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Russian-German Cooperation SYSTEM LAPTEV SEA:
The Expedition LENA 2008

Edited by
Dirk Wagner, Paul Overduin, Mikhail N. Grigoriev,
Christian Knoblauch and Dimitry Yu. Bolshiyanov

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Russian-German Cooperation SYSTEM LAPTEV SEA:

The Expedition LENA 2008

by the participants of the expedition

edited by Dirk Wagner, Paul Overduin, Mikhail N. Grigoriev, Christian Knoblauch and Dimitry Yu. Bolshiyanov

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Team 3 of the Expedition LENA 2008 – *Mathias Ulrich, Frank Günther, Sebastian Rößler, Anne Morgenstern, Fabian Beermann, Sebastian Zubrzycki*

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The Russian-German Expedition LENA 2008 was a successful and memorable field campaign in the Siberian Arctic. Within the scope of the Russian-German Cooperation we continued our research on permafrost related processes and on the microbial world in extreme environments. LENA 2008 brought up new ideas for the continuation our long-term ecological studies, especially during the pilot expedition from 9-21 August, where coastal scientists were introduced to the Lena Delta and inshore coasts of the Laptev Sea.

The expedition LENA 2008 would not have been possible without the help and support of all our colleagues and friends in Moscow, St. Petersburg, Yakutzk and Tiksi. We wish to thank *Dimitri V. Melnitschenko*, *Alexander Y. Gukov* and all the people from Tiksi. Our special gratitude goes to *Alexander Y. Dereviagin* and *Mikhail N. Grigoriev* for their benefit in Moscow and Yakutsk.

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1. Introduction

Dirk Wagner and Dimitry Yu. Bolshiyanov

The Laptev Sea and its hinterland – especially the Lena Delta – is one of the key regions for the understanding of the dynamic of the Arctic climate system. On the basis of previous investigations of the Russian-German Cooperation SYSTEM LAPTEV SEA 2000 (1998-2002) many results for the climate reconstruction of the late Quaternary and the understanding of the modern permafrost system in the Siberian Arctic were obtained and presented in a collection of papers (e.g. Rachold, 2002; Andreev et al., 2004; Kobabe et al., 2004; Schirrmeister et al., 2003; Hubberten et al., 2004; Wagner et al., 2005; Gilichinsky et al., 2007). The investigations indicate the close interaction of the coupled land-ocean system of the Laptev Sea with the Siberian hinterland. The present knowledge shows that environmental changes in this area do not only affect the Arctic region but also contribute to variations in the global climate system.

Within the framework of the Russian-German cooperation several expeditions to the Lena Delta, the Laptev Sea coastal region and the New Siberian Islands have been carried out since 1998 (e.g. Rachold and Grigoriev, 1999; Pfeiffer and Grigoriev, 2002; Grigoriev et al., 2003; Schirrmeister et al., 2004; Wagner and Bolshiyanov, 2006; Boike et al., 2007). Based on the experience and results of more than one decade of successful research in the Lena Delta region, the main focus of the 11th expedition was on trace gas flux measurements (CH_4, CO_2), on the relationships of structure and function of microbial communities involved in carbon fluxes, on water and energy balances, and on hydrobiological and geomorphological processes. The scientific work was carried out by five interdisciplinary teams of 10 Russian and 19 German scientists from spring to autumn 2008.

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2. Expedition Itinerary

Dirk Wagner and Dimitry Yu. Bolshiyanov

Within the framework of the expedition LENA 2008 five teams worked from the middle of May until the beginning of September on Samoylov Island, Siberia (N 72°22, E 126°28). The interdisciplinary team included microbiologists, molecular ecologists, soil scientists, geologists, geomorphologists, geocryologists, hydrologists and hydrobiologists (Table 2-1). Their research was focused on modern processes in the Lena Delta.

Table 2-1: List of participant.

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IL: Sukachev Institute of Forest, Russian Academy of Science, 660036 Akademgorodok, Krasnoyarsk, Russia

LDR: Lena Delta Reserve
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PIY: Permafrost Institute, Russian Academy of Science, 677018 Yakutsk, Yakutia, Russia

YU: York University, Toronto, ON M3J 1P3, Canada

Team 1 (July 7 – August 4, Samoylov):

Team 1 continued the long-term measurements of methane emission from low-centred ice-wedge polygons, which started in 1999. Furthermore, it concentrated on microbiological studies of carbon and nitrogen cycling microorganisms in permafrost-affected soils, micrometeorological and hydrological investigations of the permafrost landscape, and long-term studies on the zooplankton composition in tundra lakes (➔ Chapters 3, 4, 5, 7 and 10).

Team 2 (August 3 – September 1, Samoylov):

Team 2 carried on the investigations began by Team 1. Furthermore, the hydrology and geomorphology of the Lena River were studied (➔ Chapters 3, 4, 5, 6, 7 and 12).

Team 3 (August 3 – September 1, Kurungnakh):

Team 3 concentrated on investigations of periglacial surface features and landscape evolution on Ice Complex deposits in the southern central Lena Delta (➔ Chapter 8 and 9).

Team 4 (September 1 – October 13, Samoylov):

Team 4 continued the micrometeorological long-term measurements and the hydrological investigations of the permafrost landscapes (➔ Chapters 7).

Team 5 (August 3 – August 18, Bykovski Peninsula):

Team 5 carried out field studies on coastal dynamics and on marine permafrost distribution (➔ Chapter 11 and 13).

The expedition was coordinated by Prof. H.-W. Hubberten (AWI Potsdam), Prof. D.Yu. Bolshiyanov (AARI, St. Petersburg) and Prof. M.N. Grigoriev (PIY, Yakutsk).

The report contains contributions of the participants. The authors are responsible for content and correctness.

3. Methane Fluxes and Microbial Community Analyses in Permafrost Environments of the Lena Delta

3.1 Functional Microbial Ecology of Methanogenic Archaea and Methane-Oxidizing Bacteria on Kurungnakh Island

Christian Knoblauch, Susanne Liebner, Anna Urban, Svetlana Evgrafova, Irina Grodnitskaja and Dirk Wagner

3.1.1 Background

Northern-latitude soils play a particular role in the global methane cycle because they contain one third of the global organic carbon pool (Post *et al.*, 1982). One third of northern-latitude soils are underlain by permafrost (Zhang *et al.*, 1999), and only a shallow surface layer (the active layer) thaws during the short summer period. These soils are characterized by the accumulation of organic matter, anaerobic carbon turnover, and methane production. The effects of the observed and predicted climate changes will be stronger in the Arctic than the global average, and warming over the land in the Arctic north is expected to be twice as high as the global mean. As a result, increasing methane emissions from Arctic wetlands are expected (Wuebbles and Hayhoe, 2002). The most important sink for methane in wetland soils is the activity of aerobic methane-oxidizing bacteria, which use methane as their sole energy and carbon source. Depending on environmental conditions, methanotrophic bacteria may oxidize more than 90% of the methane produced before it reaches the atmosphere (Roslev and King, 1996; Popp *et al.*, 2000). Hence, the methane flux from soils to the atmosphere is a function of the microbiological processes methane production and methane oxidation. Recent studies indicate that methane turnover in permafrost soils is conducted by highly adapted microorganisms that differ from those in temperate environments (Liebner and Wagner, 2006; Knoblauch *et al.*, 2008). To identify the microorganisms involved in the methane cycle in permafrost soils, we labeled their membrane lipids (PLFA, PLEL) and their DNA using specific ^{13}C-labelled substrates. Furthermore, potential activities of methanogenesis and methane oxidation were measured at the research station on Samoylov.

3.1.2 Field Experiments and Methods

Field site and sampling

Two low centred polygons on the island Kurugnakh were sampled, one at the bottom of a large Alas, the second on the plain of the ice complex (Figure 3-1).

Figure 3-1: Position of the sampling sites on Kurugnakh Island.

At each site two soil profiles were sampled, one in the centre of the polygon and one on the rim (Table 3-1). During sampling, a soil monolith was retrieved by a spade and subsamples were taken each 5 cm and transported to Samoylov for further experiments. To investigate methane turnover in undisturbed soil samples profile 3 (Kur3) was sampled using stainless steel cylinders that were pushed by hand from the soil surface to the permafrost (35cm). Subsequently the cylinders were retrieved by a spade and sealed at the bottom by rubber stoppers. Finally they were transported to Samoylov in upright position for further experiments. Soil temperature profiles were measured at all sampling sites.

Table 3-1: Description of the four profiles sampled on Kurugnakh.

site	Alas (72°19N, 126°13E)		plain (72°19N, 126°15E)	
profile	Kur1 (centre)	Kur2 (rim)	Kur3 (centre)	Kur4 (rim)
great soil group*	Fibristel	Aquiturbel	Fibristel	Aquiturbel
water level (cm below soil surface)	0	> 19	0	> 22
depth of permafrost table (cm)	24	19	35	22

* according to (USDA, 2006)

As a reference site, in the rim and the centre of a polygon on Samoylov (Liebner and Wagner, 2006) mixed and undisturbed soil samples were retrieved as described above.

Aerobic carbon mineralization

Aerobic carbon mineralization was quantified using mixed samples incubated at Samoylov. Therefore, 25g of fresh soil were weighted into 250 ml glass flasks that were sealed with black rubber stoppers. Subsequently methane was added to the headspace of the samples to give a final concentration of approx. 2000 ppm (v:v). All samples were incubated at 3°C. Methane and CO_2 concentrations were measured repeatedly and the rate of methane oxidation and CO_2 production was calculated from the linear decrease of methane and the linear increase of CO_2 in the headspace of the samples.

Anaerobic carbon mineralization

Methane and CO_2 production was measured under anaerobic conditions in batch incubations as described above. In contrast to the aerobic incubations, the gas in the bottles was exchanged against pure nitrogen to establish anoxic conditions and no methane was added. Methane and CO_2 concentrations were measured repeatedly and gas production rates were calculated from the linear increase of CO_2 and methane in the headspace of the samples.

Stable isotope probing (SIP) of methane oxidisers

Methane oxidising microorganisms in profile Kur3 and the polygon on Samoylov were labelled with ^{13}C by incubating 25g of mixed sample aerobically as described for aerobic carbon mineralization measurements (sea above). Pure $^{13}CH_4$ was added to the headspace of the sample (approx. 1,400ppm in air). After the methane concentration fell below 500ppm, the samples were frozen for further analysis of the stable isotope composition of microbial PLFA in Germany.

For labelling DNA of methane oxidisers, 5g of mixed sample from the profiles Kur3 and the polygon on Samoylov (Liebner and Wagner, 2006) were incubated in 120 ml glas bottles under an atmosphere of approx. 5% pure $^{13}CH_4$ in air. After 5 weeks incubation the experiment was stopped, and the samples were deep frozen for further analysis of the labelled DNA in Germany.

Stable isotope probing (SIP) of methanogens

For labelling DNA of methanogenic archaea, 20 g of mixed sample from the Kur3 Profile and the sampled polygon on Samoylov were weighted into 120 ml bottles. Subsequently, 20 ml of anaerobic sterile demineralised water was added, the flasks were closed by rubber stoppers and the headspace was exchanged against pure N_2. Finally, either 20ml H_2 plus 4 ml $^{13}CO_2$, or ^{13}C-acetate (final concentration 500µmol) were added. After about four weeks, all samples were deep frozen for further analysis of the labelled DNA in Germany.

Extraction of dissolved organic matter

The dissolved organic matter (DOM) was extracted from soil samples of the four profiles (Kur1-4) studied on Kurugnakh. Therefore 9g of fresh sample were weighted into 100ml glass flasks, 45 ml distilled water was added, the flask closed and shaken on a rotary shaker for one hour. Subsequently the extract was filtered (Gelman 0.47µm, Supor 450) under nitrogen (1 bar overpressure) and the filtrate deep frozen for further analysis in Germany.

Profiles of soil methane and CO_2

To quantify the concentration of trace gases in profiles of the four sampling sites on Kurugnakh, two different methods were applied. From the water saturated profiles Kur1 and Kur3 a soil monolith was retrieved with a spade and from every 5 cm layer between the surface and the permafrost table a subsample was taken with a serrated knife. Subsequently the subsample (approx. 50g) was placed in a 250 ml glass bottle containing 55 ml of saturated NaCl. The Bottle was closed with a rubber stopper and shaken vigorously. Gas concentration in the soil solution was calculated from the gas concentration in the headspace of the bottle and the amount of pore water in the sample.

Gas concentrations in the well drained profiles Kur2 and Kur4 were measured in gas samples directly retrieved from the soil pores in the respective depth using a syringe connected to a 40 cm long needle. The gas sample was injected into a glass tube replacing a saturated solution of NaCl. Gas concentrations were calculated in the soil pore water using the Bunsen coefficients for methane and CO_2 solubility in water.

3.1.3 Preliminary Results

Depth profiles of CH_4 and CO_2

Methane and CO_2 concentration showed a clear trend in all sampled soils (Figure 3-2) with highest concentrations close to the permafrost table and lowest at the soil surface. Highest gas concentrations were found in the two water saturated profiles Kur1 and Kur3 in the centre of the sampled polygons with maximum concentrations of 9.8mM and 0.89mM for carbon dioxide and methane respectively at the bottom of profile Kur 3. In the two well drained rim profiles (Kur2, Kur4), methane concentrations were very low throughout the whole profile, indicating the absence of methanogenesis.

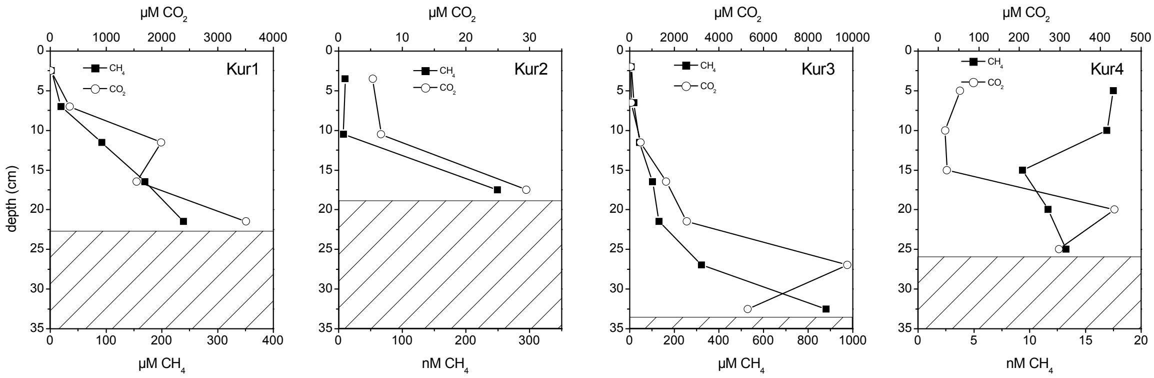


Figure 3-2: Methane and CO_2 concentrations in pore water of the studied profiles.

Aerobic carbon mineralization

The mineralization of organic matter in the two sampled sites (Figure 3-3) showed similar patterns in all studied profiles. Carbon dioxide production was always highest at the soil surface and decreased towards the permafrost table. At both sites CO_2 production was higher in the water saturated soils of the polygon centre than in the rim of the profiles. Significant methane oxidation rates were only found in the water saturated soils of the two polygon centres with maximum values in the uppermost 10 cm. In the soils of the rim, where no elevated methane concentrations were present, very low (potential) rates of methane oxidations were observed, indicating a minor importance of the methane cycle in the rims of the polygons.

