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Arctic Land Expeditions in Permafrost Research in 2023

Edited by

Anne Morgenstern and Milena Gottschalk
with contributions of the participants

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Titel: Auswahl des Probennahmeortes am East Channel des Mackenzie River in der Nähe von Inuvik, Kanada, im Mai 2023 (Foto: Anne Morgenstern, AWI)

Cover: Choosing the sampling location at the East Channel of the Mackenzie River near Inuvik, Canada, in May 2023 (Photo: Anne Morgenstern, AWI)

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Arctic Land Expeditions in Permafrost Research in 2023

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Jens Strauss, Simone M. Stuenzi, Claire Treat

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1. ÜBERBLICK

Guido Grosse

DE.AWI

Dieser Bericht gibt einen Überblick über die arktischen Landexpeditionen, die im Jahr 2023 im Bereich Permafrostforschung durchgeführt wurden. Mit unseren Forschungen wollen wir den vergangenen, gegenwärtigen und zukünftigen Wandel der nördlichen Permafrost-Ökosysteme unter einem sich erwärmenden Klima und einer sich ändernden Landnutzung charakterisieren, um die damit verbundenen globalen und regionalen Rückkopplungen abzuschätzen. Die Expeditionen deckten ein breites Spektrum an Themen ab und umfassten Untersuchungen zu:

- Landformen der Permafrostdegradation in kontinuierlichem eisreichem Permafrost,
- Variabilität der Biogeochemie des Mackenzie River, seiner Kohlenstofffracht und ihrer Quellen,
- Wechselwirkungen zwischen Küstendynamik und Tauen von submarinem Permafrost,
- Detektieren von Bodeneis mit Hilfe einer Reihe geophysikalischer Methoden, einschließlich Elektromagnetik, Elektrischer Widerstandstomographie, Umgebungsgeräusch-Tomographie und Bodenradar,
- Permafrostdynamik an kontaminierten Standorten,
- Degradierung von gefrorenem Boden in einer diskontinuierlichen Permafrostlandschaft und Palsa-Mooren,
- Wechselwirkung zwischen meteorologischen Bedingungen, Permafrostcharakteristika und Schnee-Vegetations-Rückkopplung.

Abbildung 1.1 zeigt einen Überblick über die Feldstandorte. Tabelle 1.1 enthält eine Übersicht über alle Expeditionen und deren Bezug zum Forschungsprogramm.

Die Expeditionen konnten sich auf die unerlässliche Unterstützung durch die organisierenden Institutionen, Förderorganisationen, lokalen Partnerorganisationen, Gemeinden und Einzelpersonen verlassen.

Insbesondere möchten wir der Universität Helsinki für die umfassende Unterstützung der Expedition nach Finnland zu ihrer *Kilpisjärvi Biological Station* danken.

Nach der ersten Expedition im Jahr 2022 (Boike et al. 2024) wurde die zweite Expedition nach Westgrönland im Rahmen des BMBF-geförderten WTZ-Projekts MOMENT (Permafrost Research Towards Integrated Observation and Modelling of the Methane Budget of Ecosystems) in Zusammenarbeit mit Projektpartnern der Universität Hamburg, des Helmholtz-Zentrums Potsdam GFZ Deutsches GeoForschungsZentrum, der Leibniz Universität Hannover und der Universität zu Köln durchgeführt (Steffens et al. 2025). Wir bedanken uns dafür, dass wir auf dem angestammten Land des Volkes der Kalaallit Nunaat, früher und heute, Feldforschung betreiben durften und würdigen mit Anerkennung das Land selbst und das Volk der Kalaallit. Darüber hinaus danken wir der Universität Kopenhagen für die umfassende Unterstützung durch ihre Forschungsstation *Arctic Station* sowie den Mitarbeitenden der Station für ihre Unterstützung.

SUMMARY

This report provides an overview of Arctic land expeditions that were carried out in 2023 for permafrost research. With our research we aim to characterize the past, present and future transitions of northern permafrost ecosystems under a warming climate and changing land use in order to constrain related global and regional feedbacks. The expeditions covered a wide range of topics and included investigations on:

- landforms of permafrost degradation in continuous ice-rich permafrost,
- the variability in Mackenzie River biogeochemistry, the carbon load and its sources,
- interactions between coastal dynamics and subsea permafrost thaw,
- the detection of ground ice using a suite of geophysical methods including electromagnetics, resistivity, ambient noise and ground-penetrating radar,
- permafrost dynamics at contaminated sites,
- degrading frozen ground in a discontinuous permafrost landscape and palsa mires,
- the interaction between meteorological conditions, permafrost characteristics, and snow-vegetation-feedback.

Figure 1.1 shows an overview of the field sites. Table 1.1 contains a summary of all expeditions including their relation to the research programme. More details on two selected expeditions of the entire portfolio of Arctic Land Expeditions in Permafrost Research in 2023 can be found in the following chapters.

The expeditions depended on essential support of the organizing institutions, funding agencies, local partner organizations, communities, and individuals.

In particular, we would like to express our appreciation to the University of Helsinki for providing full support at their *Kilpisjärvi Biological Station* for the expedition to Finland.

