from Kongsfjorden allow new findings to be placed into a larger historical context. Kongsfjorden also lends itself to dedicated training of the next generation of polar researchers. In 2024 four iC3-affiliated ECRs joined fieldwork in Kongsfjorden to study heavy metal fluxes from glacial rivers to the fjord. In 2025, two PhD students from the first iC3 PhD cohort will collect data in Kongsfjorden as an essential part of their theses.

*Written by Philipp Assmy*

### **Methanice**

In 2024, an in-situ observatory in Adventdalen, deployed together with Methanice collaborator Andrew Bowen (Woods Hole Oceanographic Institution), successfully monitored the exceptional stability of the water reservoir trapped beneath the ice at Lagoon Pingo, near Longyearbyen. Additional funding through the Svalbard Field Grant allowed expansion of Methanice field campaigns beyond Adventdalen, targeting four distinct seepage settings: terrestrial pingos, glacial icings, sea ice, and frozen lakes. These investigations aim to enhance our understanding of biological processes occurring at the seasonal ice-water interface.

*Written by Dimitri Kalenitchenko*



Photo: Gabrielle Kleber

## GlasiGas

Dr. Gabrielle Kleber (IC3 postdoctoral researcher) has led GlasiGas field campaigns to study terrestrial and marine methane emissions in glacier forefields across Svalbard. She and her team measured and mapped extensive methane supersaturation in fjord waters at the margin of six tidewater glaciers on Svalbard, and have made year-round monthly observations at one tidewater glacier margin to monitor the spatial and temporal dynamics of methane emissions from the fjord. On land, Dr. Kleber and her team surveyed the melt rivers of 19 glaciers on Svalbard, finding that each is an active source of methane to the Arctic atmosphere. To observe the temporal dynamics of these systems, the team also completed three melt-season studies at a single glacier catchment and produced seasonal methane flux estimates from river to atmosphere. The findings from the GlasiGas project have emphasized the important yet overlooked role that glacier forefields play in Arctic methane emissions.

*Written by Gabrielle Kleber*



Photo: Guillaume Lamarche Gagnon

## Greenland

Leveraging extensive experience amongst iC3 scientists in west Greenland, and Norwegian research vessel access to offshore eastern Greenland, iC3 has been able to support several Greenland science missions in 2023 and 2024. Here we highlight three such campaigns, demonstrating the scope of iC3's ice-to-ocean remit.

### **GoNorth research expedition to northern Greenland**

Several iC3 researchers were part of the research expedition GoNorth onboard RV Kronprins Haakon to remote northern Greenland in August/September 2024. The cruise collected a unique set of seawater pelagic (water column) and benthic (marine sediment) samples on the Greenland shelf and in two of Greenland's northernmost fjords with two key aims: (1) understand the impacts of glacier melt and ice distribution on coastal biogeochemical cycles and ecosystems as our climate warms, and (2) assess the impact of previous glacier retreat and high melt periods on past and present day subglacial carbon release and biogeochemical cycles. The iC3 team is particularly interested in understanding how fjord ecosystems and carbon cycling in polar regions are likely to respond to rapid warming and associated ice sheet mass loss. A comprehensive set of water, sediment and geophysical samples were taken by UiT iC3-affiliated PhD student Frank Jakobsen and shipped to labs in Tromsø, Bergen, Bremerhaven, and Philadelphia (USA) for analysis of carbon, nutrients, toxic and biologically beneficial metals, elemental isotopes and ecosystem community composition. Among those working on these samples, new iC3 PhD student Ricarda Runte and her supervisor, Dr. Jon Hawkings (iC3 RU2 assistant lead), are working on the marine sediments to understand the source and reactivity of organic carbon and nutrients in fjords. They look to assess how carbon might be buried in fjord sediments over short to longer time periods, and therefore provide a sink of atmospheric CO<sub>2</sub>.

*Written by Jon Hawkings*

### **Subglacial methane, carbon and nutrient release in Southwest Greenland**

During the summer field season of 2023, iC3 conducted a collaborative field campaign in Southwest Greenland (Kangerlussuaq sector), with the aim of better understanding methane and carbon releases from the Greenland Ice Sheet. Joining the Cryoeco group (Charles University, Prague) on their MARCH4G project, iC3 scientists assisted with sampling of glacial meltwaters destined for radiocarbon dating of subglacial methane emitted in the sector, in an effort to decipher its origin (e.g. from old vs new carbon). Our team at iC3 focussed on sensor deployment to obtain high-resolution data on the temporal variability of subglacial methane emissions. High-end commercial sensors (kindly provided by the University of Bristol, UK) were also co-deployed alongside methane sensors developed by the MetICE project (University of Copenhagen), with very promising results for the future development of low-cost technology sensors for the monitoring of methane in glacial streams. iC3 also joined the BiCycles lab (led from the University of Pennsylvania by iC3 RU2 assistant lead Jon Hawkings,) on their MEGA project monitoring mercury and organic carbon released from the Greenland Ice Sheet in meltwaters and Arctic lakes. Work on the lakes also set the stage for a future campaign in 2025, which will explore what these water bodies reveal about glacial carbon and methane cycling beneath the present-day ice sheet.

*Written by Guillaume Lamarche-Gagnon*



Photo: Daniel Albert

### **Drilling to the bed of the Greenland Ice Sheet**

The large and unaccounted stores of methane locked beneath the Greenland and Antarctic ice sheets could represent a ticking time bomb for future climate change.

With ambitions of accessing and sampling this hidden environment, ic3 members participated in two drilling campaigns on the Greenland ice sheet during 2023 and 2024. Working with Charles University, Prague on their MARCH4G ERC-funded project, the international team successfully utilised a clean hot-water drill system to breach ice thicknesses of over 1.2 km at multiple sites.

In a first for Greenland, a subglacial lake was drilled into during the 2024 field campaign, from which water samples and four sediment cores were recovered. These unique samples will be utilised for detailed geochemical analyses of organic carbon, microbial ecology and methanogenesis.

*Written by Henry Patton*



Photo: Henry Patton



Photo: Henry Patton



Photo: Tore Hattermann

## Antarctica

ic3 has participated in three Antarctic campaigns, led by NPI and international collaborators. The first, a drilling campaign on Fimbul Ice Shelf, Dronning Maud Land (DML), provided a rare opportunity to sample sub-ice shelf environments and sediments. The second and third, via the annual Southern Ocean transect of the Antarctic resupply vessel from South Africa to Dronning Maud Land, led by NPI, studied marine ecosystems, biogeochemical cycling and cored sedimentary records.

### **Drilling campaign, Fimbul Ice Shelf, Dronning Maud Land (DML)**

An extensive and successful 50-day long field campaign was led by NPI during the 2023/24 Austral season, to deploy the Fimbulisen Ice Shelf Observatory (FIO) as part of the Troll Observing Network. In collaboration with the British Antarctic Survey, a hot water drill was used to deploy a suite of autonomous oceanographic sensors which, together with surface instrumentation, will provide insights into ice shelf mass balance. FIO will provide measurements that will help us understand the processes shaping ice sheet mass balance as well as oceanic properties under the largest ice shelf in DML. A time series of oceanic properties beneath Fimbulisen was initially established with moorings that were deployed through hot-water-drill holes at three sites during NPI's Fimbulisen field campaign in 2009/10.

Today these instruments provide the longest continuous record of ocean temperature and currents under an Antarctic ice shelf, showing that a sudden shift towards sustained warm inflow since mid-2016 was caused by large-scale changes in the Southern Ocean climate. These changes had direct implications for basal melting at Fimbulisen during 2016–19, illustrating how remote processes impact the ice-shelf mass balance in this sector of Antarctica. In-situ water sampling, sediment coring and visuals through the ice-shelf borehole further provide unique insights into the past evolution of the physical environment and its connection to the marine ecosystem and carbon cycle. Complemented by the array of multi-disciplinary oceanographic moorings in front of the ice shelf, these observatories provide unique insights into the coastal marine environment in the Atlantic sector of East Antarctica, its relevance for marine ecosystems, ice sheet mass balance and sea level, and linkages to large-scale climate dynamics.

