ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

752
2021

Berichte
zur Polar- und Meeresforschung
Reports on Polar and Marine Research

Expeditions to Fennoscandia in 2020

Edited by

Matthias Fuchs, Lona van Delden, Nele Lehmann and
Torben Windirsch

HELMHOLTZ

Die Berichte zur Polar- und Meeresforschung werden vom Alfred-Wegener-Institut, Helmholtz-Zentrum für Polar- und Meeresforschung (AWI) in Bremerhaven, Deutschland, in Fortsetzung der vormaligen Berichte zur Polarforschung herausgegeben. Sie erscheinen in unregelmäßiger Abfolge.

Die Berichte zur Polar- und Meeresforschung enthalten Darstellungen und Ergebnisse der vom AWI selbst oder mit seiner Unterstützung durchgeführten Forschungsarbeiten in den Polargebieten und in den Meeren.

Die Publikationen umfassen Expeditionsberichte der vom AWI betriebenen Schiffe, Flugzeuge und Stationen, Forschungsergebnisse (inkl. Dissertationen) des Instituts und des Archivs für deutsche Polarforschung, sowie Abstracts und Proceedings von nationalen und internationalen Tagungen und Workshops des AWI.

Die Beiträge geben nicht notwendigerweise die Auffassung des AWI wider.

Herausgeber
Dr. Horst Bornemann

Redaktionelle Bearbeitung und Layout
Susan Amir Sawadkuhi

Alfred-Wegener-Institut
Helmholtz-Zentrum für Polar- und Meeresforschung
Am Handelshafen 12
27570 Bremerhaven
Germany

www.awi.de
www.awi.de/reports

The Reports on Polar and Marine Research are issued by the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI) in Bremerhaven, Germany, succeeding the former Reports on Polar Research. They are published at irregular intervals.

The Reports on Polar and Marine Research contain presentations and results of research activities in polar regions and in the seas either carried out by the AWI or with its support.

Publications comprise expedition reports of the ships, aircrafts, and stations operated by the AWI, research results (incl. dissertations) of the Institute and the Archiv für deutsche Polarforschung, as well as abstracts and proceedings of national and international conferences and workshops of the AWI.

The papers contained in the Reports do not necessarily reflect the opinion of the AWI.

Editor
Dr. Horst Bornemann

Editorial editing and layout
Susan Amir Sawadkuhi

Alfred-Wegener-Institut
Helmholtz-Zentrum für Polar- und Meeresforschung
Am Handelshafen 12
27570 Bremerhaven
Germany

www.awi.de
www.awi.de/en/reports

Titel: Entlang des Flusses Gaskabohki in der herbstlichen Tundra-Landschaft von Iskorasfjellet, Norwegen (Foto: Nele Lehmann)

Cover: Along the river Gaskabohki in the fall tundra landscape of Iskorasfjellet, Norway (Photo: Nele Lehmann)

Expeditions to Fennoscandia in 2020

Edited by
Matthias Fuchs, Lona van Delden, Nele Lehmann and
Torben Windirsch

Please cite or link this publication using the identifiers

https://hdl.handle.net/10013/epic.a03eca13-0199-4959-a40d-1eb5369c2582
https://doi.org/10.48433/BzPM_0752_2021

ISSN 1866-3192

Expeditions to Fennoscandia in 2020

Expedition to Kutuharju Field Research Station 31.08. - 25.09.2020

Expedition to Iškoras 19.09. - 11.10.2020

Expedition to Siikaneva 19.10. - 25.10.2020

Chief scientists

Torben Windirsch (AWI/Universität Potsdam), Nele Lehmann (AWI/Hereon), Lona van Delden (AWI)

Contents

This publication should preferebly be opened with a pdf reader to allow full functionality of all embedded hyperlinks

Chapter 1

Introduction

Matthias Fuchs[1], Lona van Delden[1], Nele Lehmann[1,2], and Torben Windirsch[1,3]

[1] Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany

[2] Helmholtz Zentrum Hereon, Institute of Carbon Cycles, Geesthacht, Germany

[3] University of Potsdam, Institute for Geosciences, Potsdam, Germany

Overview

This edition of *Berichte zur Polar- und Meeresforschung / Reports on Polar and Marine Sciences* includes three independent expedition reports and gives an overview on the AWI Potsdam Permafrost Research Section expedition activities during fall 2020. All three expeditions were carried out in Fennoscandia and cover investigations on the biogeochemistry, hydrology and ecology. The main focus areas were Kaamanen in the Inari community (Northern Finland), Iškoras (Northern Norway) and Siikaneva (Western Finland) (Figure 1.1).

Due to the COVID-19 pandemic, the expeditions followed strict travel, quarantine and hygiene rules and were carried out with a limited number of participants only. This posed challenges for the planning, organisation and realization before and during the expeditions. In consequence, the main mode of transport was a (camper) van for all three expeditions. At the same time, the camper van served as quarantine-conform accommodation during the Kutuharju and Siikaneva expeditions, which allowed the participants to carry out field work remotely and self-sufficient from the local population.

Expedition to Fennoscandia 2020 – Participants and itinerary

All three campaigns travelled on the same route to Finland. This included the drive to Travemünde (Germany), where the crew including (camper) van boarded the ferry to Helsinki. After this two-night-passage, the teams travelled north to their respective field locations. The study area of the first expedition was the Kutuharju Field Research Station located in Kaamanen in the Inari community in Finnish Lapland. This campaign was led by Torben Windirsch and is part of his PhD project *Permafrost Carbon Stabilization by Recreating a Herbivore-Driven Ecosystem* (PeCHEc) (Chapter 2). The second campaign was led by Nele Lehmann and was located at the mountainside of Iškorasfjellet, Karasjok Municipality in the county Troms og Finnmark in Northern Norway. This expedition was carried out under the name *Alkalinity observations in a degrading permafrost catchment* and is part of Nele Lehmann's PhD project (Chapter 3). The third field campaign was led by Lona van Delden and is part of the ERC project *FluxWIN*. This campaign set up the long-term monitoring program at the Siikaneva peat mire in Western Finland (Chapter 4). All participants and their affiliations are listed in the appendix (Tables A.1.1 - A.1.3) and group photographs of the individual campaigns are presented in Figures 1.2 - 1.4.

This report consists of contributions from the expedition participants. The authors of the contributions are responsible for content and correctness.

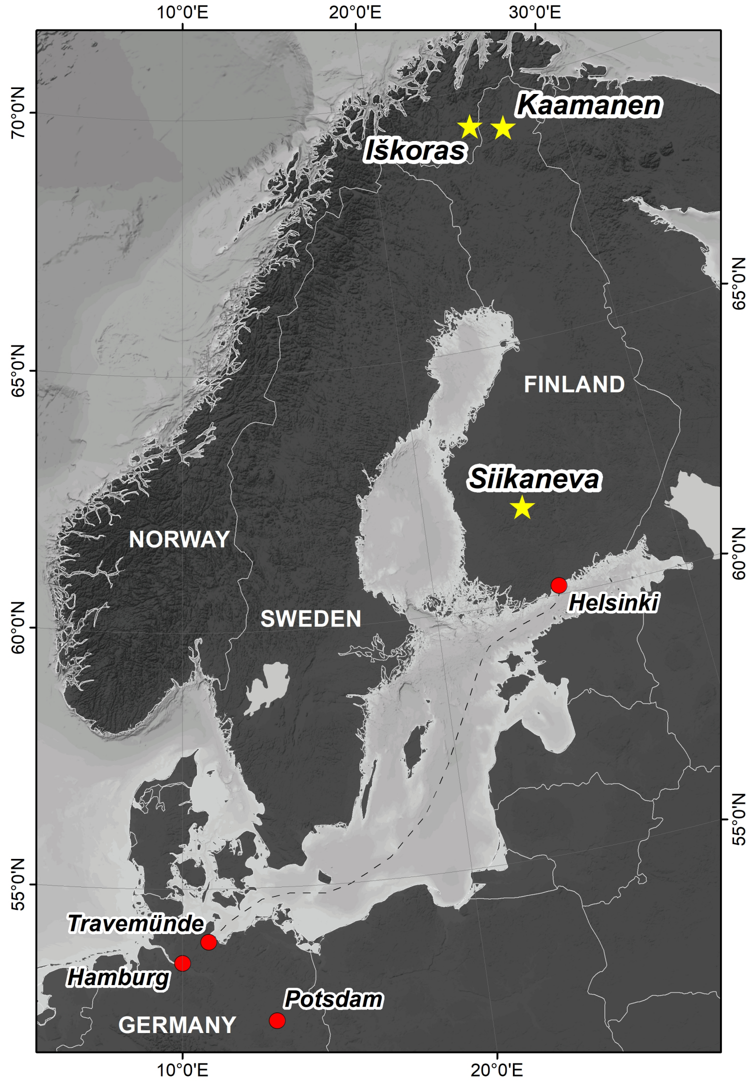

Figure 1.1: *Overview of the study regions during the Fennoscandia 2020 expeditions. Yellow stars indicate field sites, red dots indicate start or transit locations and the dashed line from Travemünde to Helsinki marks the ferry passage.*

Data management

The data collected within the framework *Expeditions to Fennoscandia in 2020* will be archived on the Pangaea data set repository (`https://pangaea.de/`) under different campaign lables. The data from the Kutuharju expediton (Chapter 2) will be archived under the campaign label **FN-Land_2020_Inari**, data from the Iškoras expedition (Chapter 3) will be archived under the campaign label **NO-Land_2020_Iskoras** and data from the Siikaneva expedition (Chapter 4) will be archived under the **FluxWIN** project and campaign label **FN-Land_2020_SiikanevaPeatland**.

Acknowledgements

The expeditions to Fennoscandia depended on essential support from the Permafrost Research Section at the Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany. Individual funding and additional support for the three different campaigns are acknowledged in the indiviudal chapters.