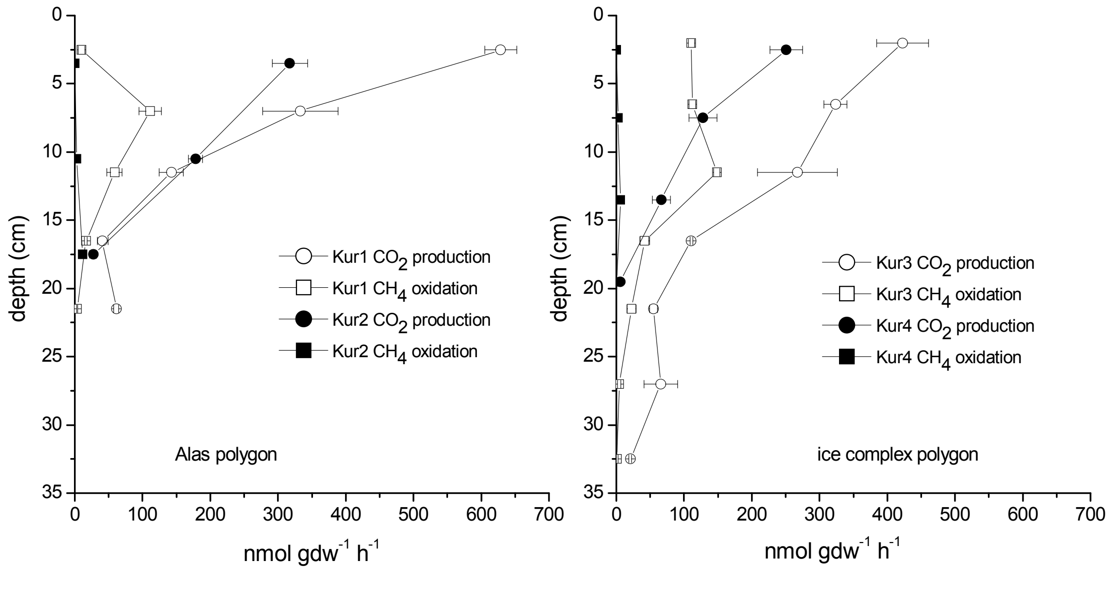


Figure 3-3: Depth profiles of CO_2 production (circles) and CH_4 oxidation (squares) in the centre (open symbols) and the rim (closed symbols) of the two polygons sampled in the Alas depression and on the plain of the ice complex.

3.2 Methane Production and Consumption in Polygonal Tundra Environments of the Lena Delta, Siberia: Linking Microbial Function and Methane Fluxes

Susanne Liebner

3.2.1 Introduction

The project, which was carried out in the frame of a "DAAD Postdoc-Programm-Forschungsstipendium", aims at understanding the sources and sinks of methane in soils of the polygonal tundra on Samoylov Island. During the last years, molecular studies that were carried out on methane oxidizing bacteria (MOB) and methanogenic archaea (MA) were mainly DNA based (Ganzert et al. 2007, Liebner & Wagner 2007, Liebner et al. 2009) and did not distinguish between metabolically active and passive microorganisms. Also, methane fluxes thus far were solely measured above the ground (Kutzbach et al. 2003, Wagner et al. 2003, Wille et al. 2008, Sachs et al. 2008). Little is, however, known about the subsurface fluxes of methane and our understanding on the zones of methane production and methane oxidation remains vague. The main objective of this study, therefore, is to link microbial function and methane fluxes in polygonal tundra sites from Samoylov Island. Particularly, the composition and abundance of MOB that are essentially active and directly contribute to the consumption of methane in the active layer shall be identified using stable isotope probing (SIP). In addition, pore water and pore air methane profiles were determined and shall be used for calculating methane fluxes in the active layer. To improve an understanding of the zones of methane production and consumption, this analysis was accompanied by oxygen measurements in the soil using optodes.

3.2.2 Materials and Methods

Gas Analysis

CH_4 and CO_2 were analyzed by gas chromatography using an Agilent 7890 gas chromatograph (Agilent Technologies, Germany), equipped with a poraplot Q column (2 m). Helium served as a carrier (27 ml min^{-1}). Injector temperature was 75 °C and oven temperature was 40 °C. An FID detector was used at a temperature of 250 °C. Gas samples were injected with a gas tight, 500 µl Hamilton syringe.

Pore water methane profiles

Pore water and pore air methane profiles were sampled at 5 different sites within the polygonal tundra on Samoylov Island:

1. Polygon centre without *Carex aquatilis*
2. Polygon centre with *Carex aquatilis*

3. Polygon centre with *Carex aquatilis* that was cut below the water surface
4. Transition between centre and rim
5. Polygon rim

Messing tubes (ø 2mm) with three-way-stopcocks connected to their ends were installed at the different sampling sites in depth of 1-40 cm. 2 ml pore water (avoiding air bubbles) or air were extracted and injected into a 14 ml vial. The vials were pre-flushed with pure nitrogen and equilibrated to ambient air pressure. Headspace methane concentrations were determined via gas chromatography.

Stable Isotope Probing (SIP) on MOB using $^{13}CH_4$

Small active-layer cores were sampled at the rim and the centre of a low-centred polygon using sharp steel cores (ø 56 mm, L=30 cm). Three cores were sampled for both, polygon rim and polygon centre. The cores were sectioned with a sterile knife into 5 cm thick sections. Six aliquots of the depths 5-10 cm and 15-20 cm (additionally of depth 25-30 cm for the rim cores) were placed into 120 ml serum bottles and incubated at 3 and 21 °C for 4-8 weeks (depending on the activity) in an atmosphere of 4-5 % $^{13}CH_4$. Decrease of headspace methane concentrations was measured once per week through gas chromatography.

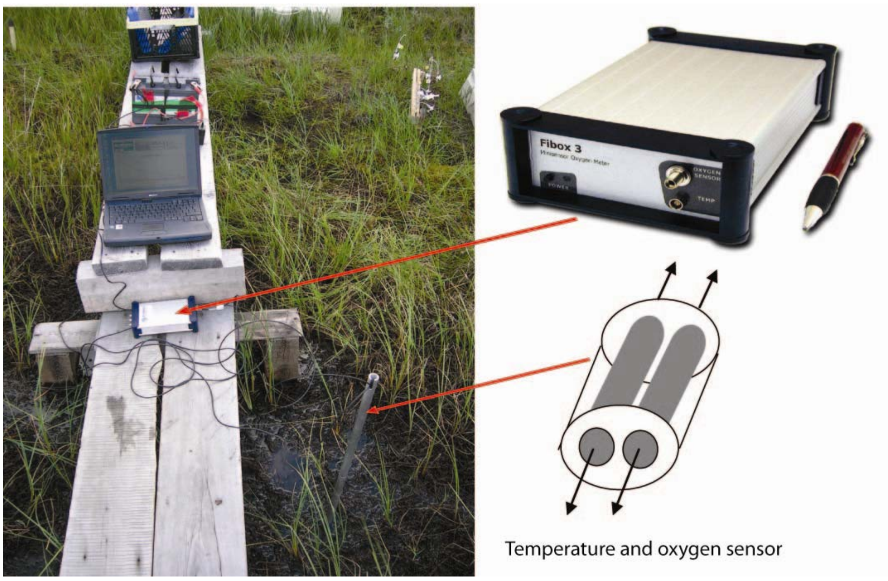


Figure 3-4: Setup of optode oxygen sensor in the field.

Oxygen profiling using Optodes

Oxygen profiles in rim and centre of a low-centred polygon were measured with a Fibox 3-trace oxygen sensor (Fa.Presens, Germany). Figure 3-4 shows setup of the instrument in the field and illustrates that measurements were compensated for temperature. Oxygen profiles were also determined in fresh active-layer cores in the laboratory.

3.2.3 Preliminary Results

Active-layer methane profiles

Gradients within the active-layer varied markedly depending on the level of *Carex* vegetation (Fig. 3-5a-c).

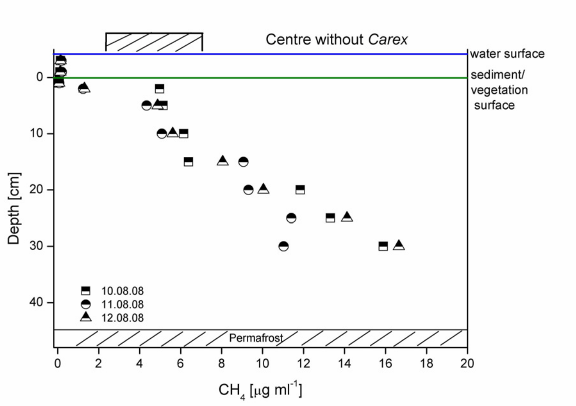
Accordingly, methane concentrations in comparable depths were twice as high in sites without *Carex* than in sites with *Carex*. Cutting of *Carex* plants below the water surface, however, did not effect methane concentrations in the deep within the week of measurements. Still, 3 days after cutting, a discontinuity in the profile was observed in 12.5 cm soil depth (Fig. 3-5c).

In the transition between centre and rim, methane concentrations varied between 0.14 µg ml^{-1} near the surface, and 1.3 µg ml^{-1} near the permafrost table (Fig. 3-5d). Gradients indicate production of methane in the transition near the permafrost table as well as between 5 and 15 cm. In between these zones a sink of methane must be expected.

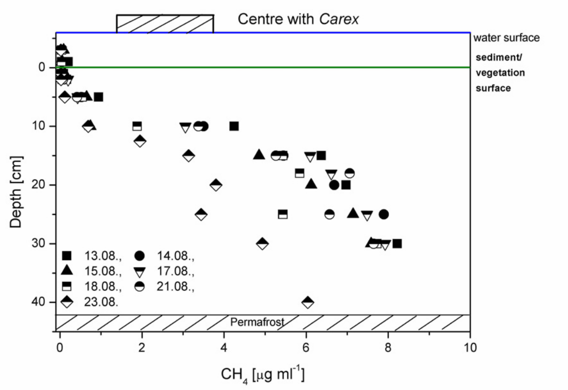
In the rim profile, methane concentrations varied between 0.03 µg ml^{-1} near the surface, and almost 7 µg ml^{-1} near the permafrost table. Above the water table (30 cm depth), methane concentrations decreased rapidly (Fig. 3-5e).

DNA-SIP Incubations

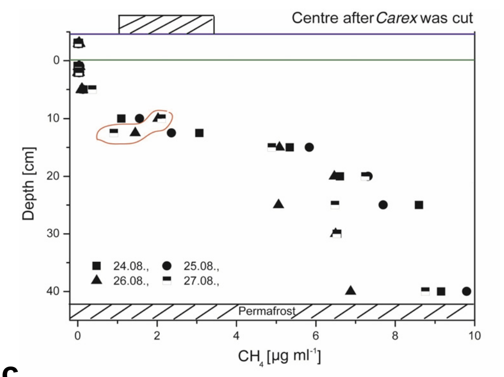
In total, 30 $^{13}CH_4$ labeled methanotrophic enrichments were obtained, 12 for the polygon centre and 18 for the polygon rim. Methane oxidizing activity of these enrichments is illustrated in Figure 3-6.



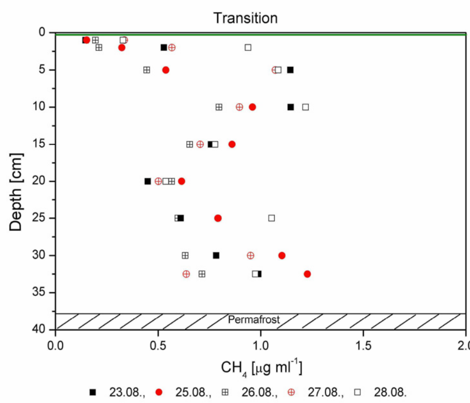
a



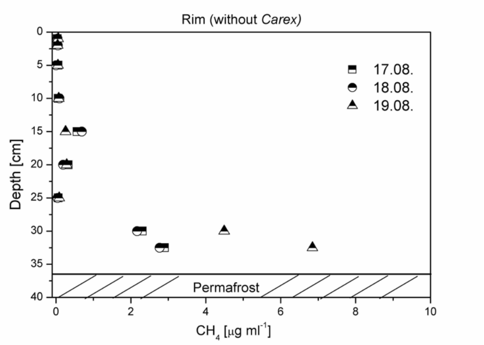
b



c



d



e

Figure 3-5: Pore water (a-d) and pore air (e) methane profiles in the active-layer of **a)** a polygon centre without *Carex*, **b)** polygon centre with *Carex*, **c)** polygon centre after *Carex* was cut below the water surface, **d)** transition between polygon centre and rim and **e)** polygon rim.

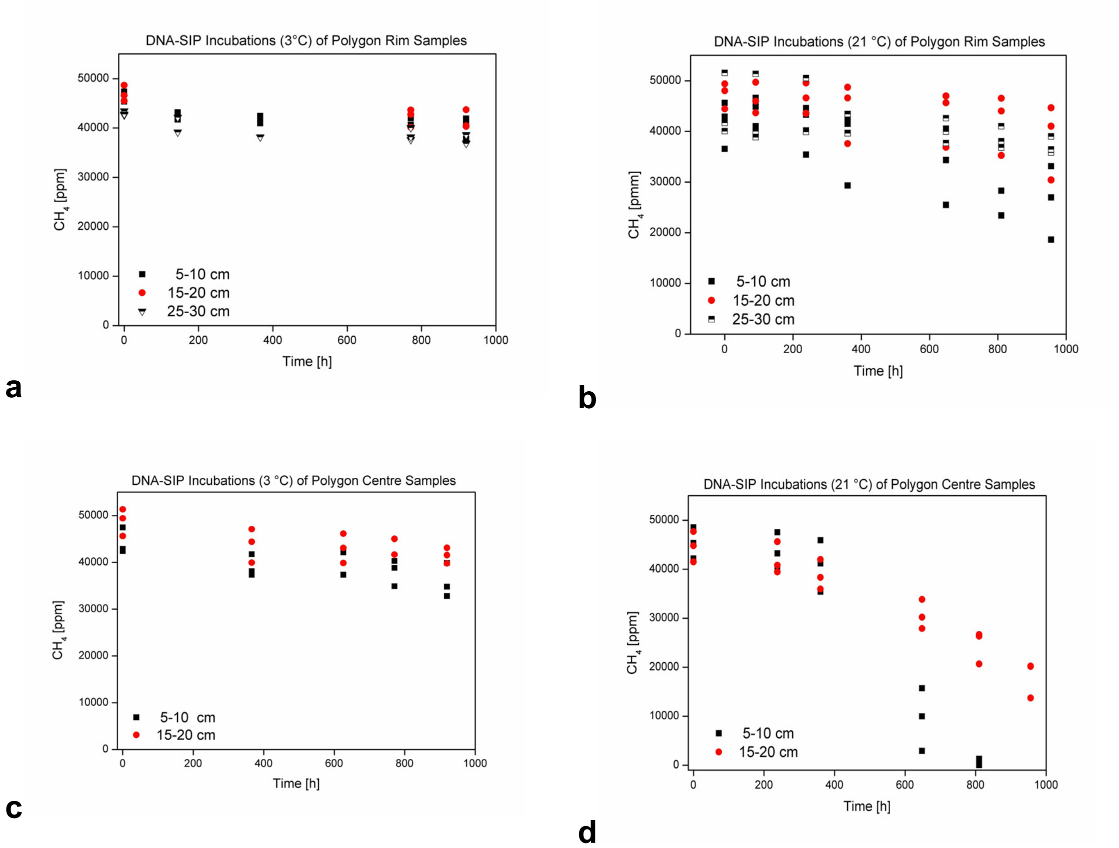


Figure 3-6: Oxidation of $^{13}CH_4$ in active-layer samples from **a)** polygon rim at 3°C, **b)** polygon rim at 21°C, **c)** polygon centre at 3°C and **d)** polygon centre at 21°C.

Oxygen profiles

Oxygen profiling in situ was not successful due to the high drift of the optode sensor. This drift was most likely a result of diffusion barriers caused by turbulent oxygen fluxes (centre) or by soil particle clogging (rim) at the sensor tip. Consequently, oxygen profiling was only performed in active-layer cores in the laboratory. Little channels were pre-drilled into these cores so that clogging of the sensor, for example, could be prevented.

Figure 3-7 shows an example of an oxygen profile in a centre core that was waterlogged and had a moss layer at the vegetation surface. Within this moss layer (1-7.5 cm), the production of oxygen could be observed. Below 7.5 cm oxygen got depleted.