*Written by Tore Hattermann*



Photo: Tore Hattermann



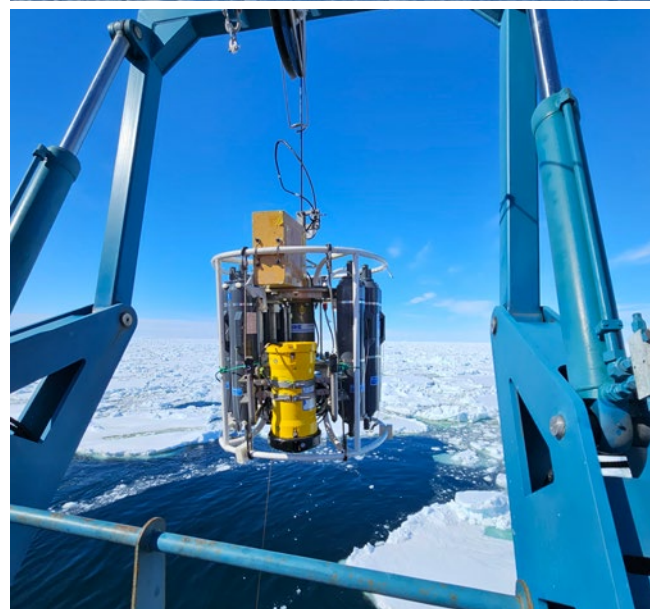
All photos on this page: Sebastien Moreau

### Troll transect expeditions

In January 2024, the Transekttokt 2024 to the Kong Haakon VII Sea investigated how the breaking and melting of sea ice floes in summer support the rich Southern Ocean food web, which attracts the iconic migratory baleen whales to their summer feeding grounds. The share of sea ice primary productivity to this great feeding event is probably changing with the recent decreases observed in the Southern Ocean sea-ice extent. In addition, cryosphere-ocean interactions play a crucial role in shaping unique and very productive sea-ice microhabitats. During the Transekttokt 2024, researchers collected samples and data to study the biology (from algae to zooplankton) and biogeochemistry (carbon and nutrients) inside and below the sea ice, and conducted micro-structure profiles to assess ocean-ice turbulent nutrient fluxes.

In January 2025, the Transekttokt 2025 cruise focussed on the role of the receding ice edge in fostering phytoplankton blooms and influencing biogeochemical cycles in the Kong Haakon VII Sea. Three deep sea moorings were retrieved and redeployed. These continuously measure ocean dynamics and collect biogeochemical samples from the crucial sea ice zone of the Southern Ocean, where very few data exist, yet initial results indicate significant deep carbon export. Researchers also collected a range of biological (phytoplankton and ice algae) and biogeochemical (carbon and nutrient) samples in the upper ocean along the receding sea ice edge following a North-South gradient. During the cruise a pronounced and well-defined sea ice edge bloom was observed, along with striking numbers of baleen whales (including several observed Blue Whales) feeding actively on krill swarms along the northern part of the sea ice pack.

*Written by Sebastien Moreau*



# Innovation and technology (iT1)

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## Innovation and Technology Development in Polar Cryospheric Science

In 2024, iT1 focused on advancing technological solutions to enhance research in polar cryospheric science. A key priority was the assessment and optimization of existing tools and methodologies to ensure a cohesive and integrated strategy for iC3.

A comprehensive audit of current technologies was conducted to identify gaps and opportunities for improvement, providing the foundation for development of a strategic roadmap to shape iC3's long-term technology strategy. This process included engaging with researchers and engineers to evaluate field performance, data quality, and interoperability of scientific instruments. Additionally, we held meetings with several companies developing advanced sensors and autonomous platforms, including drones, gliders, and AUVs automatic underwater vehicles, to assess emerging technologies relevant to our research needs and explore potential collaborations.

We contributed to discussions on applying artificial intelligence (AI) in cryospheric research, advising on the potential of AI-driven data analysis, automated feature detection, and machine learning applications for processing large datasets. These efforts are helping to identify opportunities where AI can enhance data interpretation and improve efficiency in polar research. Specifically, we also contributed our expertise to an UiT AI Centre proposal, which focuses on the democratization of AI. By participating in these discussions, we helped shape strategies to lower technical barriers, promote open-access AI solutions, and support interdisciplinary applications of AI in environmental research.

Significant advances have also been made by iC3 scientists in advancing modelling capacity in Norway via the Norwegian Earth System Model and through unique sensor development for polar research.

*Written by Stefan Bünz*



Photo: Tore Hattermann

## NorESM – modelling ice sheet and climate interactions

“My main goal within iC3 is to implement a dynamic Antarctic ice sheet component in NorESM, and to include ice-ocean processes that are crucial for the present-day and future ice loss in Antarctica.”

– Petra Langebroek, NORCE and UiT, Assistant Lead RU5

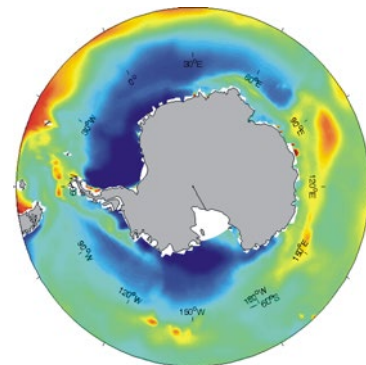


Image: Death, R., et al., 2014. Antarctic ice sheet fertilises the Southern Ocean, *Biogeosciences*, 11, 2635–2643, <https://doi.org/10.5194/bg-11-2635-2014>

To study the global impacts of changing ice sheets on the Earth’s climate and carbon budget, iC3 employs the global Earth System Model NorESM, hosted by iC3 partner NORCE. This numerical model computes processes and feedbacks in the world’s ocean, atmosphere, sea ice and land biosphere. It also includes biogeochemistry in the ocean and aerosol chemistry in the atmosphere.

Until a few years ago, NorESM did not resolve ice sheet dynamics. The Greenland and Antarctic ice sheets were treated as large white stagnant mountains, only allowing for snow processes on top of these mountains. Recently, NorESM developers at NORCE have included a dynamic and interactive Greenland Ice Sheet. And currently, supported by iC3, the focus is on also

including a pertinent Antarctic Ice Sheet. This work is not trivial, as ice sheets interact with all components of the Earth system. Snowfall, melt, ablation and other surface processes determine the surface forcing for the ice sheet. In turn, changes in albedo and surface elevation impact atmospheric processes.

Another example is the connection with the ocean. When ice sheets calve icebergs, or when ice shelves or snow melt, there is a freshwater flux from the ice to the ocean. In turn, ocean temperatures and currents impact the ice melting. Large progress has been made during 2024, with several important technical model advances, providing important milestones to a solid implementation of the Antarctic Ice Sheet into NorESM over the coming year.

This work strongly benefits from our fruitful collaboration with colleagues at NCAR (USA) and in the NorESM consortium, supported by large RCN infrastructure projects such as INES2.

Written by Petra Langebroek

“This technical work is a crucial first step to be able to simulate how future ice sheet changes impact the global carbon cycle”

– Michele Petrini, NORCE, RU5

## Miniature sensors to advance Arctic climate monitoring

As the Arctic environment experiences rapid and unpredictable changes, the need for comprehensive and high-resolution measurement data becomes increasingly critical for accurate monitoring and forecasting. Optical spectroscopy is pivotal in this endeavour, providing highly sensitive and selective methods for on-site and in-situ measurements of atmospheric and environmental parameters.

The UiT Department of Physics and Technology is leading the way in photonic technology development in Norway, particularly in the realm of nanophotonic sensors based on spectroscopy methods. The team led by iC3 member Prof. Jana Jágerská, specializes in the development and advancement of on-chip spectroscopy—a groundbreaking approach that integrates laboratory-grade spectroscopic capabilities into miniaturized, portable, and handheld devices.

By harnessing cutting-edge on-chip technologies, Jágerská, along with Ragnar Seton and Roman Zakoldaev, is transforming traditionally bulky and complex laboratory instruments into compact solutions without sacrificing measurement sensitivity or precision. Their targeted analytes include greenhouse gases and their isotopes, primarily methane and carbon dioxide, in both air and aqueous environments.