Figure 1.2: *The expedition participants to the Kutuharju Field Research Station*

Figure 1.3: *The Iškoras expedition team*

Figure 1.4: *The expedition team to Siikaneva*

Chapter 2

Expedition to Kutuharju Field Research Station, Northern Finland, September 2020

Torben Windirsch[1,2], Matthias Fuchs[1], Guido Grosse[1,2], Otto Habeck[3*], Mathias Ulrich[4*], and Jens Strauss[1*]*

[1] Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany
[2] University of Potsdam, Institute for Geosciences, Potsdam, Germany
[3] University of Hamburg, Institute for Anthropology, Hamburg, Germany
[4] University of Leipzig, Institute for Geography, Germany
[*] not in the field

Correspondence: Torben Windirsch (torben.windirsch@awi.de)

Fieldwork period and location
From August 31th to September 25th, 2020 at the Kutuharju Field Research Station (69.14615°N / 26.99690°E) and in the Inari municipality in northern Finland

Introduction
General scientific rationale and objectives
In the context of global climate change, the global carbon stock and its storage mechanisms need to be assessed in detail. In particular Arctic permafrost soils, which are highly vulnerable to climate warming due to their adaption to cold climatic conditions, store enormous amounts of carbon. This carbon is becoming available for microorganisms and is potentially getting released into the atmosphere as a consequence of permafrost thawing. Several pathways such as degassing from thawing ground or the fluvial transport into the ocean are studied, and more data and observations are needed.
With the PhD project PeCHEc (*Permafrost Carbon Stabilization by Recreating a Herbivore-Driven Ecosystem*), the major aim is to identify the impact of grazing intensity on carbon accumulation and storage both in the active layer and in the permafrost table (Olofsson et al. 2018). In order to complete the observations also into Arctic non-permafrost areas, the Finland 2020 campaign was set up as a follow-up to the Cherskiy 2019 campaign (Windirsch et al. 2021).

Expedition itinerary and general logistics

The expedition was conducted using a camper van for easy equipment and sample transportation, mobility and independence (Figure 2.1) in order to be remote and self-sustained during the COVID-19 pandemic. Also, we decided to travel via ferry across the Baltic Sea in order to cross as few borders as possible, due to the COVID-19 situation and hence travel restrictions for several European countries.

As a result of using a camper van, we were able to set camp in short walking distance to all of our field sites, making field logistics easy, since the equipment and samples needed to be carried only short distances. As no frozen samples were taken, the samples were stored in thermoboxes after returning from the field, and left outside over night to cool. Biomarker samples were frozen using the van's freezer and an additional active freezer. While travelling took quite some time, fieldwork was carried out in a short and efficient manner as a result of very short distances (Table 2.1).

Figure 2.1: *left: camper van used for transportation, travel and accomodation; right: field equipment unpacked at the Kutuharju Field Research Station*

Table 2.1: Timetable of field work

Date	**Task**
06.09.2020	Beginning of field campaign: first two locations sampled outside the station premises: RR and PR
08.09.2020	Access to the Kutuharju Field Research Station area; field recognition of potential field sites
09.09.2020	First three sites sampled: S-1, S-2 and S-5D
12.09.2020	Last site on station premises sampled: S-5F
15.09.2020	Additional reference sites sampled outside station area: FR and M-1
17.09.2020	Starting the way back: meetings with researchers along the way to discuss and distribute the reindeer herding survey (see Appendix A.2) associated with this field campaign

Study region

The study region for this expedition was the northern part of Finland, in the municipality of Inari. The area is characterized by glacial features such as eskers, drumlins, moraines and an overall sandy and shallow sediment layer with gravel underneath. In between these features, lakes and wetlands formed since the end of glaciation, with peat accumulations up to 1.5 m (sites S-5D and M-1) and vegetated by grasslands and heath vegetation such as *Empetrum nigrum*, *Betula nana* and *Vaccinium myrtillus* (Figure 2.2). More elevated areas are vegetated by *Betula* and *Pinus* communities in rather sparse extent. Almost omnipresent are traces of foxes, voles, lemmings and most prominently reindeer (Figure 2.2) and moose.

Figure 2.2: *left: reindeer at the edge of a Betula-dominated forest; right: in the foreground: a grass-covered wetland; in the background: a small lake surrounded by elevated areas covered by Pinus forest*

Field methods and sampling strategy

Likewise to the Cherskiy field campaing (see Windirsch et al. 2021), a sampling approach was chosen where field sites with different grazing intensities by reindeers were sampled. Samples were taken in forest areas as well as in open grasslands and wetlands, both on controlled grazing areas of the Kutuharju Field Research Station, run by the Reindeer Herders' Association of Finland, and in close-by non-managed areas. This was done to not only compare the different grazing intensities, but also to assess the current natural state in terms of soil carbon storage.

The goal was to retrieve samples from areas characterized by different grazing intensity and in different vegetation areas. In sandy areas, we sampled until we reached a gravel / bed rock layer, while in peat, we drilled until we reached the sand layer, capturing the transition zone as well (Figure 2.3).

We used two sampling techniques, depending on the ground characteristics:

- In sandy areas, we dug a profile using spades and sampled one side of the profile using fixed-volume cylinders (FVC) with a volume of 250 cm^3. In order to retrieve enough sample mass, two full cylinders were taken for every sampled depth. Biomarker samples were sampled additionally in the same profile.
- In peatlands, we used a peat corer and a hammer (Figure 2.3), retrieving half a core with a diameter of 5 cm. To retrieve sufficient sample mass, two cores were drilled next to each other. The cores were subsampled in the field in 5 cm sections using a knife. Biomarker samples were collected from one of the two adjacent cores.

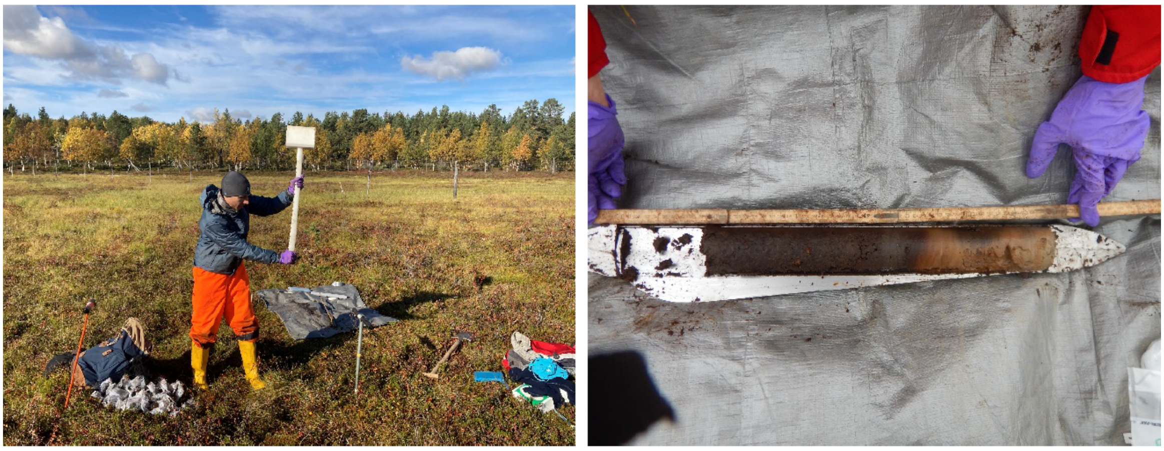

Figure 2.3: *left: using a peat corer in a peatland at site S-3W; right: peat core with sand transition obtained at site S-5D-B 100 – 140 cm below surface; the cores have been subsampled in the field in 5 cm sections.*

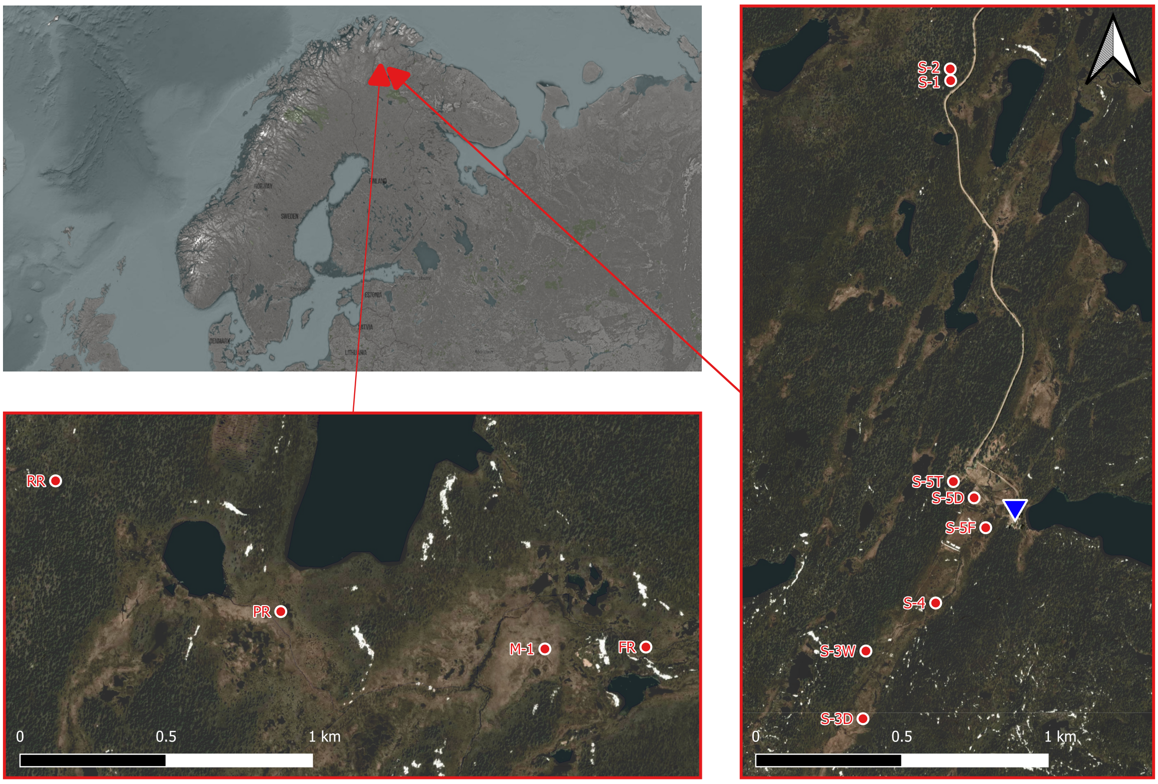

Figure 2.4: *Maps showing the sampling locations and their location within Finland (top left); sampling sites outside the research station premises (bottom left); sampling sites on the station area with different grazing intensities from 1 (no grazing) to 5 (intensive grazing); the research station is marked with a blue triangle.*

Preliminary results

During the initial field recognition, we saw that intensively grazed peat areas contain a different vegetation. From low intensively grazed to intensively grazed areas, vegetation shifted from heterogeneous tundra vegetation (*Empetrum*, *Vaccinium*, *Betula nana*, *Salix*) to grasslands with only one dominant species. Also, we found the peat to be more compact in areas with high grazing intensity.