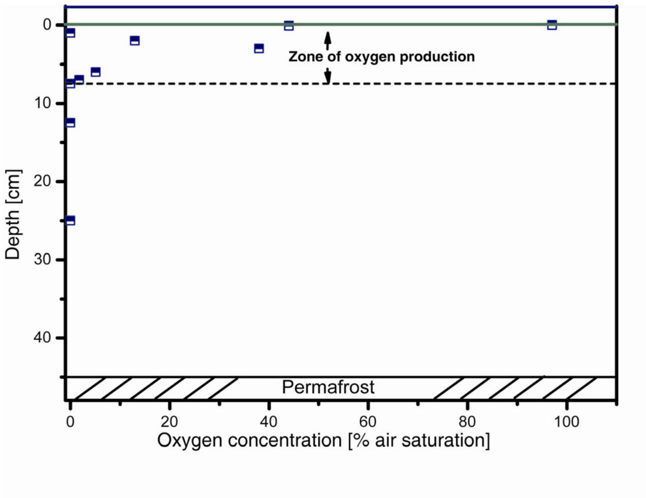


Figure 3-7: Oxygen profile in an active-layer core of a waterlogged polygon centre.

3.3 Long-term Studies on Methane Fluxes from Low-center Ice-wedge Polygons

Dirk Wagner, Katharina Koch, Irina Grodnitskaja, Susanne Liebner and Svetlana Evgrafova

Daily measurements of net methane (CH_4) fluxes, thaw depth, water level and soil temperature were carried out from the middle of July to the beginning of September 2008 at the low-centre polygon site. This investigation pertained to an ongoing long-term study of trace gas emissions, which started in 1998. The flux measurements were determined using five static chambers (PVC transparent, 12.5 l) for the polygon rim and depression, respectively. The chambers consisted of a 50 x 50 cm stainless steel base installed permanently 15 cm into the active layer. Water filled channels on top of the steel base provided airtight seals of the chamber components. Each chamber was fitted with four ports connected with two perforated pipes fixed inside the chamber. Chamber headspace was sampled over 30 min by pumping headspace air through a gas collecting jar connected with gastight tubes. CH_4 fluxes were calculated from the chamber volume and the linear increase in CH_4 concentration.

CH_4 concentrations were determined with a gas chromatograph (Agilent) in the field laboratory (Hubberten et al., 2006). The instrument was equipped with a Poraplot Q stainless steel column, which operated with pure helium as carrier gas at a flow rate of 20 ml min^{-1}. CH_4 was analysed by a flame ionization detector. The injector/detector temperatures were set at 160 °C and the column oven at 80 °C. All gas sample analyses were done after calibration of the gas chromatograph with standard gases. The detailed analysis of the data set is in progress.

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4. Nitrogen Fluxes in Different Permafrost Soils of Samoylov Island, Lena Delta

Claudia Fiencke, Tina Sanders and Eva-Maria Pfeiffer

4.1 Introduction

Most of the nitrogen (N-) transformations in ecosystems are carried out exclusively by highly specialized microorganisms (e.g. N-fixing bacteria, nitrifiers, denitrifiers). Although the N-cycling in soils is well studied under temperate conditions, little is known about the control of element fluxes in Arctic permafrost soils and diversity of participating microorganisms. Transformation of nitrogen in the soil is crucial for growth of plants and microorganisms. Imbalances in N-cycling are due to nitrate leaching, the release of the climate relevant gas nitrous oxide (N_2O) and increase the methane emission (Adamsen & King, 1993; Carini et al., 2003).

Nitrogen in Arctic ecosystems is dominated by physical and biogeochemical controls which are unique to the generally cold-dominated environment. Drastic seasonal fluctuations in temperature, a short growing season, cold soil temperature and the occurrence of permafrost are some of the obvious physical controls on nitrogen cycling and biological activity. Most of the nitrogen accumulates in the organic substance in response to low soil temperatures, excessive soil moisture and low soil oxygen concentration (Gersper et al., 1980, Marion & Black, 1987; Nadelhoffer et al., 1991, Schimel et al., 1996). Standing crop in tundra vegetation store about two times more nitrogen than temperate grasslands (Van Cleve & Alexander, 1981) but through the low N-mineralization rates and lack of N-input by N-fixation and N-pollution the soils are nitrogen deficient and rely to a large extent on internal recycling (McCown, 1978).

One part of the N-transformation, the aerobic nitrification (microbiological oxidation of ammonia to nitrate via nitrite), occupies a central position within the terrestrial nitrogen cycle. Ammonia oxidation is carried out by aerobic chemolithoautotrophic ammonia oxidizing bacteria (AOB) and archaea (AOA) (Fiencke et al., 2005, Leininger et al, 2006). Formerly, AOB were described as dominant nitrifying organisms, but the recent discovery of AOA led to the hypothesis that they dominate the ammonia oxidizing community in some habitats (Leininger et al., 2006; Herrmann et al., 2008; Prosser & Nicol, 2008). Nitrite formed by ammonia oxidizing organisms is oxidized further to nitrate by nitrite oxidizers (NOB) (Fiencke et al., 2005). Generally, nitrifying bacteria are found in the upper layer of soils, especially the rhizosphere, where organic material is mineralized, and ammonia and oxygen are present. But the slow growth rates and difficulties in recovering pure cultures have hampered cultivation-dependent approaches to investigate the quantity, community composition and dynamics of nitrifiers in soil. The nitrate formed by nitrification is reduced by anaerobic denitrifying bacteria to nitrogen oxides e.g. nitrous oxide (N_2O) (Conrad, 1996). Emission of N_2O is of major importance for global warming and microbial processes in soils contribute about 70 % to the atmospheric budget of N_2O (Dickinson & Cicerone, 1986; Conrad, 1996). Due to the supply of nitrate e.g. for denitrification, nitrification plays a key part of the nitrogen cycle in soils. It increases the availability of nitrogen for plants, nitrate leaching and volatilization of nitrogen gases.

4.2 Objectives

The main focus of our field work in 2008 was the analysis of N-transformations, especially N-mineralization, nitrification and denitrification, and determination of N-content in different permafrost soils of the island Samoylov. In contrast to our previous field analysis on N-fluxes in soils at the central polygonal plain the investigations were extended to soils of the eastern flood plain (Fiencke et al., 2007; Sanders et al., 2008).

4.3 Material and Methods

Study site

The island is composed of two different geomorphologic units, which vary in moisture regime and content of organic material in soils. The western part of Samoylov represents a modern floodplain which is inundated annually during spring flood. Its elevation ranges form 1 to 5 m a.s.l. At the lowland, samples were taken from two different sampling spots, at the beach and at the floodplain (Fig. 4-1). The alluvial soils are characterized by sandy and silty fluvial deposition with high ground water label at the beach and no water above the permafrost at the floodplain. The eastern part is composed of sediments of the Late-Holocene river terrace with elevations from 10 to 16 m a.s.l., and it is partially flooded only during extreme flooding events (Kutzbach et al., 2007). At the river terrace samples were taken from three sampling spots, the wet polygonal tundra dominated by low-centred ice-wedge polygons, the dry plain area and a cliff near the research station (Fig. 4-1).

Soil classification

Soils have been classified by Soil Taxononomy (ST) (Soil Survey Staff, 2006), World Reference Base for Soil Resources (WRB) (FAO, 2006) and the Russian classification (RS) (Elovskaya, 1987). In contrast to the new Russian Soil Classification System (Shishov et al., 2001), the old system takes into account the strong influence of cryogenic processes on the permafrost-affected soils.

Soil characterization and measurement of potential N-transformations

Soil samples for investigation on Samoylov were taken on July 15, 2008 at different depths. From the fresh samples the pH, dry weight, nitrite concentration, the potential microbial ammonia oxidizing, nitrite oxidizing and denitrification activities were determined. For further microbiological, chemical and physical analysis (e.g. mineralization activities, DGGE, C/N, c(NO_3^-), c(NH_4^+), KAK, soil texture and pores) soil samples were taken and transported under unfrozen and frozen conditions to the laboratory in Hamburg. To determine N-mineralization rates in a long time experiment, litter bag were filled with dry plant material and were buried at the river terrace especially in the soils near the station and at the polygon rim and center as described by Bocock & Gilbert (1957). Nitrite concentrations were analyzed photometrically (Garrett & Nason, 1969). The potential ammonia and nitrite oxidizing activities were measured at about 6 °C for 40 days according to ISO DIN 15685. For the methods 12.5 g of fresh soil sample was applied in 50 ml medium with 0.75 mM ammonia sulfate or 300 µm sodium nitrite. To differentiate bacteria and archaea activities, in the archaea approaches the antibiotic streptomycin (4 mg/50 ml) was added. Activities were measured by nitrite formation and consumption, respectively. Denitrifying activities were analysed by nitrate consumption in anaerobic flasks with mineral media containing 1.4 mM potassium nitrate and sucrose (100 mg/l) at about 6 °C for a period of two weeks. Taken samples were frozen and transported in our laboratories for nitrate measurements.

Figure 4-1: Corona satellite image of Samoylov Island, taken on June 22, 1964. Squares indicate investigation areas. Samples were taken from the beach, floodplain, polygonal tundra and the plain and cliff near the station.

4.4 Preliminary Results

Soils of the lowland: the beach

At the beach samples were taken about 5 m from the Lena edge (N72°22`; E126°28`). Due to annually flooding, soils were characterized by change of bright sand and dark, organic rich silt layers (Fig. 4-2). The water and permafrost table was 30 cm and 70 cm below ground, respectively. Soils have been classified as Psammentic Aquorthel (ST), Haplic Cryosol Reductaquic (WRB) and Permafrost Alluvial Layered Primitive Sandy (RS).

Figure 4-2: Site and soil profile of the Psammentic Aquorthel (ST) located at the beach of Samoylov Island. Cg=alluvial deposits with gleying properties.

In the pH-neutral soils nitrite and potential activities of nitrifiers were detected at two depths (Table 4-1). Higher potential activities were found for ammonia oxidizing archaea (AOA) than for ammonia oxidizing bacteria (AOB) in the upper part of the soils. In contrast to the upper part, in the lower part only AOB activities were measured. The comparatively lower nitrite oxidizing activities (NOB) could be a reason for the accumulation of nitrite.

Table 4-1: Pore water characteristics and potential nitrification rates measured in two soil depths (0-5 cm, 10-20 cm) of the Psammentic Aquorthel (ST) at the beach of Samoylov. The values are means of two replicates.

Depth [cm]	horizon	pH (H2O)	c (NO_2^-) [µg N/g dw]	AOB-activity [ng N- NO_2^-/ g dw x h]	AOA-activity [ng N- NO_2^-/ g dw x h]	NOB-activity [ng N- NO_2^-/ g dw x h]
0-5	Cg 1	6.9	2.0	1937	3705	883
10-20	Cg 2	7.0	2.4	1327	0	1062

The floodplain

The sampling point at the floodplain was about 150 m from the Lena edge (N72°22`; E126°28`). Due to periodically flooding, soils were characterized by layers with different content of dark organic soil material (Fig. 4-3), which were termed as buried A horizons (Ab) (Soil Survey Stuff, 2006). There was no water above the permafrost table at 74 cm. Soils have been classified as Typic Psammorthel (ST), Haplic Cryosol Oxyaquic (WRB) and Permafrost Alluvial Layered Primitive Sandy (RS).

Figure 4-3: Site and soil profile of the Typic Psammorthel (ST) located at the floodplain of Samoylov Island. Ab=buried genetic A horizon.

In the pH-neutral soils nitrite and potential activities of nitrifiers were detected at two depths (Table 4-2). Higher potential activities were found for ammonia oxidizing bacteria (AOB) than for ammonia oxidizing archaea (AOA) in both depths. Although nitrite oxidizing activities (NOB) were lower than ammonia oxidizing activities, no nitrite has accumulated.

Table 4-2: Pore water characteristics and potential nitrification rates measured in two soil depths (0-5 cm, 5-15 cm) of the Typic Psammorthel (ST) at the floodplain of Samoylov. The values are means of two replicates.

Depth [cm]	horizon	pH (H2O)[a]	c (NO_2^-) [µg N/g dw]	AOB-activity [ng N- NO_2^-/ g dw x h]	AOA-activity [ng N- NO_2^-/ g dw x h]	NOB-activity [ng N- NO_2^-/ g dw x h]
0-5	A	7.3	0	3754	107	1118
5-15	A, Ab/C	7.2	0	3849	27	1175

Soils of the river terrace: the polygonal tundra

The polygonal tundra is characterized by polygonal-patterned ground with ice-wedge growth dominated by low-centred polygons. Samples were taken from the rim and center of one polygon about 500 m northwest of the station (N72°22`, E126°29`). Due to the high permafrost table at 24 cm below ground at the rim and at 22 cm at the center, soils were characterized by high moisture and accumulation of peat. The water level was found at the surface of the center and at the permafrost table of the rim. At the rim 2 cm below ground mineral soil compounds dominated. In contrast the soil of the center consisted exclusively of soil organic material (Fig. 4-4). Soils of the polygon rim showed cryoturbation. Therefore, these soils have been classified as Typic Aquiturbel (ST), Turbic Cryosol (WRB) and Permafrost Peatish Gley (RS) (Fig. 4-4a). The soils of the polygon center have been classified as Sphagnic Fibristel (ST), Cryic Histosol (WRB) and Permafrost Alluvial Muddy-Peat Gley (RS) (Fig. 4-4b).

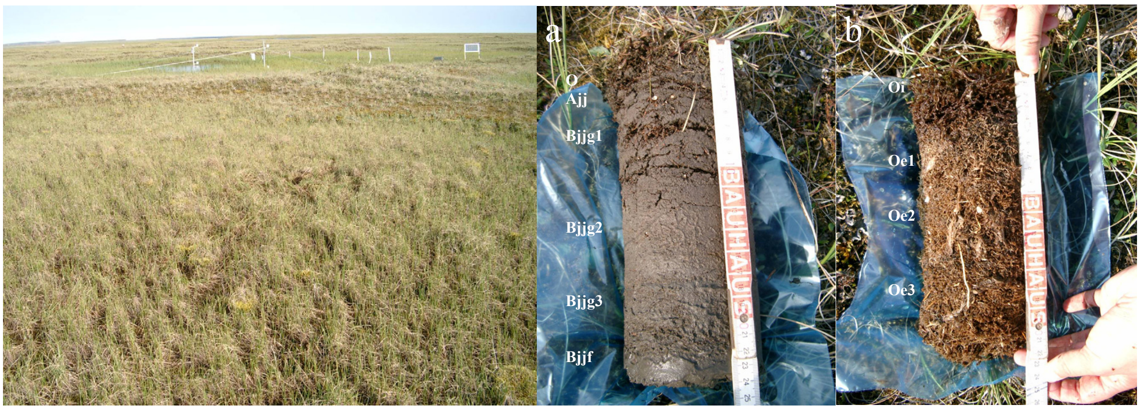

Figure 4-4: Site and soil profile of the soils of the polygonal tundra: a: Typic Aquiturbel (ST) of the polygon rim and b: Sphagnic Fibristel (ST) of the polygon center. e=organic material of intermediate decomposition, f= frozen soil, g=strong gleying, i=slightly decomposed organic material, jj=evidence of cryoturbation.

The slightly acid soils of the polygonal tundra accumulate almost no nitrite (Table 4-3). Potential bacterial ammonia oxidizing (AOB) activities were only found in depth of 5-15 cm of the polygon rim as shown before in the field experiments 2007 (Sanders et al., 2008). No archaeal ammonia oxidizing (AOA) activities were detected. Potential nitrite oxidizing (NOB) activities were measured in all depths of the rim and center. Higher activities were found at the rim than at the center and it decreased with soil depth. Nearly no nitrite accumulated.

Table 4-3: Pore water characteristics and potential nitrification rates in three soil depths (0-5 cm, 5-15 cm, 15-22/24 cm) of the polygonal tundra: polygon rim and polygon center of Samoylov. The values are means of two replicates.