Following the first expedition in 2022 (Boike et al. 2024), the second expedition to West Greenland was conducted in the framework of the BMBF-funded WTZ project MOMENT (Permafrost Research Towards Integrated Observation and Modelling of the Methane Budget of Ecosystems), in collaboration with project partners from the University of Hamburg, Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences, Leibniz Universität Hannover and University of Cologne (Steffens et al. 2025). We acknowledge that we were able to conduct fieldwork on the ancestral land of the People of Kalaallit Nunaat, past and present and honour with appreciation the land itself and the Kalaallit People. We furthermore acknowledge the full support received by the University of Copenhagen at their research station *Arctic Station* as well as the support from the station staff.

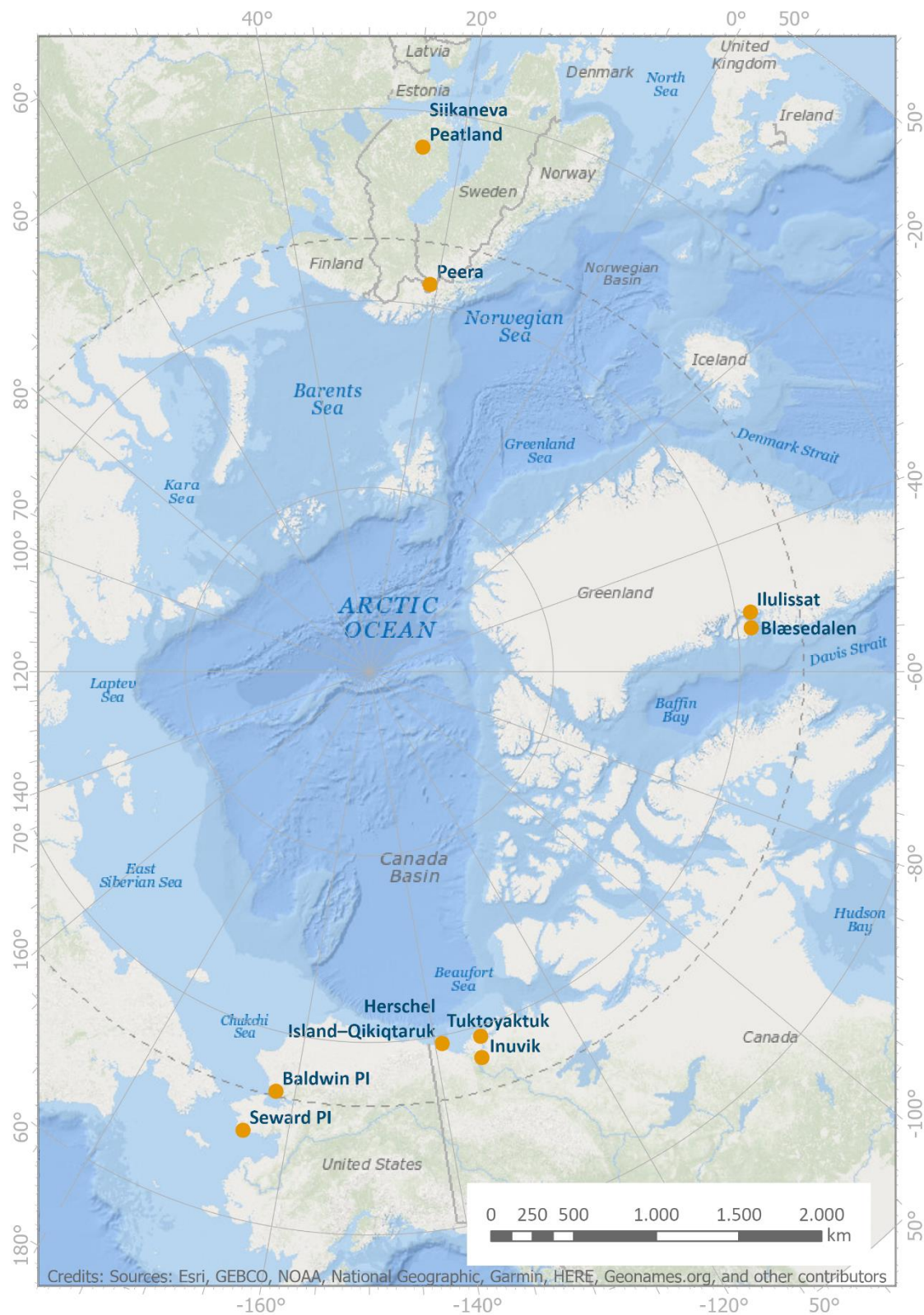


Fig. 1.1: Overview of field sites of all 2023 land expeditions of the Permafrost Research section

Tab. 1.1: List of all 2023 Arctic land expeditions in permafrost research

Expedition name and alias	Start and end date	Expedition lead	Primary Subtopic	Additional subtopics
AK-Land_2023_NWAlaska (<i>Perma-X Ground WestAlaska 2023</i>)				
	05.09.2023 – 18.09.2023	Guido Grosse	5.3	
CA-Land_2023_Inuvik (<i>DUCCEM 2023</i>)				
	02.05.2023 – 13.05.2023	Anne Morgenstern	5.3	4.1, 4.2
CA-Land_2023_NWT (<i>DEPTHAW 2023</i>)				
	03.02.2023 – 31.12.2023	Paul Overduin		
Leg 1	03.02.2023 – 18.02.2023	Paul Overduin	4.1	
Leg 2	13.07.2023 – 17.08.2023	Paul Overduin	5.3	
CA-Land_2023_YukonCoast (<i>Yukon Coast 2023</i>)				
	25.06.2023 – 03.08.2023	Hugues Lantuit	4.1	4.2, 5.3
Leg 1	25.06.2023 – 11.07.2023	Hugues Lantuit	4.1	4.2, 5.3
Leg 2	11.07.2023 – 03.08.2023	Maarten Boersma	4.1	4.2, 5.3
FN-Land_2023_SiikanevaPeatland (<i>FluxWIN/Siikaneva</i>)				
	08.05.2023 – 16.05.2023	Claire Treat	5.3	
FN-Land_2023_Lapland (<i>Finish Lapland</i>)				
	05.03.2023 – 13.03.2023	Jens Strauss	5.3	
GL-Land_2023_WestGreenland (<i>MOMENT Greenland Permafrost</i>)				
	03.09.2023 – 22.09.2023	Simone M. Stuenzi	5.3	