In ungrazed forest areas, we found abundant reindeer lichen covers on the ground as well as intensive lichen grows on tree branches, while in forest areas that were accessible for reindeer, abundancy of lichens was much lower (Figure 2.5).
The landcover difference of forest and open peatlands was visible in the soil profiles, too. In forest areas, sandy soils were dominant. In these soils, we identified four stratigraphical layers with extent varying between sampling sites. A thin organic layer is followed by a pale white sand layer (Figure 2.5). Below there is an intensive orange colored layer of sand with greyish-yellowish sand underneath. Soil depth ranged from 22 to 67 cm at our study sites.
In the open peatlands, soils were dominated by thick organic (peat) layers with a thickness of 30 to 140 cm. This peat layer could be distinguished between recent / living plants, followed by mainly undecomposed moss peat. Underneath we found compacted peat, varying in color and macro-organic contents between sampling sites. Below these peat layers, we found a greyish-yellowish sandy layer with a transition zone in between at each site, consisting of a mixture of sand and peat (Figure 2.3).


Figure 2.5: *left: on the left side of the fence, reindeer were excluded for several decades, while they roamed freely on the right side of the fence; note the significant difference in reindeer lichen ground cover; S-1 is located left of the fence, S-2 is on the right; right: soil profile at S-2, 67 cm total depth*

Conclusions

The three week long field trip to Kutuharju Field Research Station led to a collection of more than 300 soil samples whereof 23 will be analysed for biomarkers. In total, sites of five different grazing intensities (from intensively grazed to not grazed) were sampled (Table 2.2) and provide a very valuable data set in determining the effect of reindeer grazing on carbon storage in sub-arctic non-permafrost areas.

More information on this research project is accessible here: PeCHEc Project

Table 2.2: Sampling locations, depth and vegetation type

Site	Latitude [°]	Longitude [°]	Grazing intensity	Sampling	Core depth [cm]	Vegetation and state	No. of samples
RR	69.229750	26.795806	extensive, natural	FVC	35	mixed forest, dry	8
PR	69.226778	26.810111	extensive, natural	peat corer; 1 core	125	heath / grassland, wet	15
M-1	69.225944	26.826972	extensive, natural	peat corer; 1 core	169	heath / grassland, wet	32
FR	69.226000	26.833417	extensive, natural	peat corer; 2 cores	50	birch forest, semi-dry	19
S-1	69.159500	26.991278	no grazing (ca. 50 yr)	FVC	40	mixed forest, dry	8
S-2	69.159861	26.991250	extensive	FVC	67	mixed forest, dry	12
S-3D	69.142028	26.984000	extensive	FVC	42	heath / grassland, dry	6
S-3W	69.139944	26.983778	extensive	peat corer; 3 cores	100	heath / grassland, wet	36
S-4	69.143500	26.990000	extensive	peat corer; 2 cores	150	heath / grassland, wet	59
S-5T	69.147222	26.991528	intensive	FVC	22	grassland, dry	6
S-5D	69.146722	26.993306	intensive	peat corer, 3 cores	150	grassland, semi-dry	58
S-5F	69.145806	26.994306	intensive	peat corer, 2 cores	112	birch forest, wet	44

Acknowledgements

We thank the Reindeer Herders' Association of Finland (`www.paliskunnat.fi`) for granting access to the Kutuharju Field Research Station premises even during the difficult times of a virus pandemic. A very special thank to Dr. Jouko Kumpula for helping with communication.

We also want to thank Metsähallitus, namely Katja Sandgren, for providing us with all necessary research permits as well as keeping us informed about the virus situation development in our study area.

This work was carried out under Metsähallitus research permit MH 1725/2020.

T.W. was supported by the Potsdam Graduate School. This expedition is part of the Permafrost Research Section at AWI Potsdam and received great support from AWI logistics.

References

Olofsson, J. and E. Post (2018): Effects of large herbivores on tundra vegetation in a changing climate, and implications for rewilding. In: Philosophical Transactions of the Royal Society B: Biological Sciences 373.1761, p. 20170437. DOI: 10.1098/rstb.2017.0437.

Windirsch, T., J. Palmtag, N. Zimov, G. Grosse, O. Habeck, and J. Strauss (2021): “Russian-German Cooperation: Expeditions to Siberia in 2019”. In: ed. by M. Fuchs, D. Bolshiyanov, M. Grigoriev, A. Morgenstern, L. Pestryakova, L. Tsibizov, and A. Dill. Vol. 749. Berichte zur Polar- und Meeresforschung - Reports on Polar and Marine Research. Chap. 4.2 Cherskiy 2019 summer expedition, pp. 211–216. DOI: 10.48433/BzPM_0749_2021.

Chapter 3

Expedition to Iškoras in Fall 2020: Alkalinity Observations in a Degrading Permafrost Catchment

Nele Lehmann[1,2], Mascha Treblin[3], Helmuth Thomas[2], and Hugues Lantuit[1*]*

[1] Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany

[2] Helmholtz Zentrum Hereon, Institute of Carbon Cycles, Geesthacht, Germany

[3] University of Hamburg, Institute of Food Chemistry, Hamburg, Germany

[*] not in the field

Correspondence: Nele Lehmann (nele.lehmann@hereon.de)

Fieldwork period and location

From September 19th to October 11th, 2020 at the mountainside of Iškorasfjellet, Karasjok Municipality (69.30601°N / 25.30562°E); 447-620 m above sea level (asl) and along the rivers Báhkiljohnjálbmi, Karasjohka and Tanaelva in the county Troms og Finnmark in Northern Norway

Introduction

General scientific rationale and objectives

The Arctic is highly susceptible to climate change. Compared to the global mean, the Arctic surface air temperature has increased more than double over the last two decades (Meredith et al. in press.). Permafrost is particularly sensitive to rising air temperatures. In ice-rich permafrost, a change in the thermal regime can either lead to erosional events or cause surface subsidence due to a gradual deeper thawing. An enhanced permafrost degradation will alter the fluvial suspended sediment flux into the Arctic Ocean. Alkalinity – the ocean's CO_2 and pH buffer capacity – will also be affected, as riverine alkalinity is mainly produced from chemical weathering (dissolution) of minerals in watersheds including silicates as well as limestone and dolomite. The driver for the dissolution is the corrosive action of dissolved atmospheric or biologically respired CO_2. Therefore, the changing Arctic will alter regional and global carbon budgets.

With this field study, we will investigate the impact of an enhanced erosion from permafrost thaw on alkalinity in a small Arctic catchment. In particular, we will quantify a change in erosion within the catchment by comparing a pre-industrial with a current erosion rate and link this to riverine alkalinity levels.

Expedition itinerary and general logistics

During the expedition, we travelled by van for easy transport of equipment and samples (Figure 3.1). We avoided air travel in order to be agile in responding to the COVID-19 pandemic. Travel to the study site in Northern Norway took three days (1.5 days of ferry travel from Lübeck-Travemünde, Germany, to Helsinki, Finland, and 1.5 days of driving through Finland to Karasjok, Norway). Therefore, we spent 6 of 21 days traveling to and from Karasjok and the remaining 15 days working in the field (Table 3.1).

The campground in Karasjok was suitable as our "base camp", with local infrastructure (e.g., grocery store and gas station) within walking distance. Since the camper cabin had its own kitchen and bathroom, the conditions for possible self-quarantine during the COVID-19 pandemic were in place. From the campsite, we reached the

study site of Iškorasfjellet after a 40-minute drive (on asphalt and gravel roads) on 15 consecutive days. From the gravel road, where we parked the van (Figure 3.1), we walked to the sampling sites.
Since no frozen samples were taken, the samples were stored in aluminum boxes (Figure 3.1) after returning from the field and left in the van.

Figure 3.1: *left: inside the transporter with the field equipment; right: transporter parked on the gravel road at the mountainside of Iškorasfjellet*

Table 3.1: Timetable of field work - locations are shown in Figure 3.4

Date	Task
22.09. - 06.10.2020	Daily sampling at the outlet of the catchment, site Isk-R-Ga9 (daily: water samples; once: river sediment)
22.09.2020 & 29.09.2020 & 06.10.2020	Weekly sampling along the longitudinal profile of the river at the sites Isk-R-Ga1, Isk-R-Ga3 and Isk-R-Ga5 (weekly: water samples; once: river sediment)
24.09. - 02.10.2020	Grid sampling of soil cores (93 sites)
05.10. - 06.10.2020	Sampling along the rivers Báhkiljohnjálbmi, Karasjohka and Tanaelva until the Tanafjord at sites Isk-R-Ga10, Isk-R-Ga11, Isk-R-Ka1, Isk-R-Ka2, Isk-R-Ka3, Isk-R-Ka4 and Isk-R-Ka5 (once: water and river sediment samples)

Study region
The main study area of this expedition was the small catchment area of the Gaskabohki River (catchment area: 0.83 km^2) on the mountain slope of Iškorasfjellet, Karasjok Municipality. Iškorasfjellet is located inland on the Finnmarksvidda plateau (300-500 m asl, with local peaks rising above 600 m asl), which borders Finland to the south and east. In addition to studying this catchment in detail, we also sampled along the larger rivers Báhkiljohnjálbmi, Karasjohka, and Tanaelva to the Tanafjord. The Gaskabohki River drains into the Barents Sea via these three larger rivers and the Tanafjord. All of these sampling sites are located in Troms og Finnmark County in Northern Norway (Figure 3.4).

The Finnmarksvidda plateau was completely ice-covered during the Pleistocene glaciations. Due to glacial activity, ground-moraine, glaciofluvial, and glaciolacustrine sediments were accumulated on the surface geology

(Sollid et al. 1973). The area was deglaciated ca. 10,900-10,800 cal. yrs B.P. (Stroeven et al. 2016). The geology of the investigated Gaskabohki catchment at Iškorasfjellet consists of quartzite and "arkositt" (shale-free to slightly shale-like rock with 0-70% quartz, 10-90% feldspar, 0-30% mica and chlorite), in places with layers of different shales (Norway (NGU) 2020). Besides the Gaskabohki channel, drainage gullies are present (dried out at the time of sampling in the fall, Figure 3.2).

From the top of the mountain at 644 m asl., the landscape slopes down to the Iškoras peat plateau at ca. 380 m asl which is underlain by mica gneiss, mica shale, metasandstone and amphibolite (Norway (NGU) 2020). The peat began to form around 9,800 cal. yrs B.P. in the form of wet fens, which were prevalent during most of the Holocene. Dry surface conditions associated with permafrost peat plateau aggradation developed around 950–100 cal. yrs B.P., probably caused by the Little Ice Age cooling (Kjellman et al. 2018, Martin et al. 2019).