Depth [cm]	horizon	pH (H2O)[a]	c (NO_2^-) [µg N/g dw]	AOB-activity [ng N- NO_2^-/ g dw x h]	AOA-activity [ng N- NO_2^-/ g dw x h]	NOB-activity [ng N- NO_2^-/ g dw x h]
Rim						
0-5	O, Ajj	6.2	0.7	0	0	979
5-15	Bjjg1	6.5	0	1206	0	338
15-24	Bjjg2	6.2	0	0	0	409
Center						
0-5	Oi	5.9	0	8	0	254
5-15	Oe1	5.6	0	0	0	246
15-22	Oe2	5.8	0	0	0	63

The soils in front of the station

The sampling point was located about 8 m in front of the station and 3 m off the cliff (N72°22`, E126°28`). Due to previous periodically flooding, soils were characterized by sand layers with different content of dark organic soil material (Fig. 4-5), which were termed as buried A horizons (Ab) (Soil Survey Staff, 2007). There was no water above the permafrost table at 55 cm. Soils have been classified as Typic Psammorthel (ST), Haplic Cryosol (WRB) and Permafrost Alluvial Layered Primitive Sandy (RS).

Figure 4-5: Site and soil profile of the Typic Psammorthel (ST) located near the station of Samoylov Island. Ab=buried genetic A horizon.

In the slightly acid soils nitrite and potential activities of nitrifiers were detected at two depths (Table 4-4). Higher potential activities were found for ammonia and nitrite oxidizing bacteria (AOB, NOB) than for ammonia oxidizing archaea (AOA) and activities decreased with depths.

Table 4-4: Pore water characteristics and potential nitrification rates measured in two soil depths (0-5 cm, 5-15 cm) of the Typic Psammorthel (ST) in front of the station Samoylov. The values are means of two replicates.

Depth [cm]	horizon	pH (H2O)[a]	c (NO_2^-) [µg N/g dw]	AOB-activity [ng N- NO_2^-/ g dw x h]	AOA-activity [ng N- NO_2^-/ g dw x h]	NOB-activity [ng N- NO_2^-/ g dw x h]
0-5	A	6.4	6.3	2300	0	1267
5-15	A, Bw	6.5	3.5	1379	91	766

The cliff

The sampling point was located at the cliff in front of the station (N72°22`, E126°28`). Soil samples were taken at depths of 1.5 and 2.5 m below the ground (Fig. 4-6). Samples at a depth of 1.5 m dominated by mineral material and at depth of 2.5 m by organic material, respectively.

Figure 4-6: Sampling point at the cliff located near the station of Samoylov Island. Samples were taken at depth of 1.5 and 2.5 m below the ground.

The pH-neutral soils of the cliff showed slight nitrite accumulation (Table 4-5). High potential bacterial ammonia oxidizing activities (AOB) were found in both depths. Higher activities were detected in a depth of 2.5 m. No activity was found for archaeal ammonia oxidation (AOA). In contrast, nitrite oxidizing activity (NOB) was found at both samples but decreased with depth.

Table 4-5: Pore water characteristics and potential nitrification rates measured in two soil depths (1.4-1.5 m, 2.4-2.5 m) of the samples taken at the cliff in front of the station Samoylov. The values are means of two replicates.

Depth [m]	horizon	pH (H2O)[a]	c (NO_2^-) [µg N/g dw]	AOB-activity [ng N- NO_2^-/ g dw x h]	AOA-activity [ng N- NO_2^-/ g dw x h]	NOB-activity [ng N- NO_2^-/ g dw x h]
1.4-1.5	-	6.7	2.1	1639	0	1369
2.4-2.5	-	6.7	0.3	2599	0	207

4.5 Conclusions

First field investigations considered only one part of the N-cycle in soils, the aerobic N-transformation of ammonia via nitrite to nitrate (nitrification). The preliminary results showed that the potential nitrification activities differed obviously depending on soil properties, namely the pH and the moisture, therefore the aerobic conditions. Nearly no ammonia and low nitrite oxidizing activities were found at the soils of the polygonal tundra, where water saturation, accumulation of organic soil material, lower pH and probable methan emission was characteristic. In contrast high nitrification activities were found in all other examined soils characterized by neutral pH, high mineral content and aerobic conditions due to low water content. Inhibition experiments gave first hints to the microorganims involved in ammonia oxidation. With one exception in all samples bacterial activity dominated. Only in soil samples of the beach archael activity outperformed the bacterial activity.

Further microbiological, chemical and physical analysis of these soil samples will contribute to clarification on N-fluxes in Arctic permafrost soils.

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5. New Data about Zooplankton Species Composition and Distribution in the Lakes of the Lena Delta

Ekatarina Abramova and Irina Vishnyakova

5.1 Introduction

The distribution of plants and animals has occupied the interest of biologists for many years. Nevertheless our knowledge about areas of distribution of many Crustaceans in Arctic is extremely limited today. The present investigation is a contribution to the faunistic of a poorly known area, the delta of the Lena River in the northern Siberia of the Russian Arctic.

The environmental conditions for organisms in Arctic freshwater ecosystems are harsh - short ice-free period, extreme seasonality and severity in temperatures, strong seasonal gradients of ultraviolet radiation, often-low nutrient and food levels and ect. Furthermore, abiotic factors undergo temporal variations that are often strong and unpredictable. Because of this, the biodiversity of freshwater organisms is generally low. The high Arctic lakes and ponds are commonly inhabited by only a few species of rotifers, cladocerans and copepods (Hessen, 2002). These high-latitude organisms are narrowly specialized to these harsh environments, but recent studies indicate that the Arctic region and its environments are undergoing notable climate changes (Morison et. al., 2000). The Intergovernmental Panel on Climate Change (IPCC) predicts that the equilibrium global mean surface temperature will increase between 1,4 and 5,8^{o}C by the year 2100. Such warming may strongly affect Arctic organisms, which have adapted to low temperatures. Thus, the organisms in the Arctic region may be viewed as sensitive indicators of global climate change. Furthermore, recent climate warming is expected to support biological invasions. Southern species will shit northward with warm river waters, and are likely to compete with northern species. Changes in species composition at northern latitudes are likely to have a top down effect on the composition and abundance of species at lower trophic levels (ACIA Scientific report, 2008).

Main goals of the biological investigations:

- The detail analysis of the modern species composition, distribution and seasonal/interunnual specific structure variations in zooplankton populations in the different water pools in the southern part of the Lena Delta;
- The analysis zooplankton species as possible bio-indicators of ecosystem variability and predictable present-day climate changes in the Arctic regions.

5.2 Material and Methods

For detailed species composition analysis 46 qualitative zooplankton samples were collected from six lakes on Samoylov Island (Fig. 5-1).

The investigated water bodies can be characterized as:

1. Lake I is situated in low part of island on the flood-land and backwaters connected to the present rivers channel. The emergent vegetation (*Arctophila sp.*) complete covers this water pool.
2. Lakes II –VI are located on the first terrace of island. The emergent vegetation, if any, is confined to the margin and it is usually *Arctophila sp.* and rarely *Carex sp.* The pelagic fauna analysis has shown, that lake II is not under the river water influence. The lakes III and IV are submitted to influence of river waters not every year. At last lakes V and VI are subject every year to influence of river waters during a spring high water.

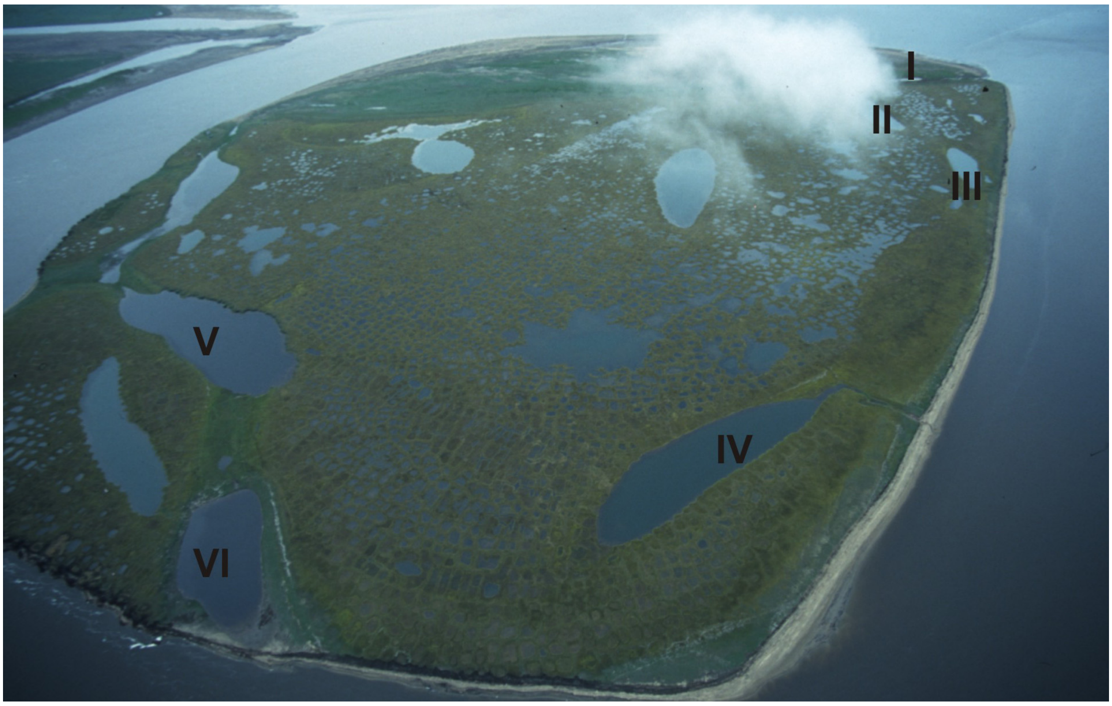

Figure 5-1: Lakes locations on Samoylov Island where zooplankton studies carried out in summer 2008 (photo G. Stoof, AWI).

Collections were made by dipping plankton net (diameter 25 cm, mesh size 100μ) among the littoral vegetation and by tossing net attached to a line out into a pond and then pulling the net slowly to the shore. Both vertical and horizontal samplings were done. Samples were preserved with 4% neutral formalin. Sample processing and detailed taxonomic investigations were carried out in the Otto Schmidt Laboratory (AARI, St. Petersburg) using binocular Olympus SZX9 and microscope Olympus BX60 with Analyzing system and drawing attachment U-DA.

In addition to the plankton sampling, pH and temperature measurements of water were made.

Table 5-1: Species composition and distribution of small plankton crustaceans in the investigated lakes on Samoylov Island.

Species	Lakes					
	I	II	III	IV	V	VI
Calanoida: Temoridae						
**Eurytemora arctica* M. Wilson and Tash, 1966	+					
**E. bilobata* Akatova, 1949					+	
E. gracilis (Sars, 1898)					+	
**E. gracilicauda* Akatova, 1949	+					+
**Eurytemora sp.new* ?					+	
Eurytemora sp. juw.					+	+
Heterocope appendiculata Sars, 1863	+				+	+
H. borealis (Fischer, 1851)		+	+			
Diaptomidae						
Eudiaptomus graciloides (Lilljeborg, 1888)	+	+		+	+	+
Mixodiaptomus theelli (Lilljeborg, 1889)	+?					
Neutrodiaptomus incongruens (Poppe, 1888)	+					+
N. pachypoditus (Rylov, 1925)	+					+
Cyclopoida:						
Acanthocyclops vernalis (Fischer, 1853)	+	+			+	
A. (Megacyclops) viridis (Jurine, 1820)	+		+		+	
C. abyssorum Sars, 1863					+	

C. furcifer Claus, 1857	+					
C. kolensis Lilljeborg,1901	+	+			+	+
C. scutifer Sars, 1863			+	+		+
C. strenuus (Fischer, 1851)				+		+
Diacyclops bicuspidatus (Claus, 1858)	+		+			+
D. bisetosus (Rehberg, 1880)					+	
Eucyclops serrulatus (Fischer, 1851)	+					+
**Macrocyclops albidus* (Jurine, 1820)	+					
Mesocyclops leuckarti (Claus, 1857)	+		+			
**Paracyclops fimbriatus* (Fischer, 1853)			+			
Harpacticoida:						
Canthocamptus glacialis Lilljeborg, 1902	+				+	
Cladocera:						
Bosmina longirostris (O.F. Muller, 1785)	+					
Chydorus sphaericus (O.F. Muller, 1785)	+					
Daphnia longispina (O.F. Muller, 1785)	+					
**Diaphanosoma brachyurum* (Lievin, 1848)	+					
**Holopedium gibberum* Zaddach, 1855	+					
**Polyphemus pediculus* (Linnaeus, 1761)	+					
**Sida crystalline* (Muller)	+					
**Simocephalus spp.*	+					

* - The new species for the lakes pelagic fauna on Samoylov Island

5.3 Preliminary Results

Monitoring zooplankton investigations have been carried out in the Lena Delta for more than the last 20 years. Abundant information has been collected about species composition and its seasonal and interunnual variations in different water pools of the Lena Delta including Samoylov Island.

An unusual situation was recorded in summer 2007-2008. Among twenty-four species of Copepoda and eight species of Cladocera which were collected in different lakes on Samoylov Island, four Calanoida species, two Cyclopoida species, and five Cladocera species were found on this island for the first time (Table 5-1). Probably, the expansion of the representatives of the boreal fauna such as *Macrocyclops albidus*, *Paracyclops fimbriatus* and five Cladocera species to the more northern regions is caused by increasing influence of the Lena river run-off during recent years. These crustaceans are quite common for water pools located about 100 km to the south from Samoylov Island. The trend of runoff increase by 10% is observed in the Lena River basin from 1936 to 2001 due to extended wet period during the second part of the last century (Berezovskaya et al., 2005).

Many faunal affinities between northern Alaska and eastern Siberia are well known. It is therefore not surprising that the small crustacean faunas of these adjacent areas also show relationships, not only with each other but with those of other arctic areas as well (Reed, 1962).

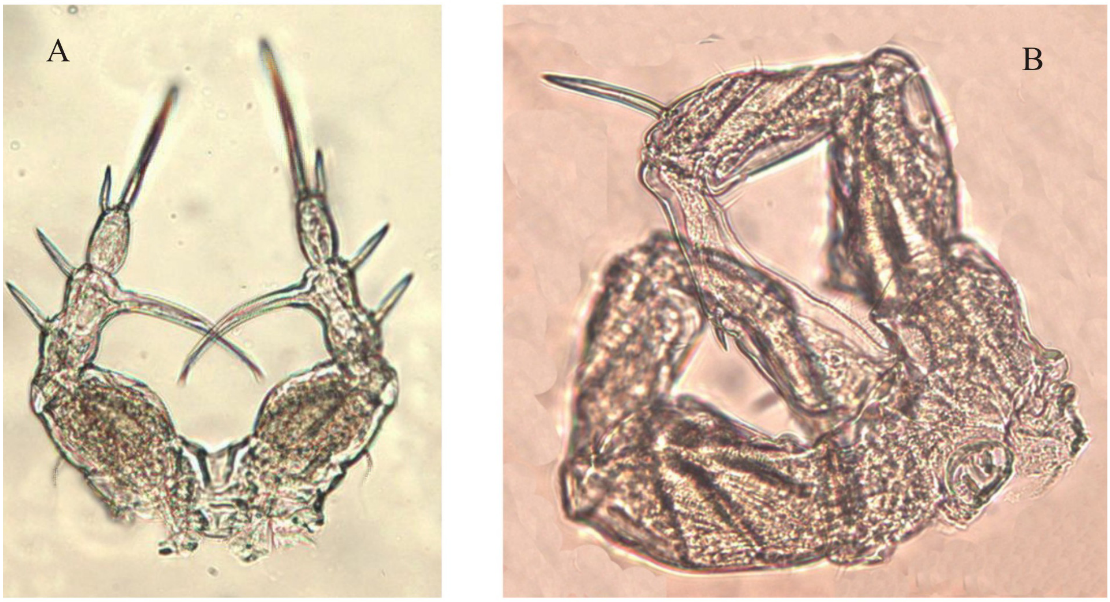

Figure 5-2: Fifth pair of legs of *Eurytemora arctica* from Samoylov: A – female; B – male.