Data management

Expedition data will be archived, published and disseminated according to international standards by the World Data Center PANGAEA Data Publisher for Earth & Environmental Science (<https://www.pangaea.de>) within two years after the end of the expedition at the latest. By default, the CC-BY license will be applied.

These expeditions were supported by the Helmholtz Research Programme “Changing Earth – Sustaining our Future” under the following Topics and Subtopics (see also Table 1):

- Topic 4: Coastal Transition Zones under Natural and Human Pressure
- Subtopic 4.1: Fluxes and transformation of energy and matter in and across compartments
- Subtopic 4.2: Coastal ecosystem sustainability against the backdrop of natural and anthropogenic drivers
- Topic 5: Landscapes of the Future: Securing terrestrial ecosystems and freshwater resources under natural dynamics and global change
- Subtopic 5.3: Determining natural functions and sensitivities of the Earth surface system

References

- Boike J, Stuenzi SM, Gottuk J, Bornemann N, Groenke B (2024) Arctic Land Expedition in Permafrost Research. The MOMENT project: Expedition to the *Arctic Station*, Qeqertarsuaq, Disko Island and Ilulissat, West Greenland in 2022. Berichte zur Polar- und Meeresforschung = Reports on polar and marine research. https://doi.org/10.57738/BzPM_0782_2024
- Steffens C, Beer C, Kutzbach L (2025) Expedition Report 2023 of the projects MOMENT and CLICCS A1. Zenodo. <https://doi.org/10.5281/zenodo.15720240>

Expedition CA-Land_2023_Inuvik (DUCCEM 2023)

02.05.2023 – 13.05.2023

**Chief scientist
Anne Morgenstern**

2. EXPEDITION CA-LAND_2023_INUVIK (DUCCEM 2023)

Anne Morgenstern¹, Felica Gehde¹;

¹DE.AWI

not in the field: Bennet Juhls¹, Paul Overduin¹

Objectives

The main goal of this expedition was to set up and implement the river water sampling program of the project “Detecting Upriver Climate Change Effects in the Mackenzie River (DUCCEM)” in the East Channel of the Mackenzie River close to Inuvik. It aims at directly observing seasonally strongly variable organic carbon concentrations and chemistry of the Mackenzie River and thus its fluxes to Arctic coastal waters.

In order to directly observe the high degree of variability in Mackenzie River biogeochemistry, the carbon load and its sources, more frequent sampling compared to previous programs is needed. Weekly observations of Mackenzie River biogeochemistry during a period covering the major phases of the hydrological year (winter under-ice flow, spring break-up and freshet, summer flow, and freeze back in fall) with a focus on the loads and quality of dissolved organic carbon will help to identify potentially changing environmental processes within the catchment, such as permafrost thaw, that are linked to climate change.

Our simplified and innovative sampling and processing scheme, which has been developed together with the Western Arctic Research Center (WARC) in Inuvik, Canada, is to allow sampling by non-specialists.

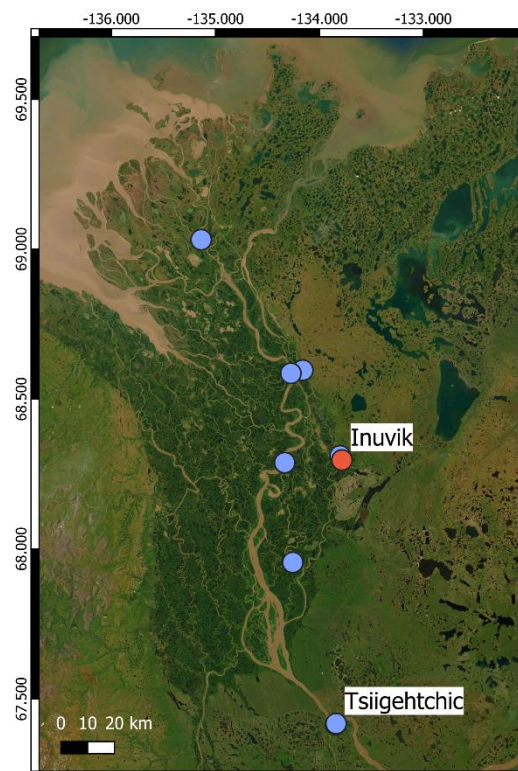


Fig. 2.1: Map of the Mackenzie Delta, the main sampling location in Inuvik (red dot) and the additional sampling locations (blue dots) (background MODIS satellite image, source:

<https://worldview.earthdata.nasa.gov/>)

Field work

The project members together with the WARC personnel identified a sampling location at the East Channel of the Mackenzie River upstream of Inuvik (Fig. 2.1), which proved scientifically suitable and easily accessible from WARC. This location will be utilized throughout the project. The project members introduced the WARC personnel to the sampling concept including sample collection, operation of the CTD (Conductivity, Temperature, and Depth) device, and laboratory procedures for sample processing and storage as well as to the supplies provided.