### Unique sensors for arctic research:

- **Sensitivity and Selectivity:** Comparable to high-end gas analyzers, with ppb-level detection limits and capability for isotope-specific detection.
- **Portability:** Highly suitable for field deployment.
- **Efficiency:** Ultra-low gas volumes allow for quick response times and compatibility with the smallest samples, such as ice-core samples.
- **Scalability:** Designed for high-volume production and operation in networks

"My commitment to creating a meaningful impact through research has been the central driving force throughout my nearly two-decade-long career. I am closer than ever to making this difference in synergy with iC3."  
– Jana Jágerská

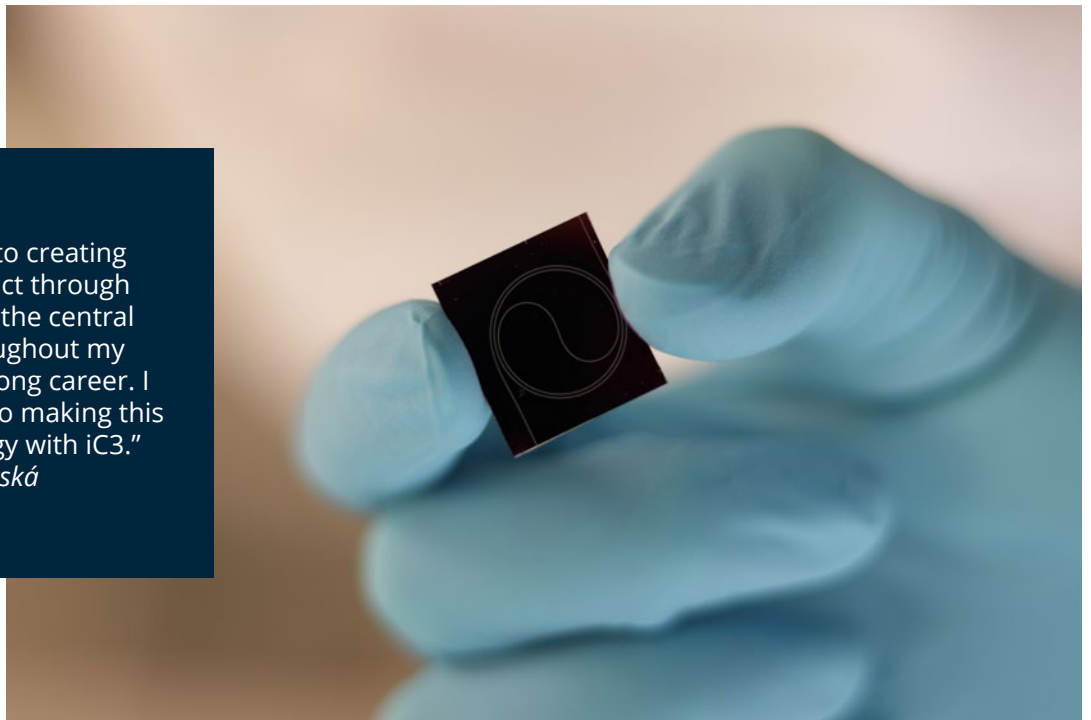


Photo: Jana Jágerská

A slightly different approach is being pursued by postdoctoral researcher Jan Viljanen, affiliated with the group. He has been awarded a prestigious two-year research grant through the European Union's highly competitive Marie Skłodowska-Curie Actions Postdoctoral Fellowship program. His project addresses the critical need for improved monitoring in glacial water systems by developing an advanced nutrient sensor to track dynamic nutrient flows from glaciers to oceans. This innovative work aims to enhance our understanding of glacial meltwater contributions to marine ecosystems and their broader environmental impact.

The collaboration between iC3, Jana Jágerská and Jan Viljanen ensures that sensor development is strategically focused on addressing the practical challenges of Arctic research, thereby pushing the boundaries of what is possible in these fields. This world-unique technology provides iC3 with a tangible advantage in achieving its ambitious goals, setting a new standard for innovation and effectiveness in climate monitoring.

*Written by Jana Jágerská*

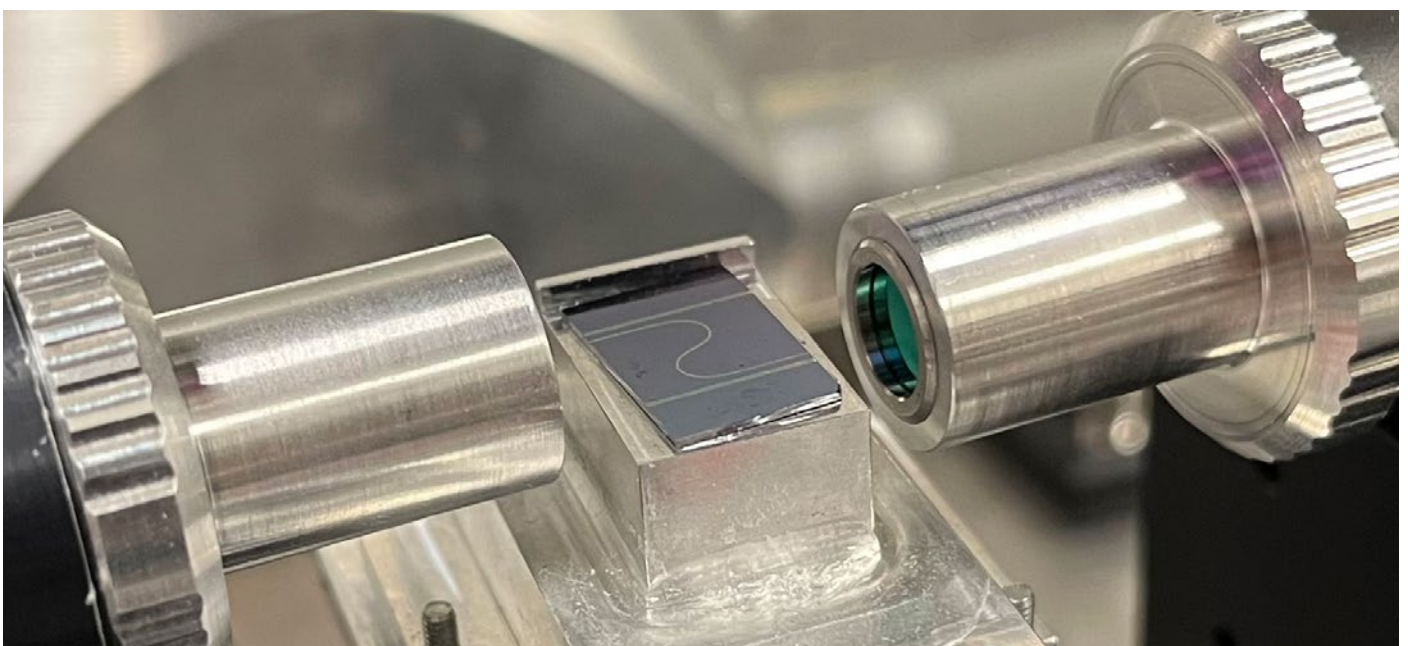


Photo: Jana Jágerská

# Training the next generation (iT2)

ECR integration and engagement is fundamental to the success and legacy of iC3. A highlight of 2024 was welcoming the first cohort of iC3-funded PhD students who kicked off their iC3 careers with an induction week, followed by participation in the first iC3 Field School “Ice-to-ocean biogeochemical cycling in a changing Arctic”

As part of our ambition to create a supportive, stimulating environment for proposal development, the iC3 proposal support programme includes an active and well-attended seminar series, covering different aspects relevant to building up proposals for national and EU funding schemes and proposal surgeries, an informal arena where those actively working on proposals can discuss and get input from iC3 colleagues. During this first period we have had a particular focus on developing strong MSCA fellowship applications and our dedicated support programme enjoyed 100% success in the 2023 funding call.

Career and personal development support has also been prioritised with a seminar series including topics such as “Reviewing scientific literature” and “Communicating scientific research with the media”, and a mentoring scheme for post-doctoral researchers and researchers. We are also pleased to support ECR initiated events such as a writing retreat.





Photo: Joost Martijn van Genuchten

## PhD induction week: Perfect point of departure

Changing jobs and my departure from the Netherlands towards the high North has been a significant step. Such life-changing moments are common in the scientific field, with many experiencing them multiple times in their careers. Still, I am getting used to seeing mountains on the horizon and not always being able to bike everywhere has been a new experience. Settling into Tromsø and starting my new position, however, has been absolutely incredible. This is due to how iC3 recognized this major transition and approached it with a well-structured induction week. This program provided a great starting point for this new chapter, and I was not alone in feeling this way:

*"Before coming to Tromsø, I had not been out of my country for so long. I was a bit stressed, but Terri and the whole iC3 team did such an excellent job of introducing us to everything and making us feel at home that I completely forgot how stressed I was." – Emeric Babut du Marès (iC3 PhD candidate)*

In contrast to the cold climates studied at iC3, the welcome at the centre was incredibly warm. The induction week, led by Terri Souster (iC3 Centre Manager), was a seven-day program in late August 2024. It covered the first days in the new position and provided a comprehensive introduction for me and three others beginning their PhD journeys at the same time. The program familiarized us with the research centre by focusing on its main scientific goals within different research units, laboratory facilities, and supporting impact themes. We had the opportunity

to meet our supervisors in person and learn about the fascinating projects of our colleagues.