According to the available published data, *Eurytemora arctica* is a pelagic species of fresh-water and brackish-water reservoirs in Alaska which was never recorded anywhere else (Borutskiy et al., 1991). In our samples this species (Fig. 5-2 a,b) was not abundant and was mostly represented by adult males and females in Lake I. *Eurytemora gracilicaudata* and *E. bilobata* occur in Alaska water bodies but were also reported in the Kolyma region (Borutskiy et al., 1991). The first species is quite rare in Samoylov lakes. But *E. bilobata* is very common and numerous in Lake V (Fig. 5-1). For sure, *E. bilobata* is well adapted for this lake and breeds in it as evidenced by the presence of all age stages in summer catches during the last several years. We could not identify one Eurytemora species, which looks very similar to *Eurytemora foveola* inhabiting the northwestern coast of Alaska, but there are several differences in the morphology of these two species. There is a probability that *Eurytemora sp.* is a new species to world fauna.

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6. Seasonal Variations of Nutrients (P, N, NH_4) in the Buor-Khaya Gulf and Tiksi Bay

Aleksander Yu. Gukov

6.1 Introduction

The behaviour of nutrients in the Laptev Sea is of the particular interest. From April to September dissolved silica carried by brackish water is rapidly consumed in all parts of the sea (Buynevich et al., 1980; Pivovarov and Smagin, 1995). During last 10 years of monitoring programmes the biogeochemistry of the south eastern part of the Laptev Sea have been studied and focused on the impact of inputs from Lena River. This study was performed in the Buor-Khaya Gulf and Tiksi Bay to assess the other nutrients (P, N, NH_4) characteristics at some four seasons.

6.2 Methods

Bottom and surface water samples were collected with 4-L Molchanov bottles in January, March, May, August, September and Oktober 1994 and 2008. Pilot ship Breez and research-ship Orlan was used for summer (August, September) and autumn (Oktober) sampling at each station shown in Figure 6-1. Winter was collected out of ice-hole on January, March and spring (May) sampling. Nutrient determination was carried out in the Land-based laboratori in Tiksi within a few days. The nutrients concentrations were determined in accordance with chemical methods (Morphy and Riley, 1962). Salinity was measured with ГМ-65 salinometer whose probe was attached just above the sampling bottle. The dissolved oxygen concentration was determined according to the Winkler method. Temperatures were measured with paired restricted-range low-temperature oceanographic reversing thermometers.

6.3 Results

Important modifications of the physical and chemical characteristics of the water are due to the mixing of fresh and salt water. The near Lena River mouth station (st.1) corresponds to the minimum salinity value encountered here less then 1%. The position of this station varies between Bykov Kape and Lena's Delta (Fig.6-1), according to the river flow. The influence of the Lena's discharge is spreaded in the surface water at all Buor-Khaya Bay.

Salinity of the bottom water during 1994 ranged from 3 to 26.7%. There are three layers stratification: the upper layer some water (0-9 m) occupied by turbidic transformed the Lena's water. On the depths (0-15 m) the sea waters with low turbidity are situated. The most turbid waters (with salinity about 16-20%) were near the bottom. The temperature of the bottom water during this period ranged from -1.2 to 2.3°C. In summer salinities coincided with maximum water temperatures. Maximum salinities occured in March (26.7%), while a minimum water temperatures were record during January (-1.2°C).

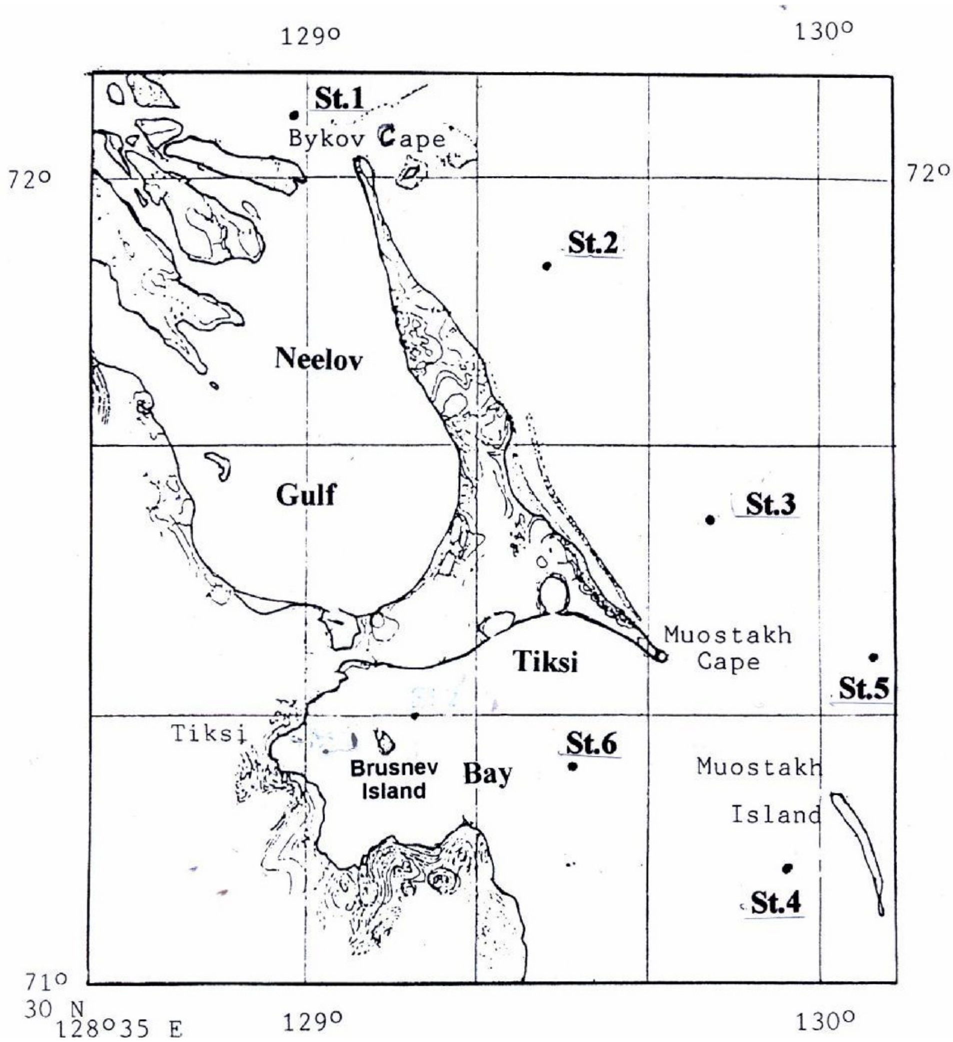

Figure 6-1: Situation of hydrochemical stations in the Buar-Khaya Gulf and Tiksi Bay.

During winter 1994, oxygen concentration at the sea surface varied only between 12.02 (st.6) and 14.88 ml/l (st.2), and the change in surfase layer saturation did not exceed 5%. The mean valve was 99.2% and standard deviation was 1.5%. Maximum oxygen saturation is usually observed near the Brusnev Island in Tiksi Bay (105-110%). In August 1994 a minimum of oxygen saturation (60%) was observed at depth of 12 m in Buor-Khaya Bay (st.5); oxygen concentration in the sufase layers during summer varied between 10.70 (st.2) and 12.37 ml/l (st.6). Seasonal variations show very different range from one nutrient to another. The largest variations were observed for total dissolved nitrogen with concentration varied in the suface layers from 0.410 mg/l in January (st.1) to 0.098 in October (st.5). Higher values occured near mouth of

Bykovskaya Branch, corresponding to higher river flow values in its place, comparison to other stations.

Mean value of nitrogen in Buor-Khaya Bay was 0.179 mg/l, in Tiksi Bay 0.242 (Tab. 6-1). The large amounts of nitrogen discharged in the Lena mouth persist in the lower part of the Bykovskaya Branch, which may be considered as partially evtrophied. Concentrations gradually decrease with increasing distance from the mouth of Bykovskaya Branch. Nitrogen is probably never limiting in the study areas. Due to nitrification in the presence of oxygen a mounts of nitrogen are always elevated. In fact, due to importance of denitrification in the deepers (anaerobic) part of Buor-Khaya Gulf, this amount would actually increase when water quality would improve to such a point that the river would aerobic near coast.

The concentrations of dissolved total phosphorus during 1994 were almost completely used upon the Lena River out flow zone. In May 1994 the meaning concentration of phosphorus in the surface layers of Tiksi Bay water was 0.010 mg/l (st.5) which is half of the bottom water concentracion at this time. During the winter dissolved total phosphorus behaves conservately, which concentration in the surface layers of Tiksi Bay water varied from 0.0074 to 0.030 mg/l and - in Buor-Khaya Gulf stations - from 0.0021 to 0.027. Maximum concentrations of about 0.64 mg/l were observed in May (st.2) in surface layer. Mean value of phosphorus in Buor-Khaya Gulf was 0.022, in Tiksi Bay 0,017.

Ammonia has the widest variation range from 0.214 mg/l in March (st.2) up to 0.009 in January (st.5). Maximum ammonia values occur in the vicinity of Muostakh Island (st.4) in central part of Tiksi Bay. Areas of high ammonia concentration commonly correspond to low dissolved oxygen values: 4 mg O/l (Sidorov and Gukov, 1992). Bottom water in the Buor-Khaya Gulf characterized by higher ammonia loads than observed in suface water. The increase of ammonia load varies between 0.016 and 0.068 mg/l for all summer and autumn samples in Tiksi Bay, exception of st.3 in August, where a remarkable stratification of waters is observed, leading to very mixed bottom water. Mean value of ammonia in Buor-Khaya Gulf was 0.045 mg/l, in Tiksi Bay 0,064.

For an estimation of a modern condition of nutrients distribution in the given area repeated researches at the same stations were carried out. Results appeared relatives on values. The maximal concentration of the total phosphorus in 2008 in a Tiksi Bay have made 0.86 mg/l, in a Buor-Khaya Bay fault 0.038, the total nitrogen, accordingly, 0.220 and 0.179. Seasonal variations in ammonia concentration are due to mineralisation in the deeper areas of Buor-Khaya Bay. Pollution of the Laptev Sea originates from various such as run-off, ship-owing and sewage effluents. Investigations of relatively polluted fresh and marine water have revialed that a decrease of the concentration of some nutrients occurs in a seaward direction. One of the most polluted part of the Laptev Sea is Bulunkan Inlet (in Tiksi Bay) (Abramova and Gukov, 1990).

Table 6-1: Nutrient characteristics of Buor-Khaya Gulf and Tiksi Bay water, collected in 1994 and 2008.

1994				
	Tiksi-Bay			
	Concentracion, mg/l			
Nutrient	mean	max	Surface water, mean	Bottom water, mean
P total	0.017	0.64	0.015	0.020
N total	0.242	0.730	0.246	0.064
NH4	0.064	0.214	0.062	0.064
Oxygen	12.35	14.88	13.65	11.05
	Buor-Khaya Gulf			
	Concentration, mg/l			
Nutrient	mean	max	Surface water, mean	Bottom water, mean
P total	0.022	0.034	0.029	0.031
N total	0.179	0.410	0.168	0.198
NH4	0.045	0.157	0.038	0.041
Oxygen	12.11	13.65	12.04	9.98
2008				
	Tiksi-Bay			
	Concentracion, mg/l			
Nutrient	mean	max	Surface water, mean	Bottom water, mean
P total	0.015	0.86	0.010	0.070
N total	0.220	0.650	0.260	0.074
NH4	0.004	0.116	0.056	0.04
Oxygen	12.55	15.0	12.96	10.95
	Buor-Khaya Gulf			
	Concentration, mg/l			
Nutrient	mean	max	Surface water, mean	Bottom water, mean
P total	0.033	0.038	0.029	0.030
N total	0.179	0.520	0.158	0.20
NH4	0.045	0.180	0.037	0.040
Oxygen	12.01	13.01	12.20	9.78

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7. Sensitivity of the Permafrost System's Water and Energy Balance under Changing Climate: A Multiscale Perspective

Moritz Langer, Niko Bornemann and Maren Grüber

Period of Fieldwork: July to October

7.1 Objectives

Main objectives during this expedition are energy and water balance processes of permafrost soils at different temporal and spatial scales at the polygonal tundra of Samoylov Island. Energy and water transfer processes are strongly affected by soil features, like water content, morphology and vegetation cover. Within the landscape of polygonal tundra these ground features vary at horizontal distances of several meters. The ground characteristics shift from dry, moss covered, mineral soils to water saturated peat soils or ponds. The polygonal tundra thus shows a high level of surface variations which are critical to energy and water exchange processes on small spatial scales. Temporal variations of soil properties like water and ice content as well as snow cover are also critical to the current energy and water transfer processes. These variations occur on temporal scales ranging from short term rain events to persisting snow cover or slow active layer melting.

The research group focuses on:

- Energy and water flux measurements at different spatial scale levels including the plot and regional scales.
- Continuous energy and water balance measurements including diurnal and annual periods.
- Mapping surface features at high spatial and temporal resolution.

7.2 Energy Flux Measurements

Three new metrological stations measuring soil heat fluxes, surface temperatures and evapotranspiration rates were installed. The new stations will give detailed data about the spatial and temporal variations of soil heat fluxes, latent heat fluxes and energy emission by long wave radiation.

A thermal infrared camera was erected on a 12 m tower, measuring high resolution soil surface temperatures (Fig. 7-1). The IR-Camera covers about 600 m² with a resolution of 10-20 cm. In conjunction with soil temperature and moisture measurements the thermographic data will be used for calculations of areal soil heat fluxes. During daytime the surface temperatures of the dry rims are generally increased compared to the wet locations. Less evident is the reverse case during nighttime when the wet locations are slightly warmer. The highest spatial temperature differences were observed during periods of clear sky conditions when radiative transfer is remarkable. The polygon rims are about 5 K warmer during midday and about 3 K colder when the sun is at its lowest position. The varying surface temperatures generally implicate spatial differences within energy transfer processes.

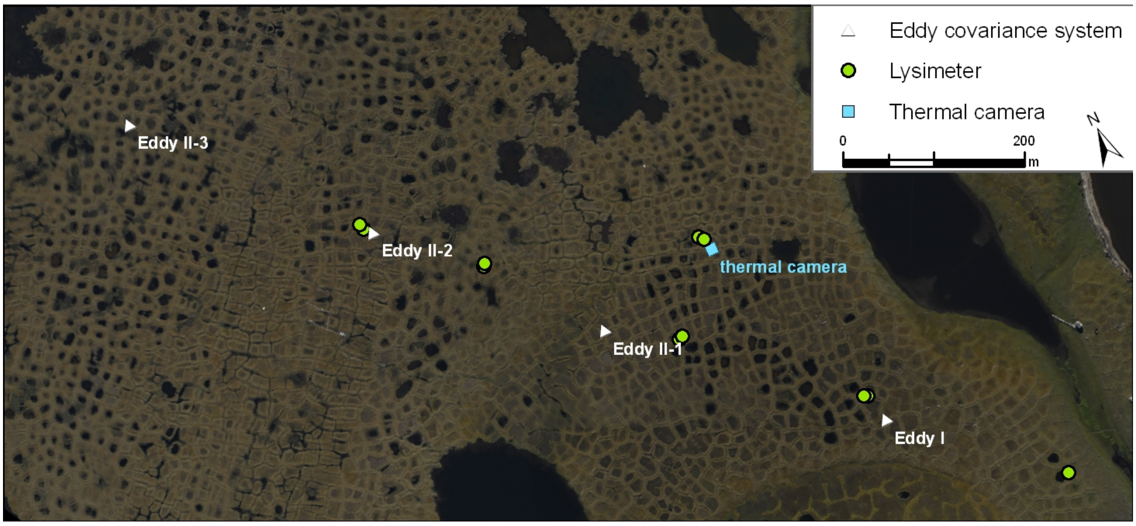

Figure 7-1: Transect of spatial distributed energy flux observations.