Tundra vegetation (e.g. lichen crusts, *Betula* shrubs and *Empetrum nigrum ssp. hermaphroditum*) is dominant at Iškorasfjellet (Figure 3.2). Below an elevation of about 570 m, mountain birch (*Betula pubescens ssp. czerepanovii*) forest is also present (Figure 3.2).

The climate of Finnmarksvidda is cold continental. For the last six years (September 2014 - August 2020) the mean summer (June-July-August) and winter (December-January-February) air temperatures were 8.7 °C and -9.3 °C, respectively (measured at the meteorological station at Iškorasfjellet, 591 m asl, SN97710; data from Klimaservicesenter 2020). Compared to the air temperature normal (1961-1990), temperatures increased by 0.2 °C and 4.2 °C, respectively. Mean monthly precipitation sums during the summer and winter for the last six years were 66 mm and 38 mm, which correspond to 117% and 237% of the monthly precipitation sums of the climate normal, respectively. The annual precipitation averaged over the last six years was 492 mm and the mean daily snow depth from September 2017 – August 2020 was 25 cm (measured at the meteorological station in Karasjok, 131 m asl, SN97251, 20 km from Iškorasfjellet; data from Klimaservicesenter 2020).

Figure 3.2: *top: typical drainage gully within the Gaskabohki catchment; bottom left: at the top of Iškorasfjellet: low tundra vegetation; bottom right: Gaskabohki river downstream at station Isk-R-Ga9: tundra vegetation with mountain birch*

Field methods and sampling strategy

The aim of the sampling campaign was to collect sediment and soil samples for erosion rate determination and water samples for alkalinity (and other hydrochemical parameters) analysis. We will deduce the pre-industrial erosion rate of the Gaskabohki catchment from ^{10}Be concentrations in river sediments. Since it is possible to calculate a catchment-wide average erosion rate from the concentration of terrestrial cosmogenic nuclides, such as ^{10}Be, from a single sample, we only collected river sediment (ca. 2 kg, grain size $<$ 3 mm, Figure 3.3) at 3 strategic sites along the river (two upstream sampling points, Isk-R-Ga1 and Isk-R-Ga3, and one at the outlet, Isk-R-Ga9, Figure 3.4). For the determination of the current erosion rate of the Gaskabohki catchment via the Plutonium isotopes ^{239}Pu + ^{240}Pu, we extracted 83 soil cores (diameter: 5 cm) in a grid sampling scheme to cover the entire catchment area and 10 soil cores as reference material on flat hill tops adjacent to the catchment (Figure 3.4). We used a mechanical corer (Figure 3.3) and sampled until we reached a gravel layer/bed rock. The sampled material was stored in inner liner tubes (Figure 3.3). We will perform the subsampling later.

Figure 3.3: *left: collecting river sediment at site Isk-R-Ga1; middle: using the mechanical corer to retrieve a soil core at site Isk-S-Ga49; right: the sampled soil was stored in inner liner tubes.*

For hydrochemical analysis of the Gaskabohki catchment, we collected water samples weekly along the longitudinal profile of the river, at sites Isk-R-Ga1, Isk-R-Ga3, Isk-R-Ga5, and daily at the outlet of the catchment, at site Isk-R-Ga9 (Figure 3.4). At every sampling location, we measured in-situ water temperature, electrical conductivity and turbidity. At site Isk-R-Ga9, we also recorded the water flow daily to calculate discharge. The different types of hydrochemical samples and their preservation techniques are shown in Table 3.2.
Besides the in-depth study of the Gaskabohki catchment, we also collected river sediment and water samples at 7 sites, Isk-R-Ga10, Isk-R-Ga11, Isk-R-Ka1, Isk-R-Ka2, Isk-R-Ka3, Isk-R-Ka4 and Isk-R-Ka5, along the rivers Báhkiljohnjálbmi, Karasjohka and Tanaelva (Figure 3.4).

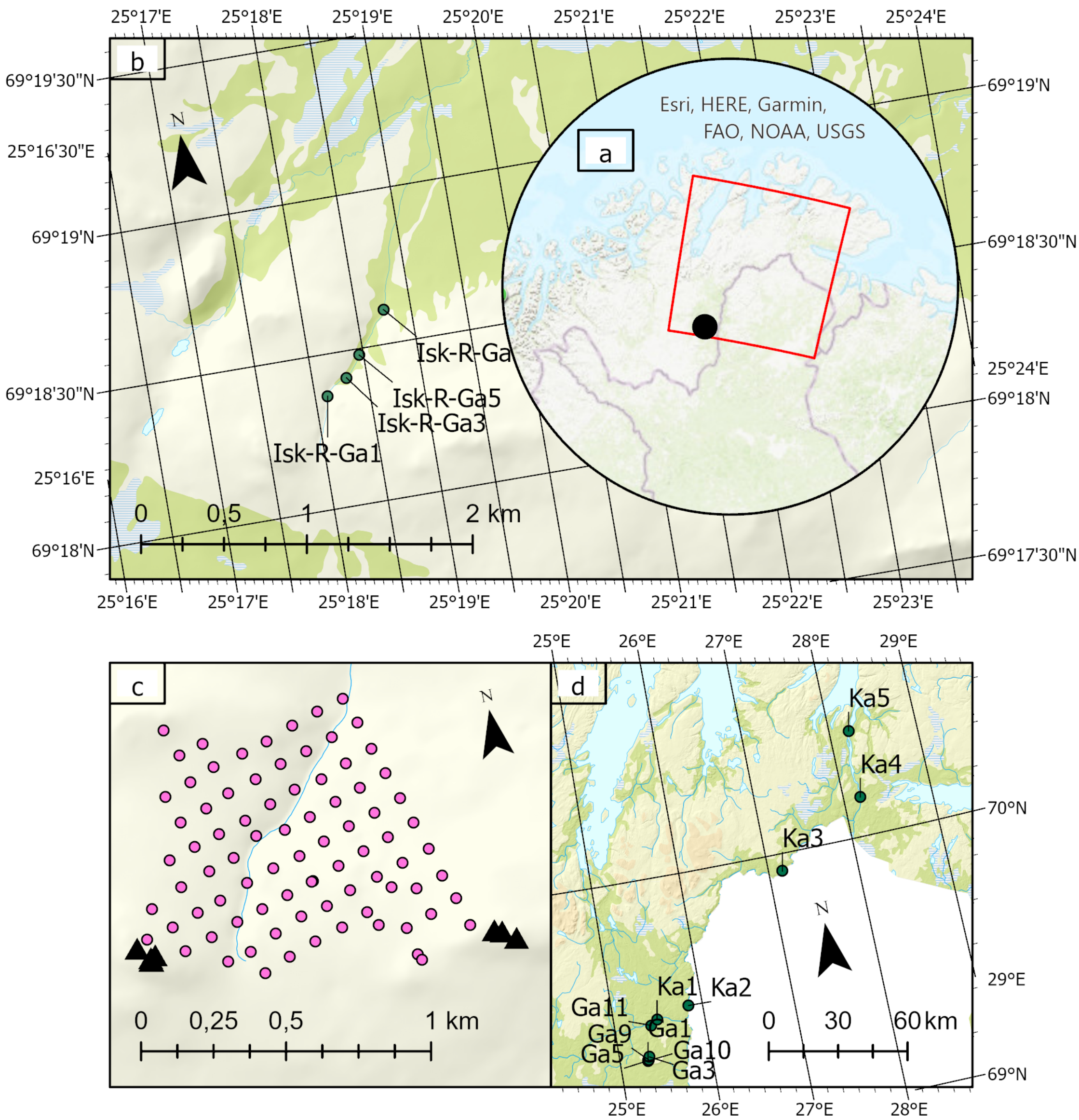

Figure 3.4: *a: location of the study site in Northern Norway, black circle: Gaskabohki watershed, red rectangle: sampling area until Tanafjord; b: water and river sediment sampling locations along the Gaskabohki river; c: grid soil sampling sites within the Gaskabohki catchment (pink circles) with reference sites (black triangles); d: water and river sediment sampling locations until the Tanafjord*

Table 3.2: Sample volume, indication of filtration and preservation techniques of the sampled hydrochemical parameters

Parameter	Sample Volume [mL]	Filtered (0.45 µm)	Preservation
Alkalinity and dissolved inorganic carbon (DIC)	300	no	Added 300 µL of $HgCl_2$ solution (sat.), no headspace, stored cool and dark
δ^{13}C-DIC	12	yes	Added 10 µL of $HgCl_2$ solution (sat.), no headspace, stored cool and dark
Cations	50	yes	Added 50 µL of HNO_3 (conc.) + stored cool and dark
Anions	15	yes	Stored cool and dark
Stable water isotopes	2	yes	Stored cool and dark

Preliminary (meta data) results

The locations and dates for the hydrochemical sampling sites with the measured water temperature, electrical conductivity and turbidity values and the types of samples collected are listed in Table A.3.5. The locations and dates for the soil samples with the measured core depths are shown in Table A.3.6. The 93 retrieved soils cores had depths from 3.5 - 41.5 cm, with 57% of all cores being 5.0 – 15.0 cm long (Figure 3.5). While retrieving the cores, we generally found that at sites where we expected erosion (at slopes) the cores were shorter than the ones from sites where we expected deposition (in depressions). This field observation is supported when the slope angle is plotted against the core depth (Figure 3.5).