Beyond the centre itself, the program also introduced us to a wider scope, such as the UiT campus and the possibilities at NPI. One of the highlights was exploring Tromsø's surrounding nature on a guided hike organized by Till Brückner (iC3 Communications Advisor). Even on the final day of the induction week, the immersion into iC3 was far from over.

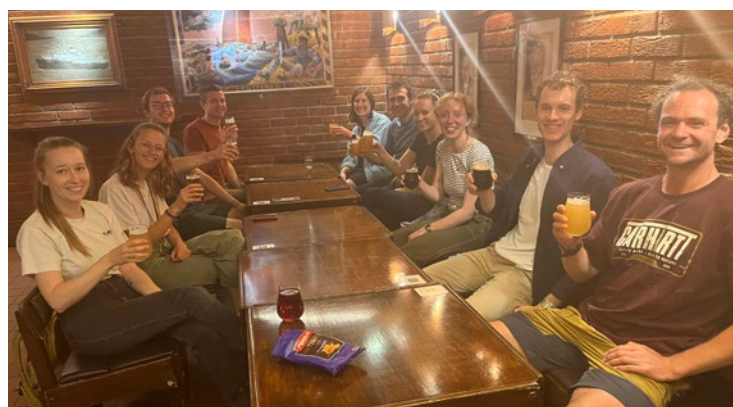


Photo: Terri Souster

A full-day workshop prepared us for the week ahead, introducing us to the centre's first-ever specialized course on Ice-to-Ocean Biogeochemical Cycling in a Changing Arctic, deepening our understanding of our own research as well as that of our colleagues. Though the induction week is now behind us, it remains a perfect point of departure for our time ahead at iC3.

*Written by Joost Martijn van Genuchten*

## iC3 Field School: A meeting of polar tribes

What happens when twenty scientists walk down from a glacier and set sail across the sea? They take samples of course. Lots of samples.

The first-ever iC3 Field School brought together two tribes, land-based researchers and seafaring scientists, to jointly investigate what happens when melting glaciers discharge meltwater into the ocean.

Working out of mountain huts near Steindalsbreen glacier, a field station and the deck of a research ship, each participant got the opportunity to learn and apply a variety of biogeochemical sampling techniques both on land and at sea.

"It's a rare chance to gain new insights through hands-on experience with a variety of samples and measurement techniques," said Joost van Genuchten, who recently joined iC3 as a PhD student. "It helped me to understand how everything connects within the broader system, something that's often easy to overlook."

Luke Simmons, a fellow PhD recruit, agreed.

***"Being out in the field is such a valuable way to comprehend both the scale and intricacy of how the terrestrial and marine realms interact".***

"One moment you're embracing the magnitude of a glacier front and its cascading meltwater discharge, and the next your peering down a microscope discussing how fresh-water input and nutrient concentrations may have influenced the marine ecosystems and species assemblages."

The course was purposefully designed to expose early career researchers to environments and methodologies that are outside their own areas of expertise, and to equip them for their future research in the polar regions, from Svalbard to Antarctica.

"You can only understand what is happening in the polar regions if you take into account the whole system," said Monica Winsborrow, who leads iC3's training component.

"We want to ensure that all of our early career researchers understand the complex connections between ice, land and oceans, and gain the skills needed to do field research across a broad range of settings."

Jemma Wadham, the iC3 director, added that

***"It is incredibly stimulating to spend five days together with researchers from so many different backgrounds."***

"The best way to develop big, exciting new research ideas is to get glaciologists, biogeochemists, marine ecologists, oceanographers and numerical modellers to simply spend time together in the field," she said.

"For example, one of our new research fellows, Jan Viljanen, is developing a new device to make it easier to measure the iron content of water. We immediately started chatting about how we could use other novel technologies to systematically monitor changing Arctic rivers and lakes."

The samples collected during the field school are now being processed in iC3's Polar MAGIC laboratory.

The PhD students participating in the Field School will later analyse the data. Their aim is to determine how mix of chemicals and nutrients released by Steindalsbreen glacier evolves during its journey down the river, and how the influx of meltwater into the fjord is affecting marine life.

"We developed a plan to study how discharge from both a glaciated and non-glaciated catchment could potentially impact the fjord system," Joost van Genuchten explained.

The iC3 Polar Research Hub has a ten-year funding horizon. The field school will run annually in the Lyngen Alps near Tromsø.

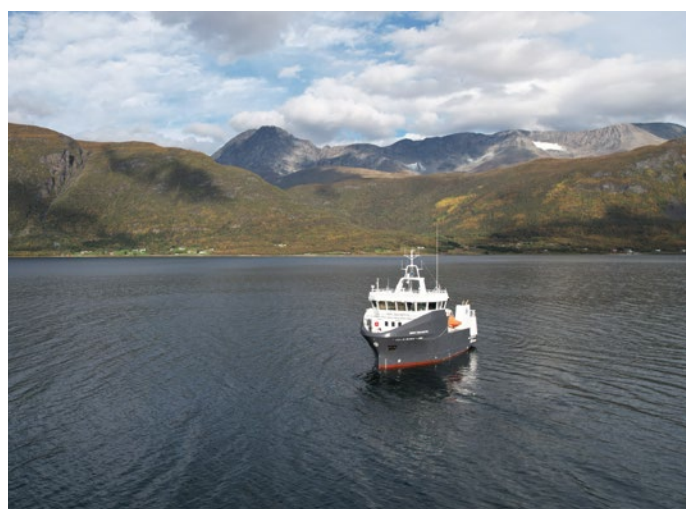
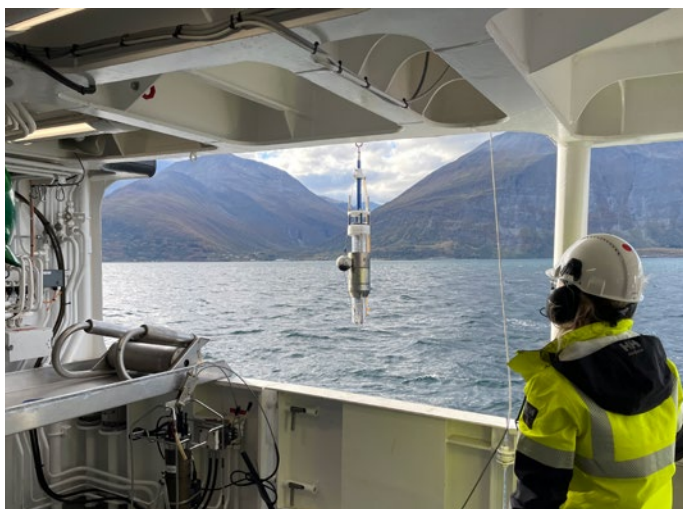
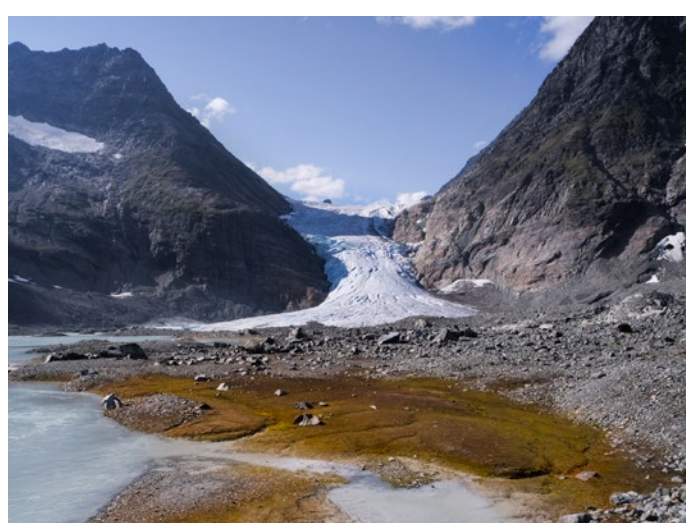
The annual field schools will enable iC3 to create a unique longitudinal dataset tracking how the glacier, the river and the fjord are changing over time, whilst training its researchers in how to study fast changing biogeochemical cycles at Earth's poles.