The first Eddy-Covariance station (erected in spring 2007) close to the west side of the island, was enhanced by a second Eddy-System. The new system was applied as a mobile station to gather simultaneous flux measurements across the island. Three different locations along a west-east transect were instrumented by the mobile system (Fig. 7-1). The first location is dominated by wet polygonal structures, while the second is characterized by dry well developed rims. The third location is situated within an area of free water bodies such as small ponds and thermo-karst lakes. The measurement period covers six weeks while the interval of data collection at the particular locations was seven days. Hence every location was passed two times by the mobile station. Differences in sensible and latent heat fluxes were observed within the wet polygonal tundra site, although landscape variations are very small. Particularly, this can be observed during clear sky conditions when differences of energy flux partitions are at maximum at dry and wet surfaces. Most evident differences in sensible heat fluxes were measured at location two, where dry surface conditions are dominant. Sensible heat flux measurements show up to 20% higher values than the reference station. Differences in latent heat fluxes could be observed at the third location, where free water bodies characterize the surrounding area. Latent heat fluxes are up to 30% lower compared to the reference station.

Two new boreholes were sunk near a large thermo karst lake. The boreholes are located within 10 m and 20 m distance from the shore and reach depths of 4 m. Frozen drill cores where taken and prepared for transportation. The drill holes were instrumented by thermocouple chains with four sensors. Further sensors were placed in the active layer next to the boreholes. The temperature data will be used to calculate the thermal effect of the thermo karst lake on the surrounding soils. First temperature observations show increasing soil temperatures towards the lake.

7.3 Water Balance Measurements

Measurement of the channel runoff

Thomson weir: This kind of the discharge measurement is used predominantly with small discharges up to 60 l/s. The control cross section of the Thomson weir consists of an equal-leg, “V” notch. The dammed up water level was measured with automatic pressure sensor and a data logger (Campbell Scientific, Inc.: CR200 Series). The actual discharge can be computed based on notch geometry and water level. During the summer season four Thomson weirs were installed at the island. One next to the station in the south-west (Fig. 7-2 AQ1), a second at the north end (Fig. 7-2 AQ2) and another at the north east coast (Fig. 7-2 AQ4). The last was build at the south east edge (Fig. 7-2 MQ1) without automatic pressure sensor. The water level was read out manually every 2-3 days.

Salt Dilution Method: Is a traditional method for measuring water discharge in turbulent streams. A defined volume of salt solution is injected at once into the stream and the dilution is measured by means of electrical conductivity in µS/cm (WTW: 340i with TeraCon 325). Through the relationship between mass of dissolved salt, electric conductivity and its temporal variation in the stream, the discharge can be computed. This method was used to calibrate the weirs.

Lake water levels: At two thermocarst lakes (Fig. 7-2 AWL2 and AWL3) the water levels were observed by automatic pressure sensors. The water levels of four other lakes (Fig. 7-2, WL1, WL2, WL4, WL5) were read out manually every two days. Additionally, electric conductivity and temperature were measured.

Polygon and groundwater level transect: Next to the thermal camera a water level transect were established to observe changes among the polygons. It consisted of two pressure sensors in polygon lakes, one in the crack between and a last in another bordering polygon lake.

Pumping trials

In the end of august two pumping trials were accomplished to survey inter polygonal connectivity. For observing water level changes two different well distinct low centre polygons were selected. For the first pumping trial two pressure sensors were installed in the centres of bordering polygons and one in the crack between. To evaluate the raised water budget, a “V” notched weir box with pressure sensor was used. The second pumping test was supplemented by electric conductivity sensors. In the beginning of the trial a solution of about 5kg salt was injected into the crack to trace the possible flow between.

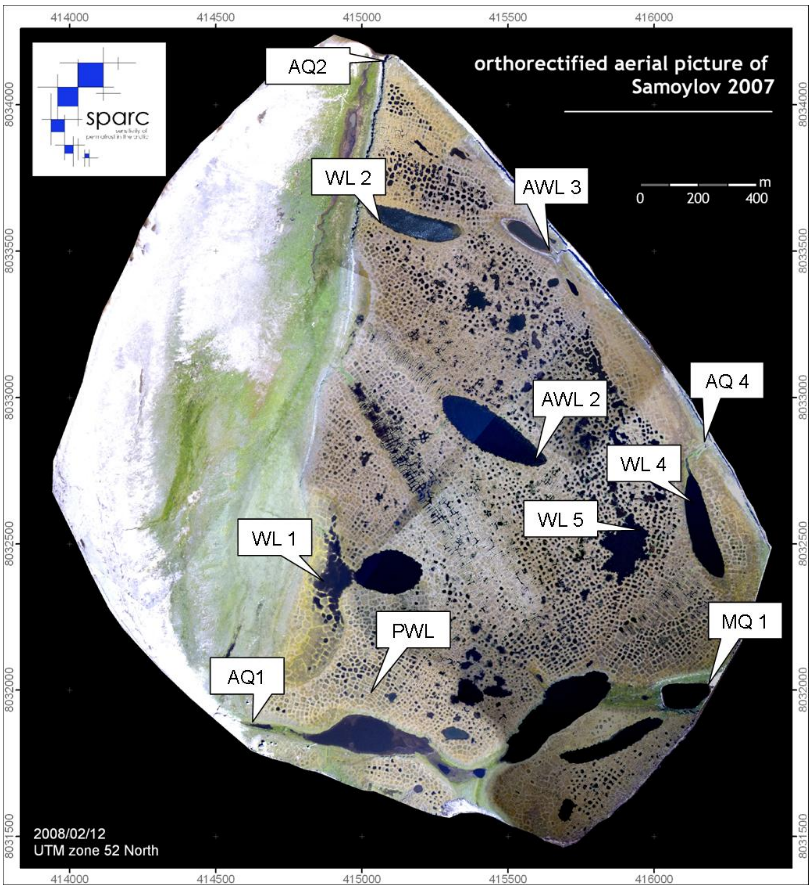

Figure 7-2: Spatial distributed water level measurements with pressure sensor.

Hydrological sampling

Water samples were taken at 6 different locations once a week from August to the end of expedition. The samples are examined for dissolved organic carbon (DOC), total organic carbon (TOC), cations, anions and dissolved gas.

Aerial and Terrestrial survey

Five aerial surveys were carried out from 01.08.2008 to 11.09.2008. This project continues the work of Marita Scheritz from the expedition in 2007. It was supplemented by an additional camera sensitive to near-infrared wavelengths and was improved by the application of two helium zeppelins instead of a balloon.

Aerial pictures were taken in visual (VIS) and simultaneously in near-infrared (NIR) spectral range. Near-Infrared wavelengths are highly reflected by chlorophyll and therefore capable for vegetation mapping.

Two cameras (Nikon D200) with 24 mm lenses were attached to the zeppelins. Low resolution images, covering the whole island, were taken from altitudes of 850 m to 1000 m. High resolution images covering an east-west transect of the island were done from altitudes of 500 m to 600 m. The corresponding ground resolutions are 40 to 50 cm² per pixel for high altitude pictures and 24 to 30 cm² per pixel for low altitude pictures.

For best picture quality aerial surveys were carried out under sunny and windless conditions. The exposure time of both cameras was chosen to be 1/400 s, with an aperture of f = 8 for VIS- and f = 7.1 for NIR-images respectively.

Already established ground control points are used for the following orthorectification of the aerial images (Scheritz et al., 2008). Twenty additional ground control points were homogeneously distributed along the east-west transect. Their positions were determined via terrestrial surveying.

Spatial distributed soil moisture and evapotranspiration measurements

Soil moisture probe and manual lysimeters were used to measure spatial and temporal variations of soil moisture and evapotranspiration. Measurements were carried out at 9 locations along the east-west transect (Fig. 7-1).

Maintenance

The already established instrumentation on soil thermal and hydrologic dynamic and micrometeorology was controlled and data retrieved. Some sensors were replaced by calibrated devices. Power supply was controlled and repaired if necessary. The unused scanner system from expedition 2007 was removed.

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8. Studies on Permafrost-affected Soils and Tundra Vegetation - Kurungnakh Island

Sebastian Zubrzycki and Fabian Beermann

8.1 Background

Permafrost-affected soils called Gelisols (Soil Survey Staff, 2006) or Cryosols (Food and Agriculture Organisation, 2006) cover nearly one fourth of the terrestrial surface in the northern hemisphere. Studies on those widespread soils have been conducted for more than 100 years (Goryachkin et al., 2004). The first studies were exploratory in nature in order to find land for agriculture. Pedoscientists study permafrost-affected soils to learn more about their active physico-chemical processes (Tarnocai, 2004).

Pedogenesis in permafrost regions takes place in the active layer above the permafrost table only during the short summer period. On the one hand, the cold conditions hinder strong pedogenesis, on the other hand, permafrost preserves records of former soil conditions.

Arctic Tundra has short growing seasons and temperatures too cold for tree growth. Underlying permafrost limits root growth. The growth forms of tundra plants include low shrubs, herbaceous perennials, grasses and sedges, mosses and lichens. Different plant communities exist within the tundra, depending on topography, soils, and other factors. Hummock tundra is dominated by grasses and sedges (notably by the hummock-forming sedge *Eriophorum vaginatum*), while the wet polygonal-tundra is dominated only by sedges (particularly by the rhizomateous sedge *Carex stans*) (Gurevitch et al., 2002).

Spatial distribution and genesis of soils as well as spatial distribution of plant communities in the southern Lena Delta provide a basis for the evaluation of the impact of environmental and climate change on permafrost landscapes.

The objectives of this field study were to characterise different types of permafrost-affected soils and to describe their properties and their spatial distribution as a preparation for a soil map of the investigated area. The vegetation-mapping was carried out to determine the factors and gradients of the spatial distribution of the plant communities.

During the last year expedition to the Lena Delta, investigations of several soil profiles have been carried out to describe soils, their properties and distribution (Zubrzycki et al., 2008). This study was continued during 2008 in a new selected study site.

The study site is located in the eastern part of Kurungnakh Island (72°20’ N; 126°18’ E). This island is situated at one of the main Lena River channels, the Olenyokskaya Channel in the southern part of Lena Delta. The Lena Delta is located in northeastern Siberia, where the Lena River cuts through the

Verkhoyansk Mountains Ridge and discharges into the Laptev Sea, which is part of the Arctic Ocean.

The Kurungnakh Island belongs to the third river terrace complex (up to 55 m a.r.l.) of the Lena Delta, which is the oldest terrace in the delta. It was formed in Middle and Late Pleistocene (Schwamborn et al., 2002, Kuzmina et al., 2003). This terrace forms autonomous islands along the Olenyokskaya and the Bykovskaya Channels. The Kurungnakh Island is located at the southeastern part of Olenyokskaya Channel (Schwamborn et al., 2002).

The climate in the Lena Delta is high-arctic with continental influence and characterized by low temperatures and low precipitation. The mean annual air temperature, measured by the meteorological station in Tiksi, which is located about 110 km to the south-east directly at the coast of the Laptev Sea, was -13.6°C during the 30-year period 1961 - 1990; the mean annual precipitation in the same period was 319mm. The average temperatures of the warmest month August and the coldest month January were 7.1°C and -32.4°C, respectively (Roshydromet, 2007), demonstrating the extreme climatic contrasts between polar day and polar night for continental polar regions.

8.2 Field Experiments and Methods

A transect from Olenyokskaya Channel in the east to a large thermokarst lake in a deep alas depression in the west with 8 points and 16 profiles was selected for the description of soils (Fig. 8-1).

This transect covers all significant geomorpholigical units of the investigated area, such as baidzharakhs (thermokarst mounds) affected by thermoerosion from cliff-side, plain surface area of the ice-complex, slopes of thermoerosion depression and the depression with their several varied elevated terraces.

A grid of the investigation area was made for spatial analysis of soils and a total of 33 points with 52 profiles described (Fig. 8-1).

Samples were collected from each layer of individual profiles for both parts of work, soil transect and soil spatial analysis.

Pedological descriptions including Munsell soil color, fresh weight, soil texture and structure, organic substance, bulk density, roots, hydromorphic features were done in the field.

Laboratory analysis on collected soil samples will be provided at the Institute for Soil Science at the University of Hamburg

The vegetation records were both taken on the transect and on the area of the alas-depression, according to the soil investigation (Fig. 8-1). Each sample-plot had an area of 0.5 x 0.5m. Lichens, Mosses and higher plants were recorded after a modified BRAUN-BLANQUET-Scale (Tab. 8-1) (Pfadenhauer, 1997). Within the polygonal tundra, two samples were taken on each spot (polygon wall and polygon centre). In the alas-depression approximately 100 spots with one or two (depending on geomorphology) sample-plots were recorded.

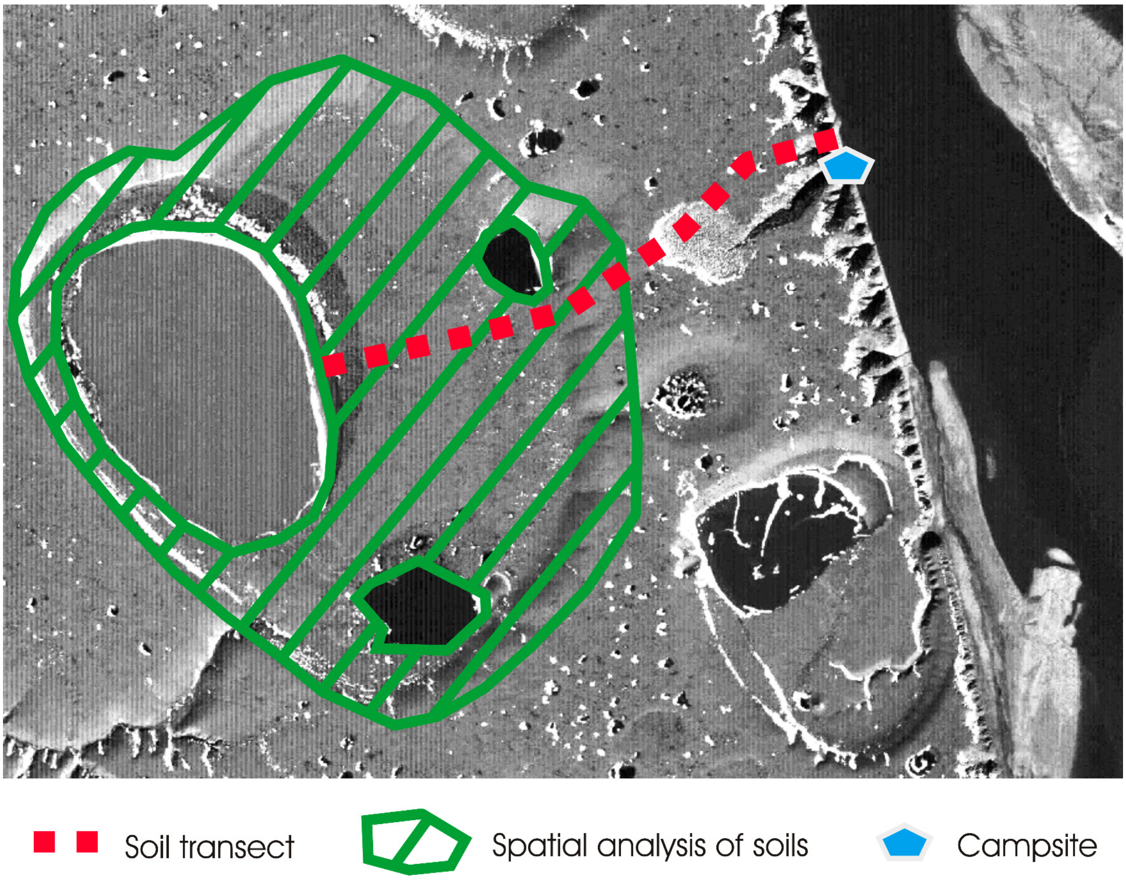

Figure 8-1: Investigation area on Kurungnakh Island.