River water sampling

The sampling procedure varies depending on the season and hydrological phase of the year. During the expedition in spring, samples were collected on four days by WARC staff and project members together (Fig. 2.2). A hole was drilled into the river ice approximately 20 m away from the shoreline using an auger drill of 8-inches (sampling location Inuvik) and 10-inches diameter (sampling location Tsiigehtchic). The snow and ice surrounding the borehole was removed by using a metallic sieve to prevent sampling the melt water. The thickness of the ice was manually measured using a measurement stick. Samples of the river water were taken below the ice by using a Niskin Water Sampler of 2.5 L (Fig. 2.3). At each sampling event two 1 L sample bottles, which got rinsed twice with river water, were taken.

After the river ice-breakup, samples were collected by hand either directly from the shoreline or approximately 15 m away. The sampling personnel waded into the river, allowing roughly a minute for any particles to settle. During the ice-free period, a dock is positioned on the river, from which the samples were taken at about 10 meters from the shoreline.

Additional samples were taken at different spots along the main channel and side arms of the Mackenzie River. Furthermore, one sample was collected from the main river close to Tsiigehtchic at the same location as has been sampled by the ArcticGRO program in order to relate DUCCEM samples to the data series of ArcticGRO, which covers a longer time period, but samples only about every two months.

The samples were split in the WARC laboratory for analysis of different parameters (Tab. 2.1, Fig. 2.3). Samples for isotopes, DOC and CDOM were immediately stored at the fridge ($\sim 6^{\circ}\text{C}$), the rest sample and the sample for total and dissolved nutrients were stored immediately at the freezer ($\sim -21^{\circ}\text{C}$).

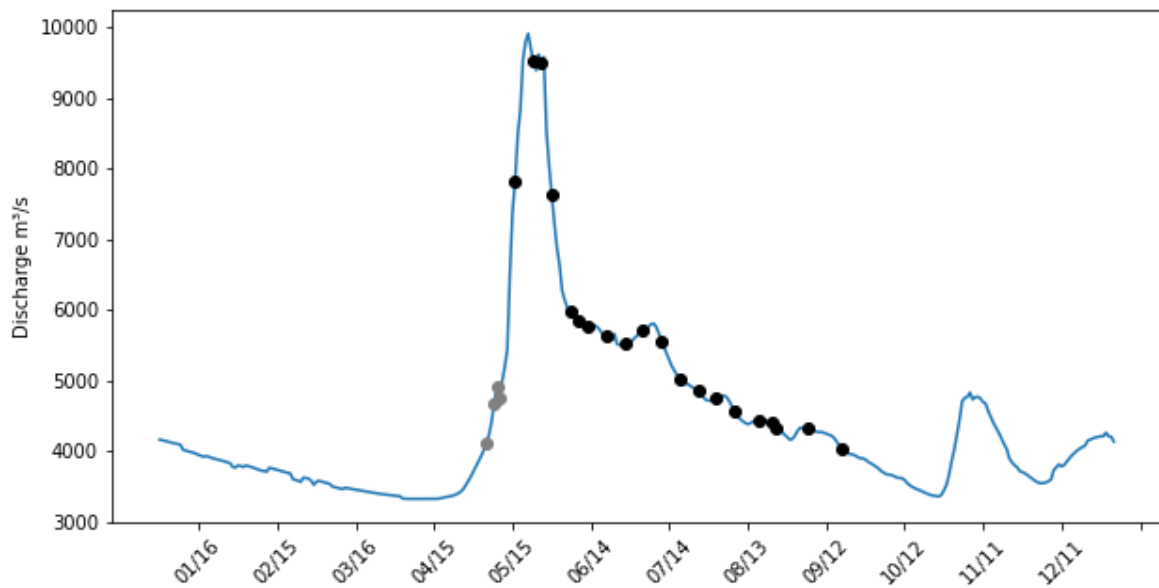


Fig. 2.2: Sampling events (grey dots: joint sampling by AWI/WARC staff, black dots: sampling by WARC staff) on the hydrograph (mean daily discharge during period 2010-2019) of the Mackenzie River (blue line)

For measuring POC, D14C, D13C and TSM sample water was filtered through a GF/F-Filter by using a Nalgene Filter Holder with Receiver. The sample water was added in steps of 100 or 200 ml by using an accordingly marked sample bottle. Depending on the visible discoloration of the filter due to the particles the total volume of sample water was adjusted. After processing, the filter was stored immediately at the freezer ($\sim -21^{\circ}\text{C}$). For further analysis the subsamples were shipped to AWI.

Once a month, three additional samples (only for POC, D14C, D13C and TSM) were taken along a transect across the width of the river by hand from a boat. Two samples are taken from each river side and one sample in the middle of the river.



Fig. 2.3: River water sampling in the East Channel in Inuvik during winter (left) and during ice-free period (center) and sample processing at WARC (right)

Measurements of temperature, electrical conductivity and discharge

Temperature and electrical conductivity were measured by using a CTD Cast Away device. In winter the device was submerged beneath the ice surface for a minimum of 10 seconds to let the device adjust to the temperature before being steadily lowered to the riverbed and pulled up again. During the ice-free period, the CTD was lowered into the water from the dock, when the dock was moved out. Otherwise, the CTD was thrown into the river from shoreline. The mean temperature and conductivity were additionally written down on protocols.