First row: Guillaume Lamarche-Gagnon



Second and third row: Jacopo Pasotti



Fourth row: Joost van Genuchten

## ECR writing retreat

Keeping motivation high as the dark and cold draw in is a battle every researcher in Tromsø is familiar with. It can be all too easy to disappear into writing isolation, not to reappear until the sun returns.

Although data processing and article writing may feel like an individual endeavour, it does not however have to be a lonely one, and iC3 joined forces with the Geoscience Research Academy of Tromsø (GReAT) to organise an ECR writing retreat at MIT FabLabs in the Lyngen Alps.

Snow crunched underfoot as 17 iC3 and GReAT ECRs took the ferry out to Lyngen one early morning in late November. The sun had said farewell for the year, and it was aurora that lit up the sky above the longhouse styled cabins where we would be staying. The aim of the writing retreat was twofold – firstly to facilitate two days of dedicated, productive work. Secondly, to encourage interaction and integration between ECRs from iC3 and GReAT, all while getting to enjoy one of the most spectacular settings that northern Norway has to offer.

Both days were dedicated to work, and attendees were pleased to report significant progress on their respective projects when we convened over mealtimes. In the evening, they enjoyed exploring the local surroundings together and socialising with games in the cabins. Everyone departed Lyngen feeling accomplished in their work and more connected to their fellow ECRs.

**“It really helped to get away from the distractions of other responsibilities, in order to have some targeted focus time”**

*– Adele Westgård, iC3 affiliated PhD*

*Written by Freya Sykes*

“It was incredible to stay at one of the first ever MIT FabLab – the location itself was very inspiring, as the origin of an international community that promotes open collaboration within science”  
*– Marie Stetzler, UIT GReAT PhD*

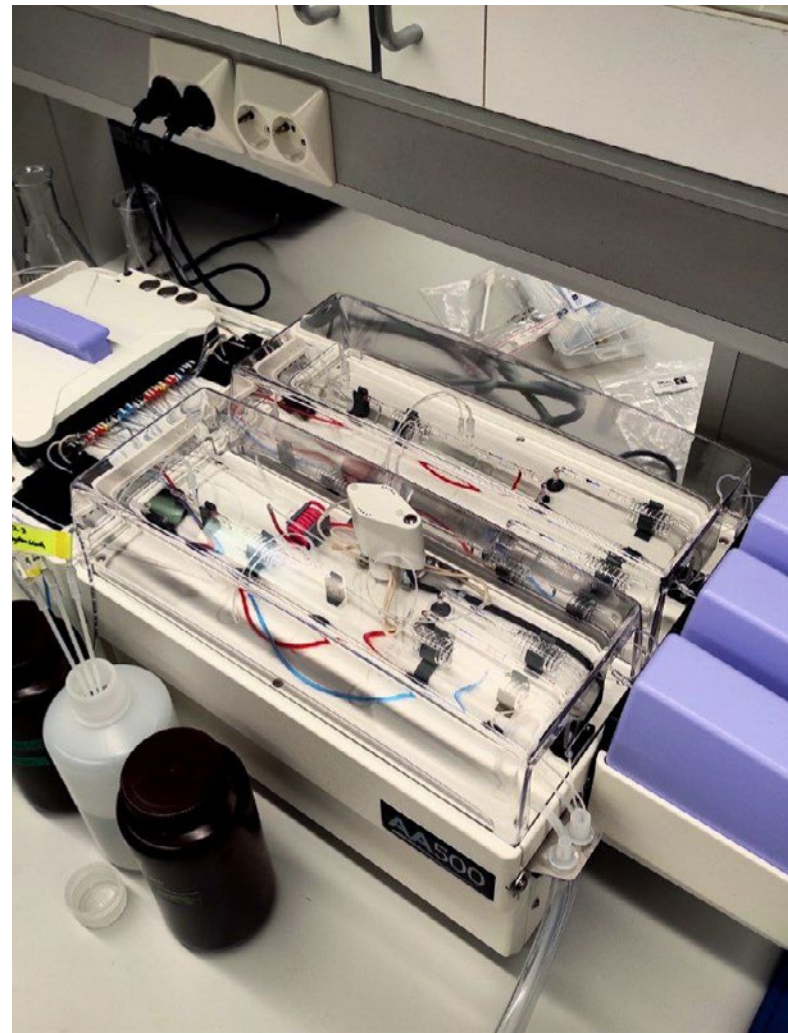


# Polar MAGIC

The Polar Laboratory for Microbes and Geochemistry in Icy Climes (Polar MAGIC) is a research laboratory within the UiT Department of Geosciences that works closely with several iC3-affiliated research projects.

The facility is equipped with state-of-the-art instruments for the detection and quantification of organic carbon and nutrients, as well as a microwave digestion system for the extraction of nutrients and metals from sediments, temperature-controlled experimental spaces and two water purification systems suitable for use in trace-element grade decontamination protocols. On the microbiology side, Polar MAGIC has an anaerobic workstation, an incubation chamber and apparatus for PCR and DNA extractions, as well as standard labware for sample preparation and culturing.

In its first year, more than 1500 samples were analysed in Polar MAGIC, not to mention a great many more samples which were processed within the facility and sent to our collaborators elsewhere. This includes nutrient data from the iC3 Field School in September. In 2025, the lab will play a big part in the preparations for the upcoming iC3 science missions across mainland Norway, Svalbard, Greenland and Antarctica.



All images on page: Rory Burford

*Written by Rory Burford*



# Data management

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For an interdisciplinary centre such as iC3, involving different organisations across multiple countries, it is important to establish a clear, transparent Data Management Plan (DMP), and this has been the key priority during this first phase.

With close collaboration across the iC3 partners, the first extended version of the iC3 DMP was published on the open access platform Septentrio. The DMP aims to provide clear guidance to iC3 members, to ensure that data is proficiently managed at all stages of the project and that it remains accessible, secure and sustainable in the long term, in compliance with the internationally recognised FAIR guiding principles.

*Written by Fabio Sarti*



# Communications

During the first full year of operations, iC3's communications aimed to promote the centre as a key player in global polar research, attract strong PhD and postdoctoral researchers, and make external researchers aware of opportunities for collaboration.

The iC3 team created a website (<https://ic3.uit.no/>) that is regularly updated with news, interviews, job opportunities and blogs summarising new publications. These items are shared with over 8,000 followers across three social media channels. By now, the LinkedIn channel alone generates over 10,000 impressions a week.

This strong online presence helped iC3 to recruit an outstanding first cohort of early career researchers. It also generated over a hundred enquiries from international researchers seeking to move to Tromsø through the European Union's MSCA postdoctoral fellowship scheme, seven of whom were shortlisted to submit proposals.

Broader audiences have been reached through coverage of iC3's research on television, radio and print media in Norway, the United States and the UK, and blogging by early career

researchers. In addition, iC3 organised three training sessions on working with the media. These training efforts were supported by science journalist Jacopo Pasotti, who won a FRONTIERS grant to spend three months embedded with the iC3 team in Tromsø.

An internal newsletter keeps iC3 researchers aware of activities across and beyond the centre, flagging new publications, funding opportunities and social events. An external newsletter will be launched soon. In late 2024, the university's Department of Geosciences allowed PhD researcher Emeric Babut du Marès to support iC3 communications part-time, which will allow the communications function to significantly ramp up its activities over the coming year.