Table 8-1: Modified BRAUN-BLANQUET-scale for vegetation records.

Symbol	Cover
r	rare, one specimen
+	few (2-5) specimen
1	up to 50 specimen, less than 5% covering
2m	over 50 specimen, up to 5% covering
2a	5% to 15% covering
2b	15% to 25% covering
3	26% to 50% covering
4	51% to 75% covering
5	76% to 100% covering

8.3 Preliminary Results

Due to field survey and field description of the investigated soil profiles, a preliminary result is that a soil-plant-complex of ground-ice rich, wet and cryoturbated Gelisols, such as Glacic and Typic Aquiturbels (Fig. 8-2) and very wet and organic rich Historthels and Histels is typical for polygonal wet sedge tundra parts of the investigation area.

Aquiturbels formed at the elevated borders of the polygons are characterized by prolonged inundation but with less organic matter accumulation and pronounced cryoturbation (Fig. 8-2).

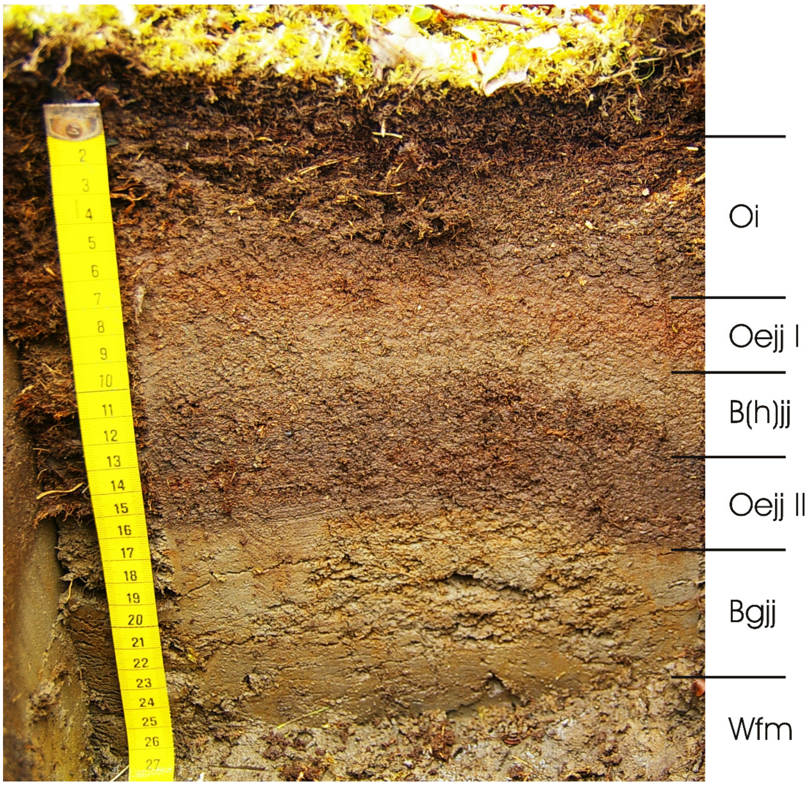

Figure 8-2: Glacic Aquiturbel from the first terrace of the alas depression. e=organic material of intermediate decomposition, f= frozen soil, g=strong gleying, h=illuvial accumulation of organic matter, i=slightly decomposed organic material, jj=evidence of cryoturbation, m=cementation or induration

Historthels and Histels were formed in depressed centers of low-centered ice-wedge polygons characterized by high water saturation to the soil surface and high organic matter accumulation due to anaerobic conditions.

Near to Olenyokskaya Channel in the erosional cliff area, sandy Gelisols developed affected by eolian sands transported from large sand banks located at opposite side of the channel. It was possible to characterise Psammorthels and Psammoturbels. They are drier than Aquiturbels and Historthels (Pfeiffer et al., 1999)

An exemplary vegetation record of a polygon of the first terrace of the alas-depression is shown in Table 8-2. In the wet polygon-centre, sedges (*Eriophorum scheuchzeri, Carex stans, C. Chodorhizza*) and undetermined Spagnum-species are the dominant species. The mostly widespread moss of the drier parts of the investigation area is *Hylocaumnium spledens*. Some species as *Betula nana* and *Salix glauca* grow in the dry as well as in the wet sites and are therefore not qualified to specify plant communities. Lichens practically occur not in the wet polygon centres.

Future work will contain statistical differentiation of the plant communities of the three terraces and the creation of a vegetation map.

Table 8-2: Polygon from the first terrace of the alas depression (differentiated into wall and centre-plot).

	wall	centre
Mosses		
Sphagnum spec.		2b
Hylocaumnium spledens	3	
Lichens		
Dactylina arctica	1	
Peltigera aphtosa	1	
Higher plants		
Betula nana	1	r
Carex chodorhizza		1
Carex stans		2a
Eriophourum scheuchzerii		1
Saxifraga punctata	+	
Potentilla palustris		2a
Rubus chamaeomorus	1	
Salix glauca	r	r
Vaccinium vitis-idae	1	

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9. Investigations of Periglacial Surface Features and Landscape Evolution on Ice Complex Deposits in the South Central Lena Delta

9.1 Scientific Background and Objectives

Anne Morgenstern and Mathias Ulrich

Ice Complex deposits are widely distributed in the Siberian Arctic. In the Lena Delta they occur on the 3^{rd} geomorphological main terrace. This terrace is distributed as a chain of relictic islands of a Late Pleistocene accumulation plain in the southern part of the delta. The stratigraphy of the 3^{rd} terrace was object of investigations during previous expeditions to the Lena Delta and shows a general pattern of fluvial sands overlain by Ice Complex sediments partly covered by Holocene deposits. Ice Complex deposits consist of peat, sands, and silts with high ground-ice content (30-80 wt%) in the form of huge ice wedges and segregation ice (Schwamborn et al., 2002, Schirrmeister et al. 2003, Wetterich et al., 2008). The surface of the 3^{rd} terrace is characterized by polygonal tundra; predominant landforms are thermokarst lakes and basins, thermo-erosional valleys, and pingos. The characteristics and evolution of these features have not been studied in much detail on the 3^{rd} Lena Delta terrace, but can provide valuable information for a better understanding of landscape dynamics, its driving forces and the time scale of associated processes. The erosional features reflect the susceptibility of the very ice-rich permafrost environment to degradation processes such as thermokarst and thermal erosion.

The main aim of our group was to investigate the morphological and surface characteristics of thermokarst features, pingos, and ice wedge polygonal structures and their controlling factors in the special context of permafrost degradation and landscape evolution in Ice Complex sediments of the 3^{rd} Lena Delta terrace. Detailed data acquisition at the field site provides exemplary information on the local scale as well as ground truth data for remote sensing and GIS analyses. The combination of both will lead to a better process understanding on the regional scale. These investigations feed into two PhD and two diploma projects:

- Morphometric characteristics and evolution of thermokarst lakes and basins in the Ice Complex of the Lena Delta,
- Thermokarst depressions and periglacial structures in ice-rich deposits as Martian analogues studies,
- Using field data and remote sensing approaches for the characterization of periglacial surfaces on the 3^{rd} Lena Delta terrace,

- Study of spatial and temporal variability (change detection) of thermokarst features in the southern Lena Delta.

9.1.1 Study Area

As investigation area we chose Kurungnakh Island, which belongs to the 3rd geomorphological main terrace and features Ice Complex sediments in most parts. It is logistically easily accessible from the Samoylov research station. A camp at the eastern shore of the island served as a base to reach the main field site: a large, partly drained thermokarst basin with three larger and numerous small lakes (Fig. 9-1).

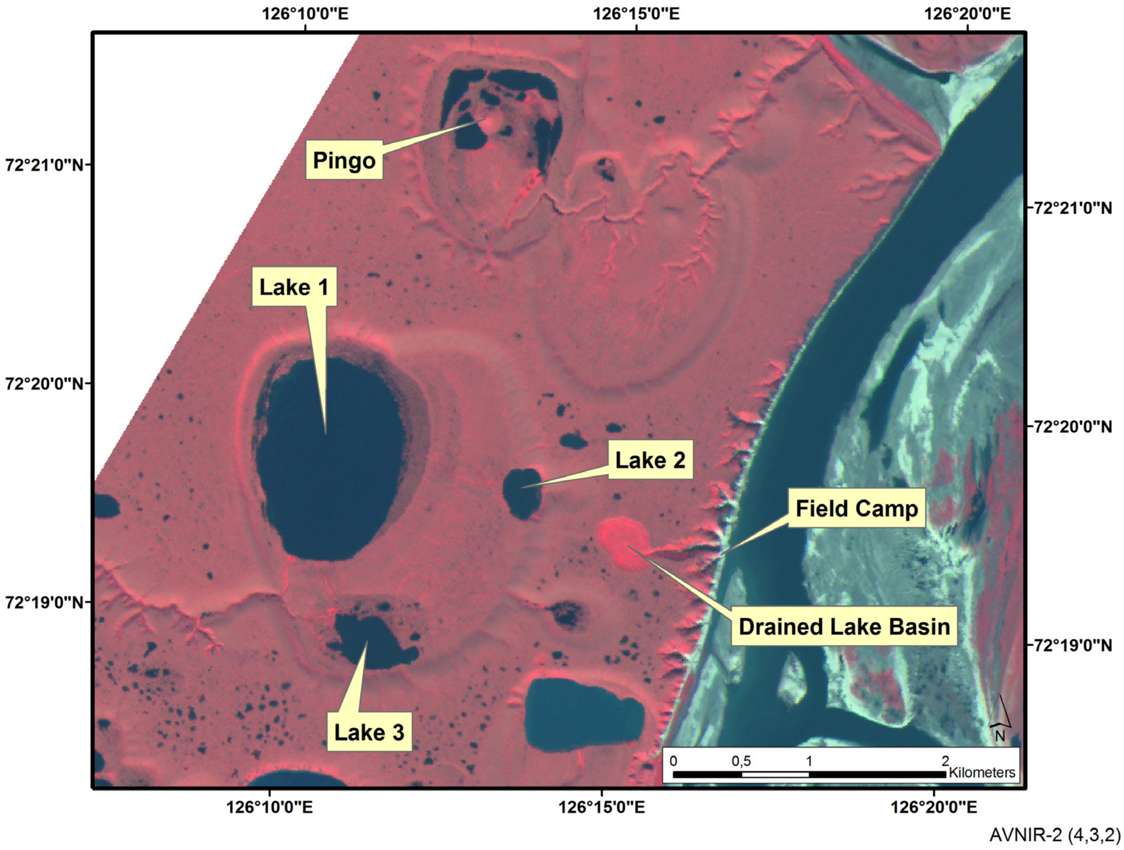

Figure 9-1: Overview of the investigation area and studied sites on Kurungnakh Island (ALOS AVNIR-2 subset, 4-3-2).

The thermokarst basin (Fig. 9-2) is of elliptical shape with its long axis oriented in N-S direction. It is about 3 km long, 2.5 km wide, and 30 m deep. The basin floor is flat despite several lake terraces around lakes 1 and 3 and is characterized by polygonal patterned ground with numerous small polygon ponds. The basin slopes have angles of about 5-10° and feature small drainage channels. All three major lakes are situated at the margins of the basin (Fig. 9-1). Lakes 1 and 2 are elliptical with major axes in N-S direction and regular shorelines whereas lake 3 is elonged in E-W direction and features an irregular shoreline. The three major lakes are hydrologically connected partly via small distinct channels with deep channel ponds, partly via broad drainage flows stretched over several polygons. The whole thermokarst basin drains through a thermo-erosional valley at the SW basin end into Olenyokskaya channel.

Further investigation sites were a partly degraded pingo in an adjacent thermokarst basin to the north of the main study area (Fig. 9-1) and a lake basin to the east of the main thermokarst basin which drained several decades ago as inferred from satellite imagery.

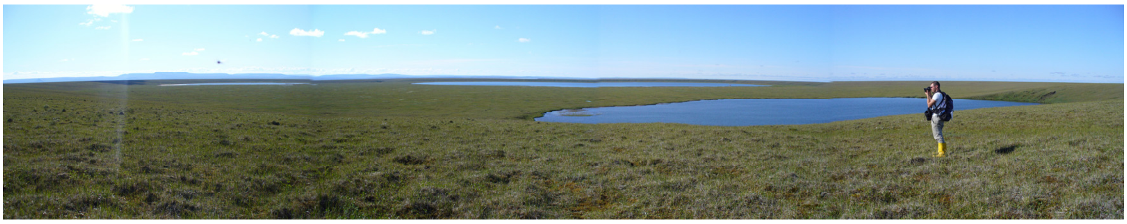

Figure 9-2: Panorama of the thermokarst basin on Kurungnakh Island (view from East to West).

9.2 Tacheometric Field Surveys

Mathias Ulrich and Frank Guenther

During our field work topographic elevation data were collected by a direct tacheometric field survey. These data will be used to produce high resolution Digital Elevation Models (DEM) for detailed investigations of thermokarst depression and pingo morphometry. Tacheometry is a geodetic method, where position and height information are determined directly in one flow of work. For this purpose a ZEISS ELTA C30 tacheometer, with an electro-optical distance measurement device, was used.

Measuring was done for the thermokarst depression and the pingo described in chapter 9.1.1 (Fig. 9-1) within a predefined local coordinate system. The direction of the local system was oriented by input of bearing north. Position and the bearing angle of the instrument must be known to measure in an absolute coordinate system. Elevation above mean sea level was derived from two trigonometric landmarks.

Regular positioning of the instrument was needed to measure the morphology of the thermokarst depression and the pingo in high resolution. For the applied “free-stationing” (Fig. 9-3, left), the measurement of at least two backside points (Fig. 9-3, right) is necessary. In average four pre-determined backside points were used for each stationing to ensure redundancy. The mean accuracy of horizontal and height stationing is less than 10 cm and 5 cm, respectively. All measurements were taken using a reflector, its position was chosen by the reflector's operator corresponding to relief energy at a representative height for the surrounding ground surface level.

Instrument tripod position was needed to be set up on drier locations, such as local polygon rims, assuring instrument stabilization on general unstable surface conditions in the wet tundra environment. However, coordinates from instrument positions were not integrated in the height point database.

Figure 9-3: left) performing stationing, right) marked backside point.

As a result we measured 2663 points for the thermokarst depression. Three backside points were marked with iron pipes in order to provide quick and easy stationing during following field campaigns. Furthermore, 603 measured points represent a pingo in the adjacent thermokarst basin north of our investigation area (Tab. 9-1).

Table 9-1: Key data of tacheometric survey.

	number of measurements	number of backside points	elevation range (m a.s.l.)	total survey area (m²)
Basin	2663	47	19,1 – 55	7.519.096
Pingo	603	7	24,6 – 52,1	44.917
Drained Lake	20	-	47,3 - 55	-

Additionally, we measured a topographical profile through the drained lake basin upon the Yedoma surface. The drained lake bottom is covered with numerous thermokarst mounds (baidzherakhs) with average heights of 2-3 m. One of them was included in the tacheometric measurement and can be seen in the middle of the profile (Fig. 9-4).

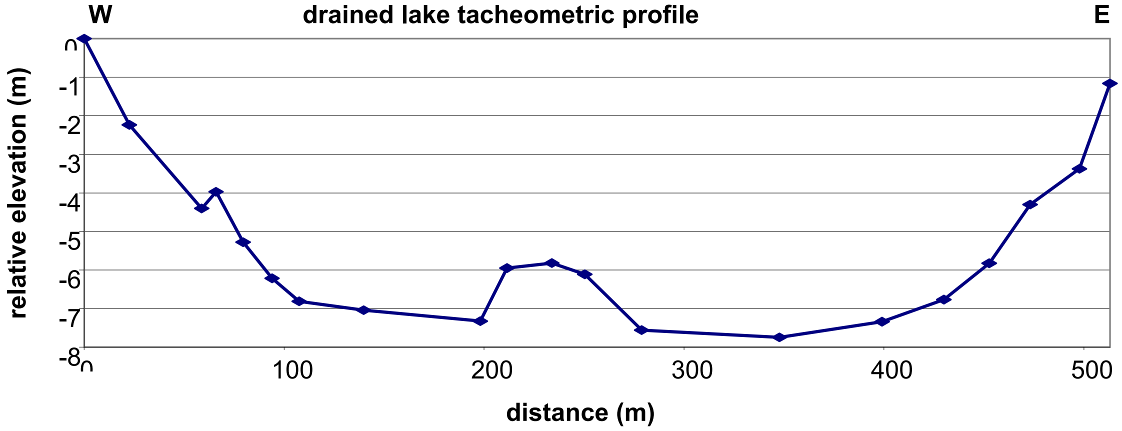

Figure 9-4: Tacheometric profile through drained lake basin.