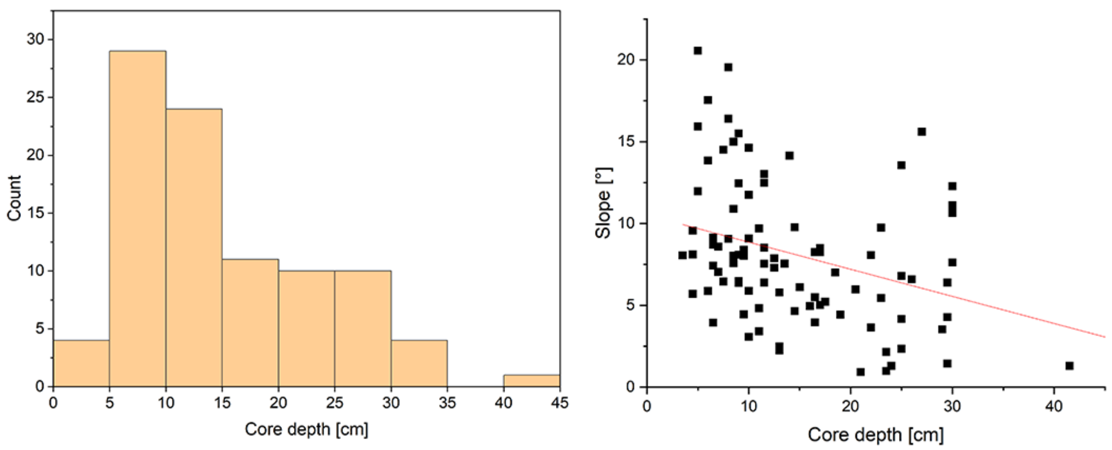

Figure 3.5: *left: distribution of the depths of the collected soil cores; right: slope vs. soil core depth*

Conclusions

During the 15 day long field campaign around Iškorasfjellet, we collected a total of 155 water samples, 10 river sediment samples and 93 soil cores at 104 different sampling sites. With this data set, we will quantify a change in erosion rate due to climate warming and investigate a possible effect on alkalinity in a small Arctic catchment.

Three blog posts were published on "Helmholtz Blogs" (in German):

- Blog post 1: Feldkampagne in Nord-Norwegen – Teil 1
- Blog post 2: Feldkampagne in Nord-Norwegen – Teil 2
- Blog post 3: Feldkampagne in Nord-Norwegen – Teil 3

Acknowledgements

We would like to thank Lukas Detjen for his help in collecting the water and soil samples during the field campaign.

We also would like to thank Dr. Sebastian Westermann, who provided important information on logistics and permit acquisition and shared his experience with field work in this area of Norway.

We conducted the field work under FeFo research permit 20/998–2.

N.L. was supported by the project *The Ocean's Alkalinity: Connecting geological and metabolic processes and time-scales*, which is funded by the Federal Ministry of Education and Research (BMBF) under *Make our Planet Great Again – German Research Initiative*, grant number 57429828, implemented by the German Academic Exchange Service (DAAD). This expedition is part of the Permafrost Research Section at AWI Potsdam and received great support from AWI logistics.

References

Kjellman, S. E., P. E. Axelsson, B. Etzelmüller, S. Westermann, and A. B. K. Sannel (2018): Holocene development of subarctic permafrost peatlands in Finnmark, northern Norway. In: The Holocene 28.12, pp. 1855–1869. DOI: 10.1177/0959683618798126.

Klimaservicesenter, Norsk (2020): *Seklima: Observations and weather statistics*. Accessed 22 December 2020. URL: https://seklima.met.no/observations/.

Martin, L. C. P., J. Nitzbon, K. S. Aas, B. Etzelmüller, H. Kristiansen, and S. Westermann (2019): Stability Conditions of Peat Plateaus and Palsas in Northern Norway. In: Journal of Geophysical Research: Earth Surface 124.3, pp. 705–719. DOI: 10.1029/2018jf004945.

Meredith, M., M. Sommerkorn, S. Cassotta, C. Derksen, A. Ekaykin, A. Hollowed, G. Kofinas, A. Mackintosh, J. Melbourne-Thomas, M. M. C. Muelbert, G. Ottersen, H. Pritchard, and E. A. G. Schuur (in press.): "IPCC Special Report on the Ocean and Cryosphere in a Changing Climate". In: ed. by H.-O. Pörtner, D. C. Roberts, V. Masson-Delmotte, P. Zhai, M. Tignor, E. Poloczanska, K. Mintenbeck, A. Alegría, M. Nicolai, A. Okem, J. Petzold, B. Rama, and N. M. Weyer. Chap. 3. Polar Regions, pp. 203–320.

Norway (NGU), Geological Survey of (2020): *Berggrunn N250*. Accessed 22 December 2020. URL: https://www.ngu.no/en/topic/datasets.

Sollid, J. L., S. Andersen, N. Hamre, O. Kjeldsen, O. Salvigsen, S. Sturød, T. Tveitå, and A. Wilhelmsen (1973): Deglaciation of Finnmark, North Norway. In: Norsk Geografisk Tidsskrift - Norwegian Journal of Geography 27.4, pp. 233–325. DOI: 10.1080/00291951.1973.9728306.

Stroeven, A. P., C. Hättestrand, J. Kleman, J. Heyman, D. Fabel, O. Fredin, B. W. Goodfellow, J. M. Harbor, J. D. Jansen, L. Olsen, M. W. Caffee, D. Fink, J. Lundqvist, G. C. Rosqvist, B. Strömberg, and K. N. Jansson (2016): Deglaciation of Fennoscandia. In: Quaternary Science Reviews 147, pp. 91–121. DOI: 10.1016/j.quascirev.2015.09.016.

Chapter 4

First FluxWIN Field Site Visit to Siikaneva, Finland, in October 2020

Lona van Delden[1], Julia Boike[1], Niko Bornemann[1], and Claire Treat[1]

[1] Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany

Correspondence: Lona van Delden (lona.van.delden@awi.de)

Fieldwork period and location
From October 19th to October 25th, 2020 at Siikaneva bog and adjacent upland forest (61.83850°N / 24.17190°E); in Ruovesi, Southwest Finland.

Introduction
General scientific rationale and objectives
The Siikaneva, Finland field work took place in October 2020 for the new FluxWIN project to investigate annual greenhouse gas flux (including CO_2, CH_4 and N_2O) dynamics in high frequency with special emphasis on the non-growing season biogeochemical drivers. This new project focuses on how carbon (C) and nitrogen (N) cycling and resulting greenhouse gas emissions are affected by soil freezing and thawing to understand how now-frozen permafrost soils will respond to permafrost thaw as soils that are always frozen shift to becoming seasonally or perennially thawed with increased plant activity.

Expedition itinerary and general logistics
To combine means of travel and transportation of equipment to the field site as well as frozen samples back to AWI, this site visit was conducted via camper van with power supply and ferry ride from Travemünde, Germany, to Helsinki, Finland and back. In Finland, Hyytiälä Research Station generously provided isolated accommodation for us instead of quarantine camping. Due to the fluent teamwork, all attempted work was completed despite quite restricting weather conditions of constant (snowy) rain. All soil and pore water samples were frozen at the end of each sampling day and transported in a portable freezer back to Germany.

Field methods and sampling
The FluxWIN field site includes three ecosystems along a moisture gradient from wetland bog to upland forest (Figure 4.1). A new meteorological station was installed at the upland forest to complement an existing weather station in the fen wetland ‘SMEAR II Siikaneva 2 wetland’, which is publicly available at Fairdata.fi. The new meteorological station ‘Forest site Siikaneva, Finland’ includes sensors for above and below ground micrometeorological measurements as shown in Figure 4.2. The belowground measurements include a soil heat flux plate as well as temperature and moisture readings down to approximately 60 cm soil depth reaching the upland bedrock (Figure 4.3).

Soil sampling took place at all three ecosystem sites in triplicate each to determine horizons down to one meter and separate samples in layers for future site descriptive analysis such as C & N stocks, SOM, particle size analysis and particle density. The upper 20 cm topsoil were sampled for bulk density in 3 layers of 0-5 cm, 5-10 cm and 10-20 cm. The subsoil was sampled with soil augers; a peat auger was used for the bog and intermediate site and a Pürkhauer for the upland site. All soil cores were separated into 10 cm layers for individual analysis. Soil samples for lipid biomarker analysis were stored separately in small honey glass jars, while samples for incubation studies were bagged. Lipid biomarkers will be analysed to elucidate the origin and distribution of organic matter for future decomposition assumptions. Porewater was sampled with rhizon probes for chemical analysis such as dissolved organic C & N, nitrate, nitrite and ammonium. $\delta^{13}C$ of dissolved CH_4 and CO_2 in the porewater shall indicate different emission pathways.

Plant Root Simulators were installed to remain in the field over the winter season to monitor nutrient availability rates for all soil ions (NO_3^-, NH_4^+, $H_2PO_4^-$, SO_4^{2-}, K^+, Ca_2^+, Mg_2^+) with ion exchange resin membranes.

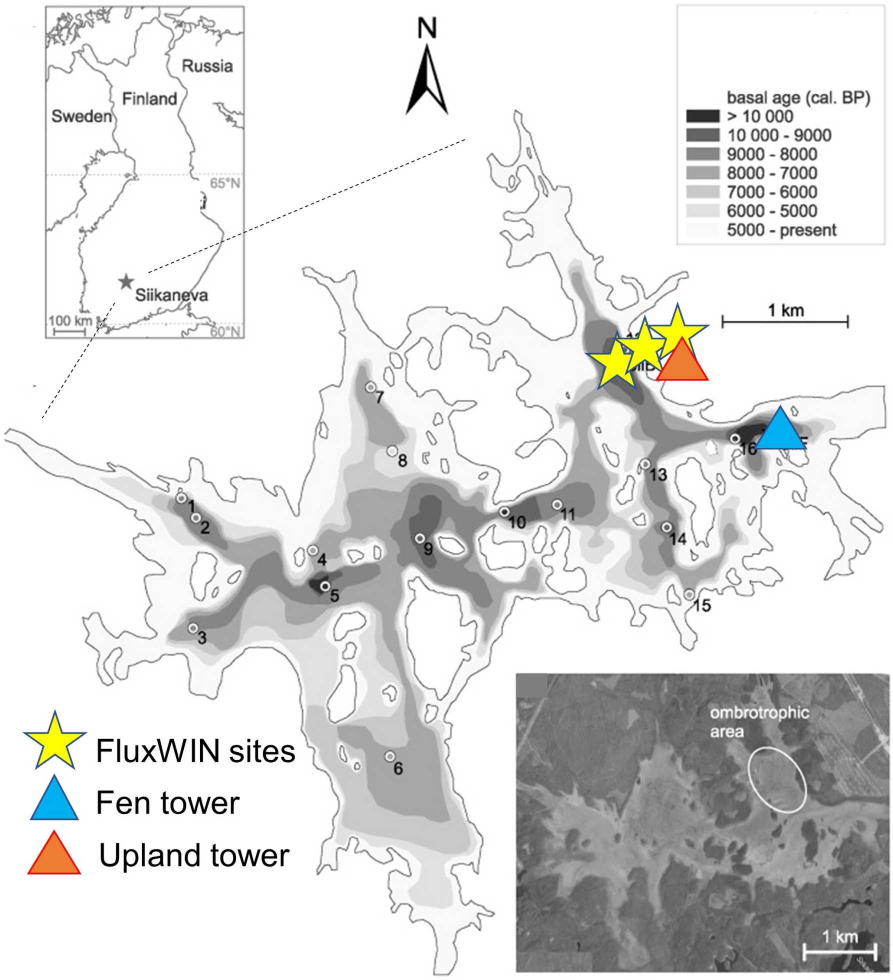

Figure 4.1: *FluxWIN site locations (yellow stars) within Finland and at the Siikaneva field site, modified from Mathijssen et al. 2016. The blue triangle indicates the location of the fen wetland meteorological station 'SMEAR II Siikaneva 2 wetland' and the orange triangle represents the newly established upland forest meteorological station 'Forest site Siikaneva'.*