*Written by Emeric Babut du Mares*



**Antarctic sea ice plays critical role in marine ecosystems – new study**

November 14th, 2024



**"The role of sea ice in the Arctic methane cycle cannot be overstated"**

November 12th, 2024



**Svalbard glaciers may be more resilient than we thought**

February 18th, 2025



**New dataset suggests that East Antarctica ice shelves may be unstable**

January 14th, 2025



**New study cracks the code of methane migration in the Arctic seafloor**

December 3rd, 2024



**Icy discovery in Svalbard reveals "a vibrant world of life waiting to be discovered"**

October 14th, 2024





# Appendices

# List of staff

Name	Organisation	Position
Jemma Wadham	UiT	Director, Professor
Monica Winsborrow	UiT	Assistant Director/IT2 Lead, Associate Professor
Terri Souster	UiT	Project Manager
Till Bruckner	UiT	Communications Advisor (50%)
Mariana Esteves	UiT	Project Coordinator
Fabio Sarti	UiT	Database Manager (50%), Head Engineer
Rory Burford	UiT	Polar MAGIC Laboratory Engineer
Alun Hubbard	UiT	RU1 Lead, Professor
Henry Patton	UiT	RU1 Assistant Lead, Researcher
Guillaume Lamarche-Gagnon	UiT	RU2 Lead, Researcher
Jon Hawkings	UiT/University of Pennsylvania, USA	RU2 Assistant Lead, Associate Professor
Philipp Assmy	NPI	RU3 Lead, Researcher
Sebastien Moreau	NPI	RU3 Assistant Lead, Researcher
Jochen Knies	Norges Geologiske Undersøkelse	RU4 Lead, Senior Researcher
Andreia Plaza Faverola	UiT	RU4 Assistant Lead, Associate Professor
Mohamed Ezat	UiT	RU4 Assistant Lead, Associate Professor
Fanny Monteiro	UiT/University of Bristol, UK	RU5 Lead, Associate Professor
Pedro Duarte	NPI	RU5 Assistant Lead, Researcher
Petra Langebroek	UiT/NORCE	RU5 Assistant Lead, Researcher
Stefan Bünz	UiT	IT1 Lead, Professor
Tore Hattermann	NPI	IT1 Assistant Lead, Researcher
Anders Schomacker	UiT	IT2 Assistant Lead, Professor
Matthias Forwick	UiT	Head of IG, Professor
Elisabeth Isaksson	NPI	Researcher
Jack Kohler	NPI	Researcher
Dimitri Kalenitchenko	UiT	Researcher
Jana Jágerská	UiT	Professor
Sandra Arndt	UiT/Universite Libre de Bruxelles, Belgium	Professor
Peter Giertzuch	UiT	Postdoctoral Fellow
Sarah Tingey	UiT	Postdoctoral Fellow
Fanny Cusset	UiT	Postdoctoral Fellow
Gabrielle Kleber	UiT	Postdoctoral Fellow
Aurelia Labarre	NPI	Postdoctoral Fellow
Jan Viljanen	UiT	Postdoctoral Fellow
Ragnar Seton	UiT	Postdoctoral Fellow
Roman Zakoldev	UiT	Postdoctoral Fellow
Akash Trivedi	UiT	Postdoctoral Fellow
Michele Petrini	NORCE	Researcher

Name	Organisation	Position
Griselda Anglada Ortiz	UiT	Postdoctoral Fellow
Joost Van Genuchten	UiT	PhD Candidate
Ricarda Runta	UiT	PhD Candidate
Luke Simmons	UiT	PhD Candidate
Emeric Babut de Mares	UiT	PhD Candidate
Megan Lenss	UiT	PhD Candidate
Lucie Goraguer	UiT	PhD Candidate
Colin Sinclair	UiT	PhD Candidate
Leonard Magerl	UiT	PhD Candidate
Silje Waaler Pedersen	UiT	PhD Candidate
Freya Sykes	UiT	PhD Candidate
Lisa Marie Delpech	UiT	PhD Candidate
Adele Westgård	UiT	PhD Candidate
Frank Jakobsen	UiT	PhD Candidate

# Publications 2023–2024

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Bellec, V. K., et al., 2024 & **Knies, J.** *New cold seep sites on the continental slope southwest to Svalbard*. *Frontiers in Earth Science*, (2024), 12 (1328357), pp. 1-18, DOI: 10.3389/feart.2024.1328357

Bellwald, B., et al., 2024 & **Winsborrow, M.** *Major tunnel valleys and sedimentation changes document extensive Early Pleistocene glaciations of the Barents Sea*. *Communications Earth & Environment*, (2024), 5 (551), pp. 1-15, DOI: 10.1038/s43247-024-01688-x

Bianchi, T. S., et al., 2024 & **Arndt, S.** *Anthropogenic impacts on mud and organic carbon cycling*. *Nature Geoscience*, (2024), 17, pp. 287-297, DOI: 10.1038/s41561-024-01405-5

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Chandler, D. M., et al., 2023 & **Hubbard, A.** *Widespread partial-depth hydrofractures in ice sheets driven by supraglacial streams*. *Nature Geoscience*, (2023), 16, pp. 605-611, DOI: 10.1038/s41561-023-01208-0

Cooke, F. A., et al., 2024 & **Plaza Faverola, A., Bünz, S.** *Semi-automated analysis of faults with meter-scale displacements and networks of planar features using high-resolution 3D seismic to investigate gas leakage at the Vestnesa Ridge, eastern Fram Strait*. *Interpretation*, (2024), 13 (1), pp. B1-T202, DOI: 10.1190/int-2024-0068.1

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**Ezat, M.**, et al., 2024. *Arctic freshwater outflow suppressed Nordic Seas overturning and oceanic heat transport during the Last Interglacial*. *Nature Communications*, (2024), 15 (8998), pp. 1-9, DOI: 10.1038/s41467-024-53401-3

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**Patton, H.**, et al., 2024 & **Knies, J., Winsborrow, M., Hubbard, A.** *Glacial erosion and quaternary landscape development of the Eurasian Arctic*. *Earth-Science Reviews*, (2024), 258 (104936), pp. 1-22, DOI: 10.1016/j.earscirev.2024.104936

Pereira Freitas, G., et al., 2024 & **Hubbard, A.** Contribution of fluorescent primary biological aerosol particles to low-level Arctic cloud residuals. *Atmospheric Chemistry and Physics (ACP)*, (2024), 24, pp. 5479-5494, DOI: 10.5194/acp-24-5479-2024

Seroussi, H., et al., 2024 & **Langebroek, P.** Evolution of the Antarctic Ice Sheet Over the Next Three Centuries From an ISMIP6 Model Ensemble. *Earth's Future*, (2024), 12 (e2024EF004561), pp. 1-44, DOI: 10.1029/2024EF004561

Seroussi, H., et al., 2023 & **Hattermann, T.** Insights into the vulnerability of Antarctic glaciers from the ISMIP6 ice sheet model ensemble and associated uncertainty. *The Cryosphere*, (2023), 17 (12), pp. 5197-5217, DOI: 10.5194/tc-17-5197-2023

Singh, A., et al., 2023 & **Moreau, S.** Absence of photophysiological response to iron addition in autumn phytoplankton in the Antarctic sea-ice zone. *Biogeosciences*, (2023), 20, pp. 3073-3091, DOI: 10.5194/bg-20-3073-2023

Sinner, M., et al., 2023 & **Knies, J.** Lack of detectable chemosynthesis at a sponge dominated subarctic methane seep. *Frontiers in Earth Science*, (2023), 11 (1203998), pp. 1-25, DOI: 10.3389/feart.2023.1203998

**Sykes, F.**, et al., 2024 & **Westgård, A.**, **Ezat, M.** Large-scale culturing of the subpolar foraminifera *Globigerina bulloides* reveals tolerance to a large range of environmental parameters associated to different life-strategies and an extended lifespan. *Journal of Plankton Research*, (2024), 46 (4), pp. 403-420, DOI: 10.1093/plankt/fbae029

Willis, M. D., et al., 2023 & **Moreau, S.** Polar oceans and sea ice in a changing climate. *Elementa: Science of the Anthropocene*, (2023), 11 (1), 00056, pp. 1-44, DOI: 10.1525/elementa.2023.00056

Wolff, I. W., et al., 2023 & **Hubbard, A.** A steady-state model reconstruction of the Patagonian ice sheet during the last glacial maximum. *Quaternary Science Advances*, (2023), 12 (100103), pp. 1-9, DOI: 10.1016/j.qsa.2023.100103

Wongpan, P., et al., 2024 & **Moreau, S.** Gross Primary Production of Antarctic Landfast Sea Ice: A Model-Based Estimate. *Journal of Geophysical Research (JGR): Oceans*, (2024), 129 (e2024JC021348), pp. 1-12, DOI: 10.1029/2024JC021348

# Presentations 2023–2024

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Alexander, A., et al., 2023 & **Assmy, P., Kohler, J.** Oral presentation. "The impact of subglacial drainage system evolution and glacier lake outburst on Arctic fjord macronutrient dynamics: Kongsfjorden, Svalbard". Svalbard Science Conference. 2023-10-30 - 2023-11-01. Oslo, Norway