In addition to taking river samples, ten discharge measurements using a SonTek RiverSurveyor M9 ADCP (Fig. 2.4) on board a remote controlled board have been conducted. The RiverSurveyor M9 is a robust and highly precise Acoustic Doppler Current Profiler (ADCP) for the mobile assessment of flow rate and flow velocity. Through redundant depth measurements using bottom tracking and an additional vertically oriented transducer, coupled with the use of ultrasound transducers of different frequencies, you achieve the highest data quality without the need for complex configuration of the measuring device. The integrated microcontroller automatically selects the optimal settings for transducer frequency, cell count and size, as well as depth and path reference, depending on the conditions. These parameters are dynamically adjusted during the measurement; therefore, if the path reference via bottom tracking fails, for instance due to the obstruction of signals caused by bedweed, the GPS/GNSS signal is automatically used for that specific area.



Fig. 2.4: CTD Cast Away measurement during winter (left) and RiverSurveyor discharge measurement during ice-free period (right) in the East Channel in Inuvik

Sampling, processing, analysis log 2023

- 2023-08-15: luggage with samples landed and got lost at BER Berlin Airport
- 2023-08-18: samples got found and arrived at AWI Potsdam, were stored at +4°C, frozen samples thawed during transport
- 2023-08-21: samples (Nutrients, GF/F-Filter) got refrozen
- 2023-08-22: pH and EC measurement by Antje Eulenburg in AWI Potsdam
- 2023-09-05: CDOM measurements of samples by Bennet Juhls and Felica Gehde in GFZ Potsdam using 5 cm cuvette, 1 cycle
- 2023-09-07: weighing of particles on GF/F-Filter for suspended particulate matter (SPM) by Felica Gehde in AWI Potsdam, Filter were thawed and dried before (2023-09-05)
- End of 2023: shipping of unfrozen GF/F-Filter to ETH Zürich for d13C, d14C measurements

Tab. 2.1: Core set of parameters

Parameter	Details	Sample Type / Volume (ml)	Preservation	Storage
Discharge (in field)	Measured in field (Sontek Riversurveyor)			
Temperature (in field)	measured during sampling (CTD Castaway)			
Electrical conductivity (in field)	measured during sampling (CTD Castaway)			
Electrical conductivity, pH (in lab)	Measured on pH & Electrical Conductivity Robot, Seal Analytical	on rest sample		frozen
Dissolved organic carbon (DOC)	filtered, 0.45 µm cellulose acetate (CA)	20 ml	acidified to with ca. 25 µl HCl (30% suprapur)	cool, dark, glass vial

Parameter	Details	Sample Type / Volume (ml)	Preservation	Storage
Colored dissolved organic material (CDOM)	filtered, 0.45 µm cellulose acetate (CA)	100 ml		cool, dark, brown glass
Stable isotopes of water	unfiltered	30 ml		cool, polyethylene bottle
Rest sample	unfiltered (for additional parameter or reanalysis if needed)	60 ml		frozen, polyethylene bottle
Nutrients, total	unfiltered	60 ml		frozen, polyethylene bottle
Nutrients, dissolved	filtered, 0.45 µm cellulose acetate (CA)	60 ml		frozen, polyethylene bottle
Particulate organic carbon (POC), Suspended organic matter (SPM), D ¹⁴ C, D ¹³ C	GF/F-Filter, 0.7 µm (precombusted at 500°C), using a Nalgene Filter Holder with Receiver (Thermo Scientific).			frozen, stored in polyethylene cases
Major cations	filtered, 0.45 µm cellulose acetate (CA)	on rest sample		frozen
Major anions	filtered, 0.45 µm cellulose acetate (CA)	on rest sample		frozen

Preliminary (expected) results

In addition to the scientific impact of the study, the results of this project will foster a better understanding of the biogeochemistry dynamics underlying seasonal and shorter term changes in river water and their links to ongoing climate change, among both the science and local communities. Since the biogeochemistry of the river is closely related to ecosystem stability and the life cycles of many organisms, these data may have societal impact in terms of food security and decision-making processes related to river water quality and watershed management.

Tab. 2.2: Coordinates of main sampling location Inuvik

Sampling location	Lat (DecDeg)	Lon (DecDeg)
Inuvik (main sampling location)	68.338	-133.7063

Tab. 2.3: List of samples, respectively discharge measurements, taken at the main sampling location Inuvik

ID	Date	Time	ID	Date	Time
TSI	05.05.2023	12:00	17	25.07.2023	9:50
2	05.05.2023	15:30	Transect bottle #1	25.07.2023	
3	08.05.2023	11:00	Transect bottle #2	25.07.2023	
4	09.05.2023	10:00	Transect bottle #3	25.07.2023	
ID	Date	Time	ID	Date	Time
5	10.05.2023	10:00	18	01.08.2023	9:50
6	16.05.2023	9:20	Discharge 1.1	02.08.2023	16:32