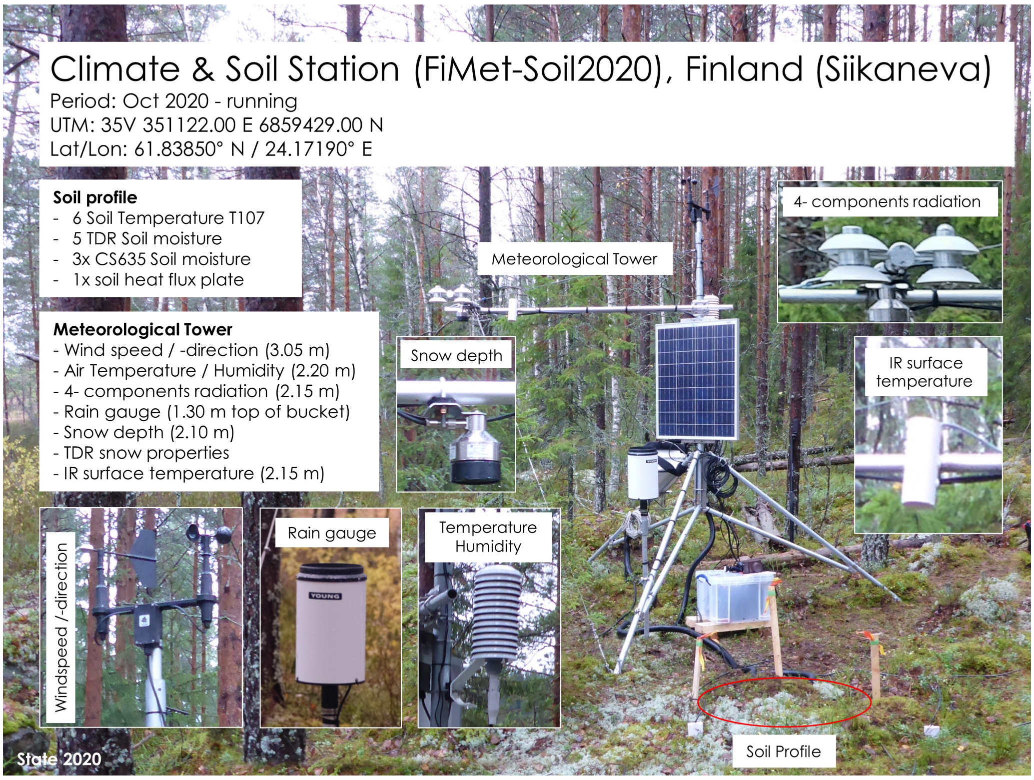

Figure 4.2: *Forest site meteorological tower overview with all sensors*

Figure 4.3: *Soil pit for installation of heat flux, temperature and moisture sensors all the way down to the bedrock in approximately 50-60 cm depth.*

Preliminary (meta data) results

The meteorological station has been successfully and continuously logging data, uploading and visualizing them in near-real-time (Figure 4.4). We apply the Observation to Archives (O2A) data flow framework, which includes the comprehensive description and management of all data with metadata, central data storage and controlled data access. The data can be accessed instantly as is via the near-real time database (Alfred Wegener Institute, 2021), while quality controlled and thematically curated datasets will be published in the PANGAEA long-term repositories.

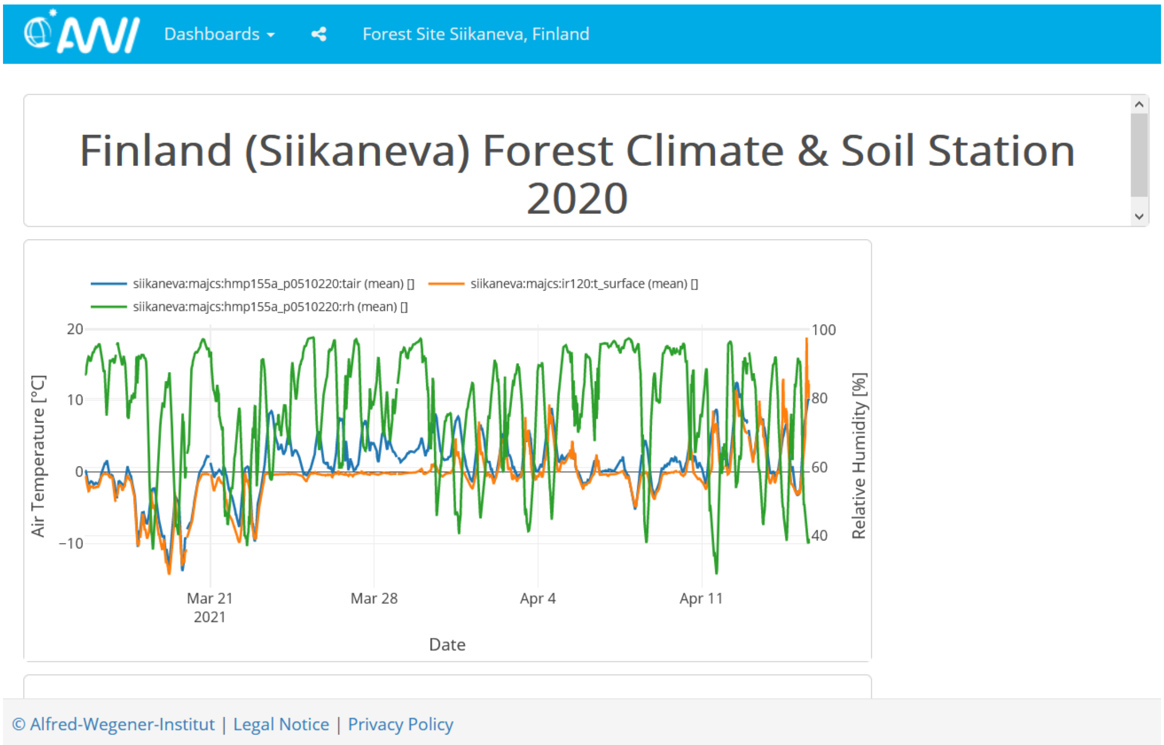

Figure 4.4: *Meteorological tower sensor logger upload to the AWI O2A Dashboard in near-real-time.*

Conclusions

Since our first visit to the FluxWin field sites at Siikaneva, Finland, our Finnish collaborators and Hyytiälä staff continued establishing infrastructure and measurement equipment throughout the winter (Figure 4.5). Janne Levula from the Hyytiälä Research Station installed a new boardwalk to our selected chamber locations in late 2020 and Sami Haapanala has started to install the automated chamber system he built for FluxWIN. We are hoping to be back at the field site as soon as the COVID-19 restrictions allow but latest in June 2021 to put the automated chamber system into operation.

Figure 4.5: *Chamber installation along the newly established boardwalk in the intermediate site (left) and upland site (right).*

Acknowledgements
The FluxWIN project is funded with a starting grant by the European Research Council (ERC, grant number 851181) running from 2020-2024.

We would like to thank the Finnish partners of the University of Helsinki and University of Eastern Finland for helping with the site selection and taking us along remotly. Many thanks to the Hyytiälä Research Station for providing isolated accommodation during these special COVID-19 times and to Janne Levula for providing the new boardwalk before the new year. Many thanks to Sami Haapanala for building the automated chamber system, putting it into place and providing us with continuous visual updates throughout the winter.

References

Mathijssen, P. J. H., M. Väliranta, A. Korrensalo, P. Alekseychik, T. Vesala, J. Rinne, and E.-S. Tuittila (2016): Reconstruction of Holocene carbon dynamics in a large boreal peatland complex, southern Finland. In: Quaternary Science Reviews 142, pp. 1–15. DOI: 10.1016/j.quascirev.2016.04.013.

Appendix

A.1 List of participants and institutions

Table A.1.1: List of participants of the expedition to Kutuharju Field Research Station

No.	Name	Institution	Duration
1	Torben Windirsch	AWI/UniP	31.08.20 - 25.09.20
2	Matthias Fuchs	AWI	31.08.20 - 25.09.20

Table A.1.2: List of participants of the expedition to Iškoras

No.	Name	Institution	Duration
1	Nele Lehmann	AWI/Hereon	19.09.20-11.10.20
2	Mascha Treblin	UniH	19.09.20-11.10.20
3	Lukas Detjen		19.09.20-11.10.20

Table A.1.3: List of participants of the expedition to Siikaneva

No.	Name	Institution	Duration
1	Lona van Delden	AWI	19.10.20-25.10.20
2	Julia Boike	AWI	19.10.20-25.10.20
3	Niko Bornemann	AWI	19.10.20-25.10.20
4	Claire Treat	AWI	19.10.20-25.10.20

Table A.1.4: List of participating institutions

Abbr.	Institution
AWI	Alfred Wegener Institute Helmholtz Centre for Polar and Marine Research, Potsdam, Germany
Hereon	Helmholtz Zentrum Hereon, Institute of Carbon Cycles, Geesthacht, Germany
UniH	University of Hamburg, Institute of Food Chemistry, Hamburg, Germany
UniP	University of Potsdam, Institute of Geosciences, Potsdam, Germany

A.2 Supplementary material - PeCHEc survey on reindeer herding

Supplementary material from Chapter 2

The supplementary material includes the PeCHEc survey, which was distributed to reindeer herders during the expedition to Kutuharju Field Research Station in September 2020.

Survey on
"Reindeer herding and environmental changes in the Inari area"

a PhD Research Project by Torben Windirsch-Woiwode
contact: torben.windirsch@awi.de

This survey aims to assess the current situation and circumstances of reindeer herding as well as environmental changes you might have noticed over the past years.

Your answers will help to further understand global climate warming and to develop sustainable strategies in reducing carbon emissions!

All data will be treated confidentially. Any reports will be in summary form, in order to maintain anonymity. If you wish, we can send you the results of the study.