**Assmy, P.**, 2023. Keynote Speaker. "The role of glaciers for polar marine ecosystems". Blue Think conference. 2023-03-13. Porto, Portugal

**Assmy, P.**, 2024. Oral presentation - mini talk. "Glaciers as a lifeline or threat for life in our seas?". Arctic Frontiers 2024. 2024-01-29 - 2024-02-01. Tromsø, Norway

**Assmy, P.**, et al., 2024 & **Duarte, P., Hawkings, J., Kohler, J., Tingey, S., Pedersen, S., Wadham, J.** Invited speaker. "Melting glaciers: lifeline or threat for Arctic fjords and coasts?". International Symposium on Polar Sciences - The 40th anniversary of CHINARE. 2024-10-29 - 2024-11-01. Shanghai, China

**Assmy, P.**, et al., 2024 & **Goraguer, L., Lenss, M., Monteiro, F., Moreau, S.** Oral presentation. "Linking polar diatom ecology with carbon and silicon cycles". SILICAMICS 4. 2024-10-14 - 2024-10-18. Brest, France

**Assmy, P., et al., 2023 & Duarte, P.** Poster. "Seasonal plankton dynamics in Kongsfjorden during two years of contrasting environmental conditions". Svalbard Science. 2023-10-31 - 2023-11-01. Oslo, Norway

**Duarte, P.**, et al., 2024 & **Assmy, P., Moreau, S.** Oral presentation. "The impacts of tidewater glacier retreat on functioning of Arctic fjords: observations and modeling". Arctic Frontiers 2024. 2024-01-29 - 2024-02-01. Tromsø, Norway

Fabbrini, A., et al., 2024 & **Westgård, A., Sykes, F., Ezat, M.** Oral presentation. "Large-scale culturing experiment of Arctic spinose species *Turborotalita quinqueloba* (planktonic foraminifera): findings and open questions". The TMS Annual Conference 2024. 2024-11-06 - 2024-11-09. Kraków, Poland

**Hawkings, J.**, 2024. Invited speaker. "How Low Can They Go? Exploring Trace Metal Biogeochemistry on the Living Skin of the Greenland Ice Sheet". PerkinElmer Global Webinar Series. 2024-09-26. Virtual

**Hawkings, J.**, 2024. Invited speaker. "The impact of glaciers on biogeochemical cycles". Temple University Seminar Series. 2024-03-29. Philadelphia, USA

**Hawkings, J.**, 2024. Invited speaker. "Trickle or treat? Understanding the role of ice sheets in Biogeochemical Cycles". Earth System Science Interdisciplinary Center (ESSIC) of the University of Maryland (UMD) seminar series. 2024-04-15. Virtual

**Hawkings, J.**, 2024. Invited speaker. "Trickle or treat? Understanding the role of ice sheets in Biogeochemical Cycles". University of Wrocław Polar Cold Regions Research Center Seminar. 2024-11-04. Wrocław, Poland

**Hawkings, J.**, 2024. Invited speaker. "Glaciers and the global iron cycle". Polish Academy of Sciences Wrocław Branch. 2024-11-05. Wrocław, Poland

**Hawkings, J.**, 2024. Invited speaker. "The influence of glacier cover on iron and manganese cycling in Patagonian rivers and fjords". University of Wrocław Physical Geography Seminar. 2024-11-07. Wrocław, Poland

**Hawkings, J.**, 2024. Invited speaker. "Glaciers and the global iron cycle". Institute of Geological Science Polish Academy of Sciences. 2024-11-14. Warsaw, Poland

**Hawkings, J.**, et al., 2024. Poster. "How Low Can They Go? Exploring Trace Metal Biogeochemistry on the Living Skin of the Greenland Ice Sheet". Goldschmidt Conference. 2024-08-18 - 2024-08-23. Chicago, USA

**Hawkings, J.**, et al., 2024. Poster. "How Low Can They Go? Exploring Trace Metal Biogeochemistry on the Living Skin of the Greenland Ice Sheet". American Geophysical Union Annual Meeting. 2024-12-08 - 2024-12-13. Washington DC, USA

**Jakobsen, F.**, et al., 2024 & **Winsborrow, M., Plaza Faverola, A.** Oral presentation. "Late Miocene onset for shelf glaciation on NE Greenland". ArcSTRAT. 2024-10-22 - 2024-10-25. Tromsø, Norway

**Lamarque-Gagnon, G.**, 2024. Invited speaker. "Subglacial methane release in (southwest) Greenland: how and how much?". Methane In Svalbard: a SIOS-funded Workshop. 2024-07-03. Longyearbyen, Svalbard

**Lamarque-Gagnon, G. & Winsborrow, M.**, 2024. Oral presentation - mini talk. "The murky story of glacier greenhouse gas emissions". Arctic Frontiers 2024. 2024-01-29 - 2024-02-01. Tromsø, Norway

**Langebroek, P.**, et al., 2024 & **Petrini, M.** Oral presentation. "Antarctic ice sheet modelling – the needs, challenges, and opportunities for Norwegian Antarctic research". Antarktissemminaret 2024. 2024-05-07 - 2024-05-08. Tromsø, Norway

Martinez Bautista, O., et al., 2024 & **Plaza Faverola, A., Winsborrow, M.** Oral presentation. "Neogene - Quaternary evolution of the north-eastern Fram gateway, European Arctic". ArcSTRAT. 2024-10-22 - 2024-10-25. Tromsø, Norway

**Patton, H.**, 2024. Invited speaker. "Modelling the Eurasian Ice Sheet". Glacial evolution of the north European ice sheets during the Quaternary: Status and Challenges. 2024-03-15. Trondheim, Norway

**Patton, H.**, et al., 2024 & **Knies, J., Andreassen, K., Winsborrow, M., Hubbard, A.** Oral presentation. "Quaternary landscape development of the Eurasian Arctic". ArcSTRAT. 2024-10-22 - 2024-10-25. Tromsø, Norway

**Patton, H.**, et al., 2023 & **Hubbard, A., Winsborrow, M., Esteves, M., Andreassen, K.** Oral presentation. "A time-transgressive perspective of glacial erosion and meltwater beneath the Eurasian ice sheet". The 4th International PalaeoArc Conference. 2023-08-27 - 2023-08-30. Akureyri, Iceland

**Sykes, F.**, et al., 2024 & **Westgård, A., Ezat, M.** Oral presentation. "The response of planktic foraminifera *Globigerina bulloides* to changing environmental parameters through extensive culturing experiments". EGU General Assembly 2024. 2024-04-14 - 2024-04-19. Vienna, Austria

**Wadham, J.**, 2024. Oral presentation - mini talk. "What's happening to glaciers and ice sheets in the Arctic?". Arctic Frontiers 2024. 2024-01-29 - 2024-02-01. Tromsø, Norway

**Wadham, J.**, et al., 2023 & **Winsborrow, M. and Souster, T.** Poster. "Centre for Ice, Cryosphere, Carbon and Climate (iC3). Closing large-scale uncertainty in Polar ice sheet impacts on the global carbon cycle". UK Arctic Conference. 2023-09-11 - 2023-09-13. Cambridge, UK

**Westgård, A.**, et al., 2024 & **Ezat, M.** Oral presentation. "Development of a proxy toolbox for reconstructing polar ocean surface hydrography based on large-scale culturing of the planktic foraminifera *Neogloboquadrina pachyderma*". EGU General Assembly 2024. 2024-04-14 - 2024-04-19. Vienna, Austria

**Winsborrow, M.**, et al., 2024. Invited speaker. "The Eurasian Ice Sheet: Status and Challenges". Glacial evolution of the north European ice sheets during the Quaternary: Status and Challenges. 2024-03-15. Trondheim, Norway

**Winsborrow, M. & Wadham, J.**, 2023. Oral presentation. "Centre for ice, Cryosphere, Carbon and Climate (iC3)- closing large scale uncertainty in Polar ice sheet impacts on the global carbon cycle". The 4th International PalaeoArc Conference. 2023-08-27 - 2023-08-30. Akureyri, Iceland