ID	Date	Time	ID	Date	Time
7	23.05.2023	10:50	Discharge 1.2	02.08.2023	16:44
8	26.05.2023	10:50	19	08.08.2023	10:30
9	30.05.2023	11:10	Discharge 2.1	11.08.2023	15:14
10	06.06.2023	13:35	Discharge 2.2	11.08.2023	15:18
Transect bottle #1	09.06.2023		Discharge 2.3	11.08.2023	15:42
Transect bottle #2	09.06.2023		Discharge 2.4	11.08.2023	15:48
Transect bottle #3	09.06.2023		Discharge 2.5	11.08.2023	15:54
11	13.06.2023	13:30	Discharge 2.6	11.08.2023	15:57
12	20.06.2023	9:35	20	17.08.2023	10:07
13	27.06.2023	9:50	21	22.08.2023	13:45
Transect bottle #1	27.06.2023		Transect bottle #1	24.08.2023	
Transect bottle #2	27.06.2023		Transect bottle #1	24.08.2023	
Transect bottle #3	27.06.2023		Transect bottle #1	24.08.2023	
14	04.07.2023	10:09	22	05.09.2023	13:35
15	11.07.2023	13:35	23	18.09.2023	14:55
16	18.07.2023	10:55			

Tab. 2.4: List of samples, respectively discharge measurements, taken at locations along the Main Channel and side arms of the Mackenzie River

ID	Date	Time	Lat (DecDeg)	Lon (DecDeg)
TSI	05.05.2023	12:00	67.454	-133.7178
MHPaul1	08.08.2023	14:35	69.0602	-135.05836
MHPaul2	08.08.2023	11:30	68.63536	-134.08055
MHPaul3-A	08.08.2023	17:38	68.6237	-134.18918
MHKalinec-A	09.08.2023	13:45	67.99232	-134.1269
MHPaul4	10.08.2023	12:33	68.32398	-134.22436
MHPaul5	11.08.2023	12:00	68.35192	-133.72331
MH-Discharge 1.1	14.08.2023	11:13	68.3246484	-134.2234683
MH-Discharge 1.2	14.08.2023	11:14	68.3246484	-134.2234683

Discharge measurements

Figure 2.5 shows an example of a cross-section near the DUCCEM main sampling location. The flow-speed of the river water is shown by the colors. Besides the flow speed and direction of the water, also the bathymetry of the river channel is mapped. This allows to estimate the discharge of the channel at that location.

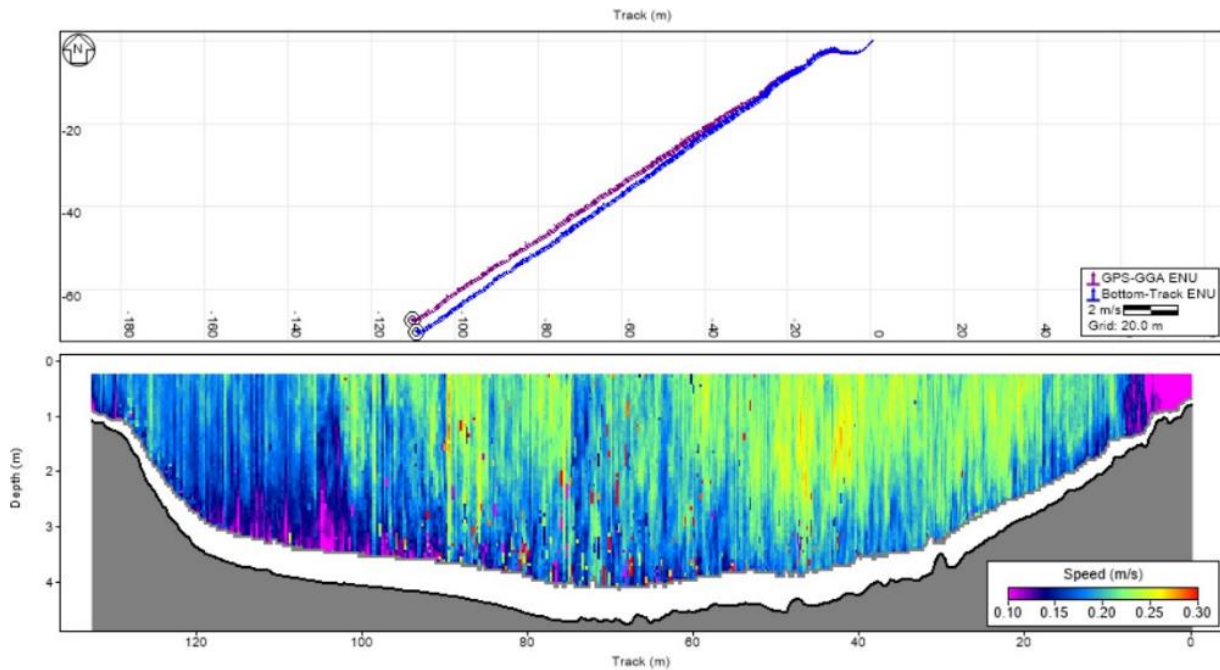


Fig. 2.5: Example of a RiverSurveyor cross-section at the DUCCEM sampling location

Data management

Results of the project will be published at multiple levels. For public access, data will be made available via an interactive webpage (<https://mackenzie-monitoring.awi.de/>). Data will be archived with a persistent doi (e.g., <https://doi.pangaea.de/10.1594/PANGAEA.913197>). Data will be publicized online as quickly as possible after laboratory analyses and quality control. Results will also be publicized in the form of peer-reviewed international scientific publications. The paper themes are preliminary, but will include a qualitative and quantitative assessment of fluvial organic carbon export via the Mackenzie, an endmember analysis of Mackenzie source water variability over the annual cycle, and a study of the correlation of sampled organic matter and remote sensing data. Further plans for dissemination include presentation of initial results at the 13th International Conference on Permafrost (ICOP 2024), which takes place in Whitehorse, YK in June 2024. In combination with this, a visit of at least one team member to Inuvik to present our results in a community-accessible format is planned, for example as part of an ARI-organized public event. Further opportunities for presentation include the Annual Yellowknife Geoscience Forum in Yellowknife, NWT in November 2024 and the ArcticNet science meeting in December 2024. For further information see chapter 1 (Data management).