You can find a more detailed description of the research project here: PeCHEc Project

You can fill out this paper sheet and send a photo of it to torben.windirsch@awi.de
or you can participate online using the QR code above or this link: PeCHEc Survey

If you have any questions regarding this survey, please contact us via email: torben.windirsch@awi.de

Q 1: Do you have any personal relation to reindeer husbandry? If yes, please describe:

Q 2: How would you define "successful" reindeer husbandry, and what does it depend on?

Q 3: In which of these landscapes do you have the most experience with reindeer?

□ Forest □ Grassland / Fields □ Mountains □ Lake side □ other

Q 4: Do you think the following characteristics have changed in your area over the last 25 to 50 years?

a) Weather / Climate	□ Yes	□ No
b) Amount of snow	□ Yes	□ No
c) Plant types	□ Yes	□ No
d) Forest fires	□ Yes	□ No
e) Underground (e.g. wet / dry)	□ Yes	□ No
f) Animal presence (not reindeer)	□ Yes	□ No
g) Reindeer migration / behaviour	□ Yes	□ No

Q 5: Are there any other environmental changes that you have noticed?

Q 6: Which of these changes do you think are the most rapid?

Q 7: Which of these changes do you worry about most?

Q 8: What do you think about the extent (overall number of reindeer) of reindeer herding in your area? Choose one answer, please:

□ There should be much more reindeer husbandry in this area.	⇒ Q 9
□ There should be a little more reindeer husbandry in this area.	⇒ Q 9
□ The current extent suits the area.	⇒ Q 12
□ There are a little too many reindeer in this area.	⇒ Q 10
□ There are way too many reindeer in this area.	⇒ Q 10

Q 9: What do you think has to be done in order to increase reindeer husbandry in this area?

Continue with Q 12, please.

Q 10: How do you think reindeer husbandry could be reduced in this area?

Q 11: Are there any things that could be done to make you more comfortable with having more reindeer around? If yes, which things should be improved/done?

Q 12: What do you think is the most important reason for reindeer herders around to maintain the current extent (number of reindeer), if you know any?

Q 13: Are you aware of any research projects in your area?

☐ Yes ☐ No

Q 14: Can you briefly describe what this research is / was about?

Q 15: Have you been involved in any of these research projects? If yes, could you describe how you were involved?

Q 16: Finally, is there anything else you would like to add?

Please indicate which age group you belong to (optional):

☐ 15-20 ☐ 21-25 ☐ 26-30 ☐ 31-35 ☐ 36-40 ☐ 41-45
☐ 46-50 ☐ 51-55 ☐ 56-60 ☐ 61-65 ☐ 66-70 ☐ 71-75
☐ 76-80 ☐ 81 or older

Your gender (optional):

Your profession (optional):

If you want to receive a summary of this survey, please provide your email address here (optional):

Thank you for Your participation! - We are grateful for Your support!

A.3 Supplementary material - Expedition to Iškoras in Fall 2020

Supplementary table from Chapter 3

Table A.3.5: Types of hydrochemical samples collected at each sampling location with the measured water temperature, electrical conductivity and turbidity values

Date & time of sampling (UTC)	Station name	Long. [°]	Lat. [°]	Water temp. [°C]	Elec. conductivity [µS/cm]	Turbidity [FNU]	Alkalinity / DIC	δ^{13}C-DIC	Cations	Anions	Stable water isotopes	River sediment
22.09.2020 07:41	Isk-R-Ga9	25.312608	69.310256	3.7	17.3	0.29	x	x	x	x	x	x
22.09.2020 07:45	Isk-R-Ga1	25.301985	69.306118	2.1	17.4	0.34	x	x	x	x	x	x
22.09.2020 11:58	Isk-R-Ga5	25.307752	69.308061	3.4	14.4	0.30	x	x	x	x	x	
23.09.2020 08:47	Isk-R-Ga3	25.305203	69.306906	2.2	15.2	0.34	x	x	x	x	x	x
23.09.2020 11:36	Isk-R-Ga9	25.312608	69.310256	2.6	17.9	0.26	x	x	x	x	x	
24.09.2020 13:36	Isk-R-Ga9	25.312608	69.310256	2.8	18.2	0.30	x	x	x	x	x	
25.09.2020 09:32	Isk-R-Ga9	25.312608	69.310256	3.9	18.2	0.61	x	x	x	x	x	
26.09.2020 09:40	Isk-R-Ga9	25.312608	69.310256	2.9	17.5	0.24	x	x	x	x	x	
27.09.2020 05:50	Isk-R-Ga9	25.312608	69.310256	1.1	18.7	0.31	x	x	x	x	x	
28.09.2020 11:47	Isk-R-Ga9	25.312608	69.310256	3.3	18.3	0.24	x	x	x	x	x	
29.09.2020 08:27	Isk-R-Ga9	25.312608	69.310256	4.7	17.8	0.30	x	x	x	x	x	
29.09.2020 09:38	Isk-R-Ga5	25.307752	69.308061	4.0	16.9	0.29	x	x	x	x	x	
29.09.2020 09:55	Isk-R-Ga3	25.305203	69.306906	4.1	15.2	0.32	x	x	x	x	x	
29.09.2020 10:11	Isk-R-Ga1	25.301985	69.306118	4.3	14.4	0.28	x	x	x	x	x	
30.09.2020 10:32	Isk-R-Ga9	25.312608	69.310256	4.7	17.8	0.25	x	x	x	x	x	
01.10.2020 11:48	Isk-R-Ga9	25.312608	69.310256	5.0	17.9	0.24	x	x	x	x	x	

Table A.3.5 (continued)

Date & time of sampling (UTC)	Station name	Long. [°]	Lat. [°]	Water temp. [°C]	Elec. conduc-tivity [µS/cm]	Turbidity [FNU]	Alkalinity / DIC	$\delta^{13}C$-DIC	Cations	Anions	Stable water isotopes	River sedi-ment
02.10.2020 11:08	Isk-R-Ga9	25.312608	69.310256	4.5	17.9	0.22	x	x	x	x	x	
03.10.2020 09:37	Isk-R-Ga9	25.312608	69.310256	4.4	18.9	0.19	x	x	x	x	x	
04.10.2020 06:38	Isk-R-Ga9	25.312608	69.310256	4.0	18.8	0.22	x	x	x	x	x	
05.10.2020 07:42	Isk-R-Ga9	25.312608	69.310256	3.5	18.3	0.23	x	x	x	x	x	
05.10.2020 10:02	Isk-R-Ga10	25.325549	69.321174	4.2	23.4	0.40	x	x	x	x	x	x
05.10.2020 12:51	Isk-R-Ga11	25.400132	69.440231	5.8	82.1	0.37	x	x	x	x	x	x
05.10.2020 13:18	Isk-R-Ka1	25.478253	69.459698	6.5	43.3	0.67	x	x	x	x	x	x
06.10.2020 07:46	Isk-R-Ga9	25.312608	69.310256	2.8	18.9	0.24	x	x	x	x	x	
06.10.2020 08:11	Isk-R-Ga5	25.307752	69.308061	2.8	17.7	0.31	x	x	x	x	x	
06.10.2020 08:28	Isk-R-Ga3	25.305203	69.306906	2.8	15.3	0.46	x	x	x	x	x	
06.10.2020 08:44	Isk-R-Ga1	25.301985	69.306118	2.8	14.5	0.29	x	x	x	x	x	
06.10.2020 10:56	Isk-R-Ka2	25.846312	69.490794	5.6	46.5	0.97	x	x	x	x	x	x
06.10.2020 13:11	Isk-R-Ka3	27.154638	69.933976	5.7	44.5	0.46	x	x	x	x	x	x
06.10.2020 14:35	Isk-R-Ka4	28.190646	70.151111	6.6	57.5	1.80	x	x	x	x	x	x
06.10.2020 15:56	Isk-R-Ka5	28.222471	70.410270	6.5	103.5	1.01	x	x	x	x	x	x

Table A.3.6: Soil coring locations with respective core depths

Date & time of sampling (UTC)	Station name	Longitude [°]	Latitude [°]	Core depth [cm]
24.09.2020 07:30	Isk-S-Ga66	25.303910	69.302851	16.5
24.09.2020 08:09	Isk-S-Ga39	25.312031	69.303363	29.5
24.09.2020 08:36	Isk-S-Ga28	25.313663	69.304436	25.0
24.09.2020 08:43	Isk-S-Ga29	25.314360	69.303120	29.0
24.09.2020 08:57	Isk-S-Ga30	25.314960	69.302270	16.5
24.09.2020 09:34	Isk-S-Ga20	25.315237	69.302070	14.5
24.09.2020 10:04	Isk-S-Ga10	25.319900	69.302888	27.0
24.09.2020 10:16	Isk-S-Ga-Ref1	25.321892	69.302651	10.0
24.09.2020 10:28	Isk-S-Ga-Ref2	25.322542	69.302573	24.5
24.09.2020 10:33	Isk-S-Ga-Ref3	25.323692	69.302303	14.0
24.09.2020 10:50	Isk-S-Ga9	25.319074	69.303772	30.0
24.09.2020 11:07	Isk-S-Ga8	25.318175	69.304534	30.0
24.09.2020 11:22	Isk-S-Ga19	25.316660	69.303431	30.0
24.09.2020 11:38	Isk-S-Ga47	25.308806	69.303466	11.0
24.09.2020 11:50	Isk-S-Ga56	25.306322	69.303177	23.0
25.09.2020 12:05	Isk-S-Ga18	25.315788	69.304275	30.0
25.09.2020 12:20	Isk-S-Ga7	25.317415	69.305416	23.0
25.09.2020 12:31	Isk-S-Ga17	25.314944	69.305137	11.5
25.09.2020 12:43	Isk-S-Ga6	25.316500	69.306300	13.5
25.09.2020 12:55	Isk-S-Ga16	25.314095	69.305984	6.5
25.09.2020 13:17	Isk-S-Ga5	25.315698	69.307114	11.5
25.09.2020 13:30	Isk-S-Ga15	25.313287	69.306788	11.5
26.09.2020 06:47	Isk-S-Ga38	25.311210	69.303802	25.0
26.09.2020 06:58	Isk-S-Ga27	25.312565	69.304832	11.5
26.09.2020 07:07	Isk-S-Ga37	25.310032	69.304563	19.0
26.09.2020 07:19	Isk-S-Ga26	25.311768	69.305683	9.5
26.09.2020 07:38	Isk-S-Ga4	25.314789	69.307937	9.0
26.09.2020 07:48	Isk-S-Ga14	25.312379	69.307625	7.0
26.09.2020 07:57	Isk-S-Ga3	25.313973	69.308751	17.0
26.09.2020 08:06	Isk-S-Ga13	25.311551	69.308452	10.0
26.09.2020 08:17	Isk-S-Ga12	25.310743	69.309310	9.0
26.09.2020 08:31	Isk-S-Ga2	25.313162	69.309625	10.0
26.09.2020 08:46	Isk-S-Ga1	25.312229	69.310431	3.5
26.09.2020 11:48	Isk-S-Ga24	25.310089	69.307337	8.0
26.09.2020 11:56	Isk-S-Ga35	25.308497	69.306190	6.0