# Seminars and workshops

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## Science

### Jana Jagerska, UiT

Technology sensors and uses in iC3  
1/22/2024

### Kate Hendry, British Antarctic Survey / Career Development

Biogeochemistry in the polar regions  
and career journey  
2/1/2024

### Tore Hattermann, NPI TONE

Antarctic Infrastructure  
2/6/2024

### Philipp Assmy, NPI

Kongsfjorden data,  
samples, plans  
2/21/2024

### Penelope Wagner, Met Office

Remote sensing and Met office data  
3/14/2024

### Fanny Monteiro, UiT

Marine Ecosystem modelling on a  
global scale and Antarctica  
3/19/2024

### Petra Langebroek, NORCE

Norwegian Earth  
System Model NorESM  
5/6/2024

### Qin Zhu, Akva Plan Niva

Antarctic Ice Sheet Modelling  
5/16/2024

### Torbjørn Eltoft, UiT

Introducing the Centre for remote  
sensing and forecasting  
6/13/2024

### Amanda Poste, NINA

Catchment to Coast  
and iC3 collaborations  
6/24/2024

### Rune Storvold, NORCE

Drones for remote sensing  
10/4/2024

### Anne Braakman Folgmann, UiT

Antarctic Iceberg monitoring  
10/24/2024

### Nils Bochow, UiT

Ice Sheet Modelling  
11/4/2024

### Dimitri Kalenitchenko, UiT

Methanice  
11/29/2024

## Proposal Development

### Inger Lin and Bjorn Hermansen, UiT

Norwegian Research Council Fund-  
ing Opportunities  
10/19/2023

### Andreia Plaza Faverola and Jana Jagerska, UiT

Norwegian Research Council  
FRIPRO Success Stories  
10/23/2023

### Theresa Mikalsen, UiT

EU Funding Opportunities  
including MSCA's, ERCs  
10/30/2023

### Petter Olsen, NOFIMA

Thematic EU calls and  
Navigating the EU Portal  
11/13/2023

### Krishna Agarwal, UiT

EU MSCA and ERC Success stories  
11/22/2023

### Jemma Wadham, UiT

Writing an award winning proposal  
3/7/2024

## Career Development

### Helle Goldman, NPI

Reviewing Scientific Literature  
2/7/2024

### Till Bruckner and Nic Flemming (Journalist), UiT and External

Communicating Scientific Research  
with the media  
2/16/2024

### Sebastein Moreau, Emily Vena- bles, Alison Bailey, Bjorn Runar Olsen, UiT/NPI

Ship based sampling methods  
5/24/2024

### Lize Verekyina, BarentsObserver

Communicating with the media  
through radio and TV  
5/30/2024

### Jenny Turton and Jacopo Pasotti

Communicating research to schools  
and journalists  
10/7/2024

### Till Bruckner, UiT

Open Science  
10/23/2024

# iC3 Affiliated projects

Project	Lead iC3 representative
SEAMSTRESS: Tectonic stress effects on Arctic methane seepage	Andreia Plaza-Faverola
METHANICE: Methanotrophic communities in ice	Dimitri Kalenitchenko
METALLICA: Meltwater release of heavy metals from glacier to ocean in a changing Arctic	Jemma Wadham
ICEBIO Doctoral Network (led by Aarhus Uni.)	Jemma Wadham
ARCLIM: The Arctic Ocean under Warm Climates	Mohamed Ezat
Into the Blue (i2B)	Jochen Knies
The Nansen Legacy	Philipp Assmy
SUDARCO Fram Centre Project	Philipp Assmy
OCEAN:ICE: Ocean-Cyosphere Exchanges in Antarctica: impacts on Climate and the Earth System	Tore Hattermann and Petra Langebroek
NuArctic: Towards a better understanding of the nutrient cycles in the 'new' Arctic Ocean and implications for future primary productivity and carbon export	Philipp Assmy
iMELT: Ocean-ice shelf Interaction and channelized Melting in Dronning Maud Land	Tore Hattermann
I-CRYME: Impact of cryosphere melting on Southern Ocean ecosystems and biogeochemical cycles	Sebastien Moreau
HAVOC: safe havens for ice-associated flora and fauna in a seasonally ice-covered Arctic Ocean	Philipp Assmy
FACE-IT: Arctic biodiversity and livelihoods	Pedro Duarte
CRiceS: Climate relevant interactions and feedbacks: the role of sea ice and snow in the polar and global climate system	Pedro Duarte
BREATHE: Bottom sea ice respiration and nutrient exchanges assessed for the Arctic	Philipp Assmy and Pedro Duarte
TONe: Troll Observasjonsnettverk	Tore Hattermann
Arctic Ocean Physics	Tore Hattermann
TiPACCs: Tipping points in Antarctic climate components	Petra Langebroek
GREASE: Greenland Ice Sheet stability and evolution	Petra Langebroek
Marine Ecosystem Response to Rapid Arctic Climate Change – Irish Marine Institute	Mohamed Ezat
WOBEC: designing and applying a biodiversity and ecosystem monitoring framework for the Weddell Sea off Antarctica	Sebastien Moreau
CLIM2Ant (From Climatic Drivers to Antarctic Ice Sheet Response: Improving Accuracy in Sea Level Rise Projections)	Tore Hattermann and Michele Petrini
GlaciGas project. A research project that will map and measure methane emissions from the basement where there used to be ice.	Gabrielle Kleber (Project PI: Andy Hodson, UNIS)
MSCA#1 – The impact of Arctic glacier forefield exposure on soil nitrogen cycling and export to coastal marine environments.	Lauara Rassmusen
MSCA#2 – Characterise and quantify the fate of bioavailable nutrients, trace metals and carbon on phytoplankton productivity and their impact on the biological carbon pump in the Southern Ocean.	Aurelie Labarre
MSCA#3 – Develop an optical measurement technique to monitor and quantify dissolved iron in glacial meltwaters.	Jan Viljanen

# iC3 collaborators

Name	Country	Organisation
Maya Bhatia	Canada	University of Alberta
Marek Stibal	Czech Republic	Charles University
Dorthe Dahl-Jensen	Denmark	Niels Bohr Institute; University of Copenhagen
Alexandre Magno Barbosa Anesio	Denmark	Aarhus University
Martyn Tranter	Denmark	Aarhus University
John Robert Hopper	Denmark	GEUS (Geological Survey of Denmark and Greenland)
Tove Nielsen	Denmark	GEUS (Geological Survey of Denmark and Greenland)
Marit-Solveig Seidenkrantz	Denmark	Aarhus University
Risto Makkonen	Finland	NEIC (Nordic E-Infrastructure Collaboration); University of Helsinki
Clara Hoppe	Germany	AWI (The Alfred Wegener Institute)
Morten H. Iversen	Germany	AWI (The Alfred Wegener Institute)
Wilken-Jon von Appen	Germany	AWI (The Alfred Wegener Institute)
Juliane Müller	Germany	AWI (The Alfred Wegener Institute)
Christian Rodehacke	Germany	AWI (The Alfred Wegener Institute)
Thomas Juul-Pedersen	Greenland	Greenland Institute of Natural Resources
Sunil Vadakkepuliambatta	India	NCPOR (National Centre for Polar and Ocean Research)
Pepijn Bakker	Netherlands	Vrije Universiteit Amsterdam
Andrew R Gorman	New Zealand	University of Otago
Alexander Tveit	Norway	UiT (The Arctic University of Norway)
Andy Hodson	Norway	UNIS (The university centre in Svalbard)
Amanda Poste	Norway	NINA (Norwegian Institute for Nature Research)
Murat V. Ardelan	Norway	NTNU (Norges teknisk-naturvitenskapelige universitet)
Cathrine Lund Myhre	Norway	NILU (The Climate and Environmental Research Institute )
Stephen Matthew Platt	Norway	NILU (The Climate and Environmental Research Institute )
Laura De Steur	Norway	NPI (The Norwegian Polar Institute)
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Mike Bentley	UK	Durham University
Martin Siegert	UK	Imperial College London
Michael Meredith	UK	BAS (The British Antarctic Survey)
Kate Hendry	UK	BAS (The British Antarctic Survey)
Daniel Goldberg	UK	The University of Edinburgh
Claus-Dieter Hillenbrand	UK	BAS (The British Antarctic Survey)
Gavin Foster	UK	University of Southampton
Tony Payne	UK	University of Bristol
Keith Makinson	UK	BAS (The British Antarctic Survey)

Keith Nicholls	UK	BAS (The British Antarctic Survey)
Matthew Mowlem	UK	National Oceanography Centre
Alexander Beaton	UK	National Oceanography Centre
John Priscu	USA	Montana State University
Fiamma Straneo	USA	SCRIPPS - UC San Diego
Ed Brook	USA	Oregon State University
William Lipscomb	USA	University Corporation for Atmospheric Research





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