Acknowledgement

Funding for the project period from May to September 2023 was provided by the INTERACT Transnational Access program until September 2023.

**Expedition FN-Land_2023_SiikanevaPeatland (FluxWIN / WWF-
Jugend Expedition Klima)**

08.05.2023 – 16.05.2023



**Chief scientist
Claire Treat**

3. EXPEDITION FN-LAND_2023_SIIKANEVAPEATLAND (FLUXWIN OUTREACH / AWI COOPERATION PROJECT WITH WWF JUGEND EXPEDITION KLIMA)

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Outline

The FluxWin Outreach expedition took place in the southwest of Finland, an area dominated by boreal forest, lakes, fens and bogs. The *Hyytiälä Forest Station* facilitates research on these ecosystems in their pristine states and hosted ten students from WWF Jugend Expedition Klima for research and communication purposes. The FluxWin team leader Claire Treat and the WWF Jugend team leader Sebastian Neubert coordinated various field programmes such as forestry measurements, peat coring in the Siikaneva peatland, and assistance in ongoing science projects.



Fig. 3.1: Siikaneva Bog



Fig. 3.2: Siikaneva Fen

Objectives

To live up to the WWF Jugend's slogan "learn, communicate and change", the expedition serves to gain a higher public understanding of the reason behind science and what kind of research is relevant for sensitive northern regions. In supervised citizen science, the students are able to gain experience in field conditions and learn to understand nature on site. Multiple activities at various stations have been included in the students' schedule to make time worthwhile. The expedition should serve as a model for engaging citizens that show interest in earth and climate research projects. To successfully include citizens into science action, communication between scientists and the public is necessary. Gaining public interest in science can be achieved through science education and communication which together represents one of the cornerstones of climate action.

Field work

Rotational field work helped students to experience relevant research methods in small groups at multiple research stations. During the first part of the expedition, the students were introduced to a warming experiment at Lakkusuo forest, where they helped to install an open-top-chamber (OTC) that simulates conditions of elevated CO₂ and O₃ in a forest environment. Later, the students received an insight into tree growth and carbon sequestration at the *Hyytiälä Forest Station*. Another large part of the expedition's field work was facilitated in the Siikaneva bog, where GHG flux measurements at vegetation removal plots were taken. Standard measurements and maintenance were done for the FluxWIN project's auto chambers that constantly measure CO₂, CH₄ and N₂O from the bog. Six peat cores were successfully removed from the top 50 cm soil surface for the science project PIPES in collaboration with the Queen's University Belfast (3 bog and 3 fen) to quantify trace metals and other pollutants. The locations of the extracted peat cores are displayed in Table 3.1.

Tab. 3.1: Peat core sampling sites

Country	Lat N	Long E	Peatland Type	Dom. Veg. Type	Site History	Sampling Lead	Site Related Research Output
Finland	61.838	24.17	Bog	Sphagnum	pristine	Claire Treat	Korrensalo et al., (2018a, 2018b, 2020)
Finland	61.833	24.191	Fen	Sedges	pristine	Claire Treat	Rinne et al., (2018)

Preliminary (expected) results

Overall, the expedition was a successful example for science and citizen interaction and helped to establish collaboration between the WWF Jugend, Alfred-Wegener-Institute, Queen's University Belfast and the *Hyytiälä Forest Station*. Similar projects can now be organised more efficiently from the gained experience and formerly created planning templates. The WWF Jugend's field work significantly improved the research success of various projects where hands-on activities have been hosted and the activities were later posted on social media for further outreach. Peat samples from the PIPES project were sent to the collaborators in Belfast for analysis to quantify trace metals and other pollutants of which the results are soon to be expected.

Data management

For further information see chapter 1 (Data management)

References

- Korrensalo A, Kettunen L, Laiho R, Alekseychik P, Vesala T, Mammarella I, Tuittila ES (2018a) Boreal bog plant communities along a water table gradient differ in their standing biomass but not their biomass production. *Journal of Vegetation Science* 29(2):136–146.
- Korrensalo A, Männistö E, Alekseychik P, Mammarella I, Rinne J, Vesala T, Tuittila ES (2018b) Small spatial variability in methane emission measured from a wet patterned boreal bog. *Biogeosciences* 15(6):1749–1761.
- Korrensalo A, Mehtatalo L, Alekseychik P, Uljas S, Mammarella I, Vesala T, Tuittila ES (2020) Varying Vegetation Composition, Respiration and Photosynthesis Decrease Temporal Variability of the CO₂ Sink in a Boreal Bog. *Ecosystems* 23(4):842–858.
- Rinne J, Tuittila ES, Peltola O, Li X, Raivonen M, Alekseychik P, Haapanala S, Pihlatie M, Aurela M, Mammarella I, Vesala T (2018) Temporal Variation of Ecosystem Scale Methane Emission From a Boreal Fen in Relation to Temperature, Water Table Position, and Carbon Dioxide Fluxes. *Global Biogeochemical Cycles* 32(7):1087–1106.