Table A.3.6 (continued)

Date & time of sampling (UTC)	Station name	Longitude [°]	Latitude [°]	Core depth [cm]
26.09.2020 12:05	Isk-S-Ga25	25.310905	69.306520	18.5
26.09.2020 12:18	Isk-S-Ga36	25.309393	69.305360	5.0
26.09.2020 12:27	Isk-S-Ga45-1	25.306995	69.305042	8.5
26.09.2020 12:37	Isk-S-Ga46	25.307852	69.304200	11.0
26.09.2020 12:47	Isk-S-Ga55	25.305471	69.304010	4.5
28.09.2020 08:09	Isk-S-Ga73	25.300601	69.303198	9.0
28.09.2020 08:23	Isk-S-Ga65	25.303009	69.303638	9.0
28.09.2020 08:33	Isk-S-Ga64	25.302249	69.304449	14.0
28.09.2020 08:43	Isk-S-Ga54	25.304603	69.304743	8.5
28.09.2020 08:55	Isk-S-Ga45-2	25.306893	69.305025	12.5
28.09.2020 09:04	Isk-S-Ga44	25.306199	69.305873	9.0
28.09.2020 09:11	Isk-S-Ga43	25.305326	69.306734	7.5
28.09.2020 09:19	Isk-S-Ga34	25.307672	69.307003	8.5
28.09.2020 10:14	Isk-S-Ga33	25.306736	69.307916	5.0
28.09.2020 10:22	Isk-S-Ga32	25.305942	69.308759	7.5
28.09.2020 10:30	Isk-S-Ga31	25.305049	69.309522	14.5
28.09.2020 10:39	Isk-S-Ga21	25.307494	69.309869	4.5
28.09.2020 10:48	Isk-S-Ga22	25.308300	69.309029	6.5
28.09.2020 10:56	Isk-S-Ga11	25.309811	69.310168	6.0
28.09.2020 12:28	Isk-S-Ga23	25.309218	69.308097	10.0
28.09.2020 12:44	Isk-S-Ga53	25.303759	69.305627	8.0
28.09.2020 13:04	Isk-S-Ga74	25.301555	69.302477	4.5
30.09.2020 06:59	Isk-S-Ga63	25.301312	69.305326	5.0
30.09.2020 07:13	Isk-S-Ga62	25.300524	69.306158	11.5
30.09.2020 07:21	Isk-S-Ga61	25.299594	69.306956	25.0
30.09.2020 07:33	Isk-S-Ga60	25.298855	69.307800	6.5
30.09.2020 07:42	Isk-S-Ga59	25.297887	69.308674	10.0
30.09.2020 07:54	Isk-S-Ga58	25.297329	69.309544	22.0
30.09.2020 08:09	Isk-S-Ga57	25.296323	69.310389	7.0
30.09.2020 08:19	Isk-S-Ga48	25.299508	69.309787	9.5
30.09.2020 08:28	Isk-S-Ga49	25.300103	69.309009	13.0
30.09.2020 08:36	Isk-S-Ga50	25.300998	69.308137	13.0
30.09.2020 08:46	Isk-S-Ga51	25.302034	69.307223	6.0
30.09.2020 08:54	Isk-S-Ga52	25.302792	69.306708	8.5
30.09.2020 09:12	Isk-S-Ga42	25.304427	69.307591	6.5

Table A.3.6 (continued)

Date & time of sampling (UTC)	Station name	Longitude [°]	Latitude [°]	Core depth [cm]
30.09.2020 09:19	Isk-S-Ga41	25.303559	69.308437	13.0
30.09.2020 09:27	Isk-S-Ga40	25.302745	69.309276	17.0
30.09.2020 11:15	Isk-S-Ga72	25.299882	69.304192	8.0
30.09.2020 11:26	Isk-S-Ga79	25.298516	69.303026	17.0
01.10.2020 07:25	Isk-S-Ga-Ref4	25.291974	69.303493	29.5
01.10.2020 07:28	Isk-S-Ga-Ref5	25.291970	69.303503	41.5
01.10.2020 07:41	Isk-S-Ga-Ref6	25.291959	69.303505	24.0
01.10.2020 07:43	Isk-S-Ga-Ref7	25.291933	69.303577	23.5
01.10.2020 07:45	Isk-S-Ga-Ref8	25.291915	69.303502	23.5
01.10.2020 08:17	Isk-S-Ga-Ref9	25.292351	69.303643	60.0
01.10.2020 08:46	Isk-S-Ga-Ref10	25.290892	69.303938	21.0
01.10.2020 09:09	Isk-S-Ga83	25.291844	69.304105	11.0
01.10.2020 09:18	Isk-S-Ga80	25.292722	69.305008	12.5
01.10.2020 09:28	Isk-S-Ga75	25.294947	69.306402	20.5
01.10.2020 09:37	Isk-S-Ga67	25.295542	69.308354	25.0
01.10.2020 09:46	Isk-S-Ga68	25.296480	69.307500	16.0
01.10.2020 09:55	Isk-S-Ga69	25.297315	69.306678	29.5
02.10.2020 08:56	Isk-S-Ga78	25.297455	69.303859	22.0
02.10.2020 09:05	Isk-S-Ga77	25.296624	69.304672	26.0
02.10.2020 09:14	Isk-S-Ga82	25.294996	69.303564	9.5
02.10.2020 09:23	Isk-S-Ga81	25.294233	69.304353	16.5
02.10.2020 09:37	Isk-S-Ga76	25.295541	69.305523	17.5
02.10.2020 09:56	Isk-S-Ga70	25.298222	69.305859	10.0
02.10.2020 10:06	Isk-S-Ga71	25.298741	69.304920	15.0

Die **Berichte zur Polar- und Meeresforschung** (ISSN 1866-3192) werden beginnend mit dem Band 569 (2008) als Open-Access-Publikation herausgegeben. Ein Verzeichnis aller Bände einschließlich der Druckausgaben (ISSN 1618-3193, Band 377-568, von 2000 bis 2008) sowie der früheren **Berichte zur Polarforschung** (ISSN 0176-5027, Band 1-376, von 1981 bis 2000) befindet sich im electronic Publication Information Center **(ePIC)** des Alfred-Wegener-Instituts, Helmholtz-Zentrum für Polar- und Meeresforschung (AWI); see https://epic.awi.de. Durch Auswahl "Reports on Polar- and Marine Research" (via "browse"/"type") wird eine Liste der Publikationen, sortiert nach Bandnummer, innerhalb der absteigenden chronologischen Reihenfolge der Jahrgänge mit Verweis auf das jeweilige pdf-Symbol zum Herunterladen angezeigt.

The **Reports on Polar and Marine Research** (ISSN 1866-3192) are available as open access publications since 2008. A table of all volumes including the printed issues (ISSN 1618-3193, Vol. 377-568, from 2000 until 2008), as well as the earlier **Reports on Polar Research** (ISSN 0176-5027, Vol. 1-376, from 1981 until 2000) is provided by the electronic Publication Information Center **(ePIC)** of the Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research (AWI); see URL https://epic.awi.de. To generate a list of all Reports, use the URL http://epic.awi.de and select "browse"/ "type" to browse "Reports on Polar and Marine Research". A chronological list in declining order will be presented, and pdf-icons displayed for downloading.

Zuletzt erschienene Ausgaben:

Recently published issues:

752 (2021) Expeditions to Fennoscandia in 2020, edited by Matthias Fuchs, Lona van Delden, Nele Lehmann, and Torben Windirsch

751 (2021) The MOSES Sternfahrt Expeditions of the Research Vessels ALBIS, LITTORINA, LUDWIG PRANDTL, MYA II and UTHÖRN to the Elbe River, Elbe Estuary and German Bight in 2020, edited by Ingeborg Bussmann, Norbert Anselm, Holger Brix, Philipp Fischer, Götz Flöser, Felix Geissler, Norbert Kamjunke

750 (2021) International Online Symposium: Focus Siberian Permafrost – Terrestrial Cryosphere and Climate Change, editorial board: Pfeiffer EM, Vybornova O, Kutzbach L, Fedorova I, Knoblauch C, Tsibizov L & Beer C

749 (2021) Russian-German Cooperation: Expeditions to Siberia in 2019, edited by Matthias Fuchs, Dmitry Bolshiyanov, Mikhail Grigoriev, Anne Morgenstern, Luidmila Pestryakova, Leonid Tsibizov, and Antonia Dill

748 (2020) Das Alfred-Wegener-Institut in der Geschichte der Polarforschung: Einführung und Chronik, 2., erweiterte und überarbeitete Auflage, von Christian R. Salewski, Reinhard A. Krause, Elias Angele

747 (2020) Reconstruction of paleo sea ice and climate dynamics based on highly branched isoprenoids at the Western Antarctic Peninsula, by Maria-Elena Vorrath

746 (2020) Deutsche Südpolar-Expedition 1901-1903 Sport Kleidung und Ausrüstung für Schlittenreisen, herausgegeben von Cornelia Lüdecke, basierend auf einem Manuskript von Hans Gazert, Beiträgen von Expeditionsteilnehmern und anderen Zeitgenossen

745 (2020) Expeditions to Antarctica: ANT-Land 2019/20 Neumayer Station III, Kohnen Station, Flight Operations and Field Campaigns, edited by Tanja Fromm, Constance Oberdieck, Thomas Matz, Christine Wesche

744 (2020) The Expedition AF122/1 Setting up the MOSAiC Distributed Network in October 2019 with Research Vessel AKADEMIK FEDOROV, edited by Thomas Krumpen and Vladimir Sokolov

ALFRED-WEGENER-INSTITUT
HELMHOLTZ-ZENTRUM FÜR POLAR-
UND MEERESFORSCHUNG

BREMERHAVEN

Am Handelshafen 12
27570 Bremerhaven
Telefon 0471 4831-0
Telefax 0471 4831-1149
www.awi.de

HELMHOLTZ