Further reading

FluxWIN junior research group: <https://www.awi.de/en/science/junior-groups/fluxwin.html>

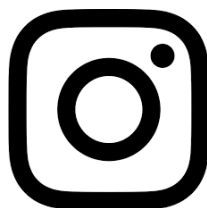
Hyytiälä Forest Station: <https://www.helsinki.fi/en/research-stations/hyytiala-forest-station>

Queen's University Belfast: <https://pure.qub.ac.uk/en/projects/pipes-pollutants-in-peatlands-from-sink-to-source-full-submission>

Photos from the Siikaneva site and information about the PIPES project: https://www.dropbox.com/sh/zvks1um9rtigzj1/AABEwDfW_IK5W59ssvOp4IHma?dl=0



Linktree: https://linktr.ee/wwf_jugend



Instagram: https://www.instagram.com/wwf_jugend/

APPENDIX

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTES

A.2 EXPEDITIONSTEILNEHMER:INNEN / EXPEDITION PARTICIPANTS

A.1 TEILNEHMENDE INSTITUTE / PARTICIPATING INSTITUTES

Affiliation	Address
CA.DFO	Fisheries and Oceans Canada
DE.AWI	Alfred-Wegener-Institut Helmholtz-Zentrum für Polar- und Meeresforschung Postfach 120161 27515 Bremerhaven Germany
DE.GFZ	Helmholtz-Zentrum Potsdam Deutsches GeoForschungsZentrum GFZ Telegrafenberg 14473 Potsdam
DE.UP	Earth and Environmental Systems University of Potsdam Karl-Liebknecht-Str. 24-25 14469 Potsdam Germany
DE.WWF	WWF Jugend Community Reinhardtstr. 18 10117 Berlin Germany

A.2 EXPEDITIONSTEILNEHMER:INNEN / EXPEDITION PARTICIPANTS

Tab. A.2.1: Participants of the expedition AK-Land_2023_NWAlaska

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Baysinger	Mackenzie	DE.AWI	Student	Permafrost
Grosse	Guido	DE.AWI	Scientist	Permafrost
Hanna	Caitlynn	US.UAF	Student	Permafrost
Inauen	Cornelia	DE.AWI	Student	Permafrost
Lübker	Tillmann	DE.AWI	Scientist	Permafrost

Tab. A.2.2: Participants of the expedition CA-Land_2023_Inuvik

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Gehde	Felica	DE.AWI	Student	Permafrost
Morgenstern	Anne	DE.AWI	Scientist	Permafrost
Not in the field				
Juhls	Bennet	DE.AWI	Scientist	Permafrost
Overduin	Paul	DE.AWI	Scientist	Permafrost

Tab. A.2.3: Participants of the expedition CA-Land_2023_NWT

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Angelopoulos	Michael	DE.AWI	Scientist	Geoscience
Cable	Bill	DE.AWI	Scientist	Permafrost
Guillemoteau	Julien	DE.UP	Scientist	Geophysics
Haberland	Christian	DE.GFZ	Scientist	Geophysics
Koyan	Philipp	DE.UP	Scientist	Geophysics
Overduin	Paul	DE.AWI	Scientist	Permafrost
Ryberg	Trond	DE.UP	Scientist	Geophysics
Tronicke	Jens	DE.UP	Scientist	Geophysics

Tab. A.2.4: Participants of the expedition CA-Land_2023_YukonCoast

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Bischoff	Verena	DE.UP	Student	Ecology
Boersma	Maarten	DE.AWI	Scientist	Biology
Byerley	Jordan	CA.DFO	Student	Biology
Juma	Gabriel	DE.AWI	PhD student	Biology
Lantuit	Hugues	DE.AWI	Scientist	Geosciences
Meunier	Cedric	DE.AWI	Scientist	Biology
Vural	Deniz	DE.AWI	PhD student	Geosciences
Weber	Caroline	DE.AWI	PhD student	Biology
Wolter	Juliane	DE.UP	Scientist	Ecology

Tab. A.2.5: Participants of the expedition FN-Land_2023_SiikanevaPeatland

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Altendeitering	Alicia	DE.WWF	Student	Permafrost
Bornemann	Hannah	DE.WWF	Student	Permafrost
Dickel	Svenja	DE.WWF	Student	Permafrost
Kersten	Flavia	DE.WWF	Student	Permafrost
Kleff	Helen	DE.WWF	Student	Permafrost
Loos	Jascha	DE.WWF	Student	Permafrost
Müller	Nina Linette	DE.WWF	Student	Permafrost
Neubert	Sebastian	DE.WWF	Youth worker	Permafrost
Thäringen	Mareike Sophia	DE.WWF	Student	Permafrost
Treat	Claire	DE.AWI	Scientist	Permafrost
van Delden	Lona	DE.AWI	Scientist	Permafrost
Warner	Daniel	DE.AWI	Technician	Permafrost
Winkler	Fee-Aurora	DE.WWF	Student	Permafrost

Tab. A.2.6: Participants of the expedition FN-Land_2023_Lapland

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Strauss	Jens	DE.AWI	Scientist	Permafrost
Laurent	Melissa	DE.AWI	Student	Permafrost
Windirsch	Torben	DE.AWI	Scientist	Permafrost

Tab. A.2.7: Participants of the expedition GL-Land_2023_WestGreenland

Name/ Last name	Vorname/ First name	Institut/ Institute	Beruf/ Profession	Fachrichtung/ Discipline
Bornemann	Niko	DE.AWI	Engineer / Technician	Permafrost
Gottuk	Jannika	DE.AWI	Student	Permafrost
Stuenzi	Simone Maria	DE.AWI	Scientist	Permafrost

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