9.3 Surface Characterization of Periglacial Relief Features

Sebastian Roessler, Anne Morgenstern, Frank Guenther and Mathias Ulrich

9.3.1 Background

Remote sensing methods and Geographic Information Systems (GIS) have proven valuable tools for the analysis of large and remote tundra regions. To achieve conclusive results with methods like multispectral land cover classifications or GIS modeling of the radiation budget using thermal remote sensing data and Digital Elevation Models (DEMs) it is indispensible to have good ground truth data. The spectral signatures in remote sensing data result mainly from differences in vegetation cover and surface moisture, which are primarily controlled by the relief situation in tundra environments (e.g., Ulrich et al., 2009). The knowledge of the specific surface and relief conditions at known locations can be used as references for training as well as for validation of the results at the different stages of analyses. Therefore, an important aim of our field investigations was to characterize different relief units and geomorphological features by their distinct surface properties to derive a training and reference set for further lab analyses.

9.3.2 Methods

At 284 sites covering all major relief units and surface elements the following properties and parameters were described and recorded:

- relief features (major relief type, relief position, micro- and meso-relief features, slope inclination),
- vegetation properties (major and minor vegetation groups, vegetation height, portion of dry vegetation, coverage),

- hydrological properties (soil/surface moisture, drainage properties, water bodies (occurrence, type, extent, depth and amount of vegetation-free water surface)).

The morphology of various forms (e.g. ice-wedge polygons, hummocks) was precisely measured by a measuring tape. A picture database was built containing over 1000 pictures of 267 investigated sites.

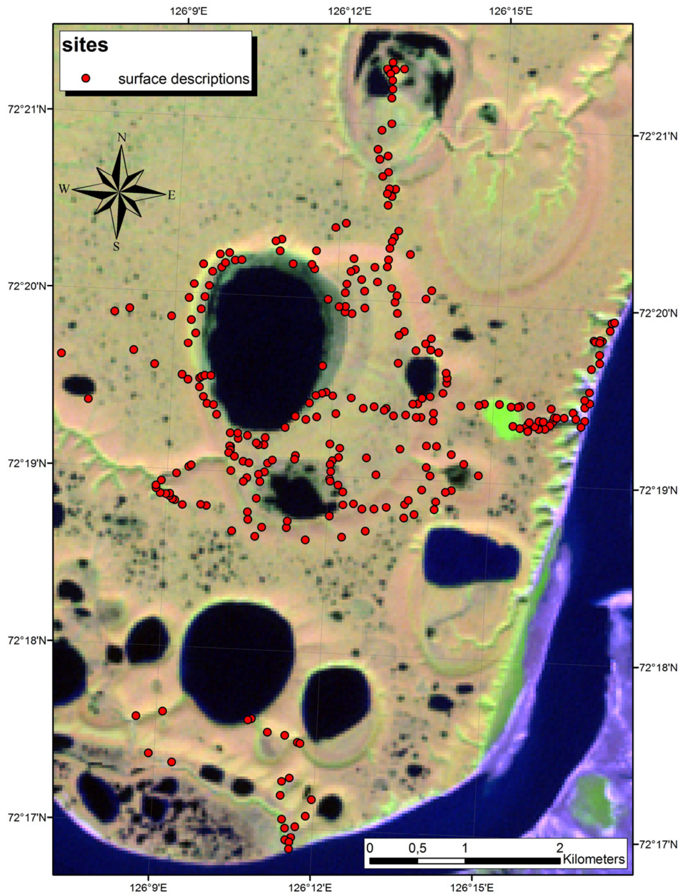

Figure 9-5: Overview of sites of detailed surface description (underlain by a Landsat-7 ETM+ subset, RGB 5-4-3, from 27.07.2000).

Active layer measurements were conducted at 565 sites, including 210 sites where surface parameters were described (see above). Additionally, three transects across the thermokarst depression were measured, as well as various profiles on top of the pingo situated in the adjacent thermokarst depression to the north of our main study area. The depth of the active layer was determined by ramming a steel pole into the ground until the permafrost table was reached. In order to obtain a representative mean value of the active layer depths, the measuring points were chosen in different micro-relief situations (on top and in-between hummocks, polygon walls and centers, etc.). In this way, up to 21 measurements were made for each site and averaged, except for the pingo transects, where singular values were measured.

Incident and reflected hemispherical solar radiation was measured on differently exposed slopes and surfaces and under different sky conditions using a Pyranometer CS300 of Campbell Scientific. Altogether, 19 different sites were measured between August 9th and 22nd, 2008. Thereof, twelve sites were measured on differently exposed thermokarst depression slopes, and seven comparative measurements were conducted on the Yedoma surface, in a thermo-erosional valley, and on a polygon pond. On the southern and northern exposed slopes of the thermokarst depression measurements could be taken as series every 2-3 hours over whole days with light to no cloud cover. Other measurement series over the whole day were taken on western and eastern exposed slopes, but unfortunately under changing sky conditions. A bigger part of the measurements was taken at different locations once a day mostly at solar noon. These field data will give an estimation of differences in the radiation balance due to relief exposure and – by calculating the albedo – provide ground truthing for spectral analyses.

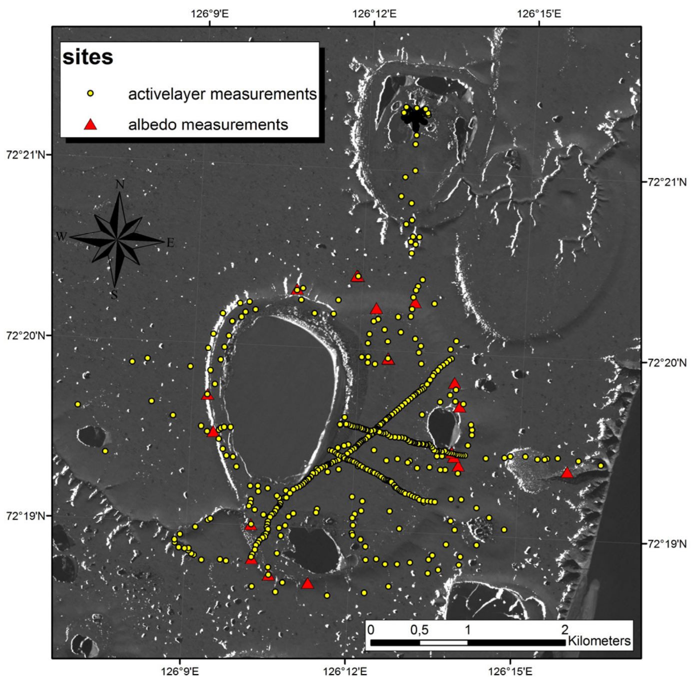

Figure 9-6: Overview of sites of active layer and albedo measurements (underlain by an ALOS PRISM subset from 21.09.2006).

9.3.3 Preliminary results

Surface description

Thermokarst depressions are well distinguishable from the surrounding areas as big topographic lows within the Ice Complex relief. The distinct relief units of the basin show different surface characteristics moderated by slope angles and exposition which influence the hydrological regime and radiation balance. The basin slopes are generally drier whereas the flat basin floor does not differ much from the surrounding uplands in its micro-relief and vegetation composition.

The flat basin floor mostly consists of well drained flat-center polygons with broad drainage channels (former water-filled polygonal troughs) between them (Fig. 9-7). The term flat-center polygon was adopted from Hinkel et al. (2003); they characterize frost polygons with indistinct rims as a “flat center form”. This term is used to classify polygons without a concave or convex center as defined by van Everdingen (1998). The surfaces of the flat-center polygons are elevated between 30 and 50 cm above the surrounding water filled troughs. The surface of the polygons is dominated by mosses (*Aulacomnium palustre, Hylocomnium spledens*) and dwarf-shrubs (mostly *Salix sp.*); only a few sedges occur on the surface. The mean vegetation height ranges between 10 and 25 cm while dwarf-shrubs can reach heights of 60 cm. The drainage channels have a dense vegetation cover, consisting of grasses, sedges and white cotton grass (*Eriophorum scheuchzeri*).

Figure 9-7: Typical surface of a flat-center polygon surrounded by drainage channels.

Within the depression several terrace-like units around lakes 1 and 3 are distinguishable, separated by more or less distinct slopes. These terraces differ by their composition of polygon forms and by their drainage properties. The lowest level is very wet and shows either surface water or a water table at the surface under a dense moss cover without pronounced drainage channels. The polygons have diameters of up to 20 m and usually an orthogonal shape (Fig. 9-8). The single ridge rims of these polygons are orientated along the lake shore. They are built up by peat moss and have average heights of 20 cm above the water table. The centers are dominated by sedges with mean vegetation heights of 40 cm. The southern part of the second lake terrace is occupied by flat-center polygons with pentagonal shapes and diameters of 15 to 17 m. The surfaces of these polygons are elevated between 30 and 50 cm above the surrounding water-filled troughs. They have either remnants of former wet centers or wet centers connected to drainage channels. In the northern part, low-center polygons are predominant (Fig. 9-9), consisting of sedge dominated centers with elevated rims covered by mosses, dwarf willows and sedges. Their size varies with diameters of usually 10 to 15 meters and rim heights of 30 to 50 cm. The mean vegetation height varies between 15 to 25 cm on the rim and 30 to 40 cm in the center.

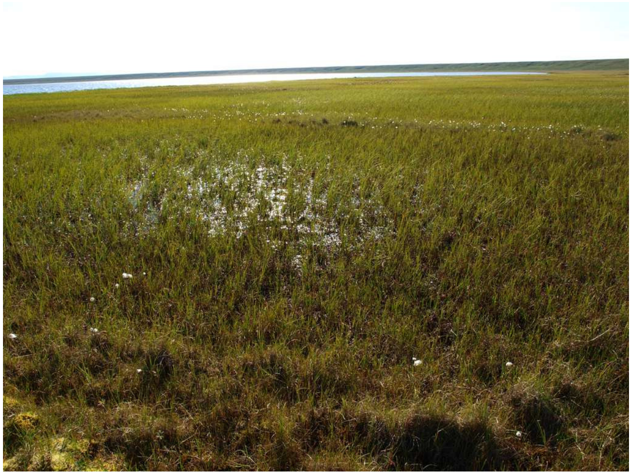

Figure 9-8: Wet low-center polygon with large polygonal pond in the center.

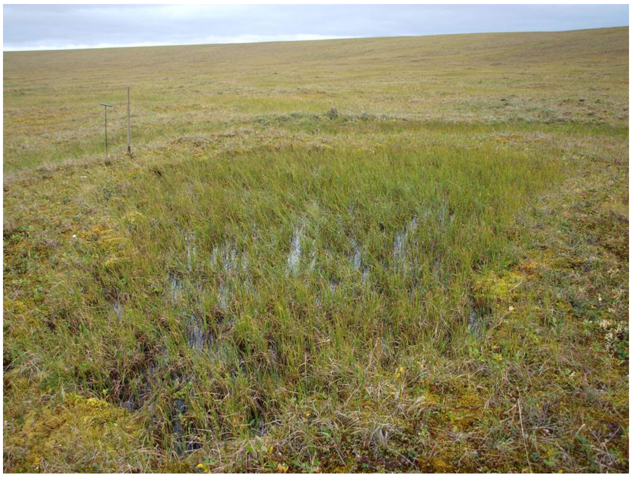

Figure 9-9: Low-center polygon with shallow polygonal pond.

A network of drainage channels within the depression is connecting the three lakes and thermo-erosional trenches on the slopes which drain the surrounding uplands. The channels are oriented along polygonal troughs and broaden when reaching the terrace edge. Because of the typical drainage pattern, these channels are called beaded streams (van Everdingen, 1998). The vegetation composition of the drainage channels is similar over the whole depression consisting of wetness adapted plants like water sedge (*Carex stans)*, white cotton grass (*Eriophorum scheuchzeri)*, peat moss (*Sphagnum sp.)*, and some hydrophilic grasses (Fig. 9-10). The mean vegetation height within the drainage channels is 50 to 70 cm with a very low portion of dry vegetation. The vegetation covers are dense, only some places with deeper water depths show vegetation free water surfaces.

Figure 9-10: Drainage channel connecting lakes 1 and 2.

The slopes of the thermokarst depression differ by their micro-relief and vegetation composition. The south facing slopes are the driest, which is reflected by the prevalent vegetation. Besides a dense moss layer with a high fraction of lichens dwarf-shrubs are dominant, mainly dwarf willow (*Salix sp.*) and dwarf birch (*Betula nana*), reaching heights of up to 70 cm in protected locations (e.g. slopes of thermo-erosional trenches). The mean vegetation height is 10 to 20 cm. Another prevailing species is mountain avens (*Dryas octopetala*). Cotton grass (*Eriophorum vaginatum*) occurs only on hummocks and has a high portion of dry plant mass. However, hummocks are less developed than on the other slopes (Fig. 9-11). They have typically diameters of 0.5 to 0.6 m and are 15 to 20 cm high.

Figure 9-11: Dry south facing slope with poorly developed hummocks.

On the south facing slope north of the eastern lake we observed an area (several square meters) of disturbed vegetation cover and slope movement (Fig. 9-12). This retrogressive thaw slump shows the present instability of the slope and points to ongoing changes in the basin contour at this site.

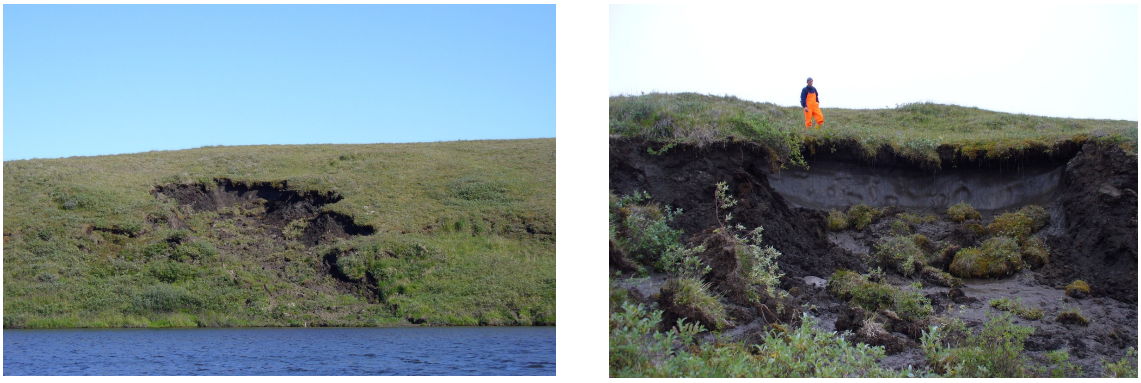

Figure 9-12: Retrogressive thaw slump at the northern shore of lake 2. The headwall reveals the massive ice of large ice wedges (right).

The west facing slope and the upper part of the north facing slope are both characterized by well developed hummocks on the whole surface. They are 30 to 40 cm in diameter and 25 to 40 cm high. The main difference to the south facing slope is the abundance of Hare's-tail cotton grass (*Eriophorum vaginatum*) which is a tussock-forming plant on top of the hummocks (Fig. 9-13). The mean vegetation height is 20 cm. The surface of the west and north facing slopes is well drained but comparatively moister than that of the south facing slope.

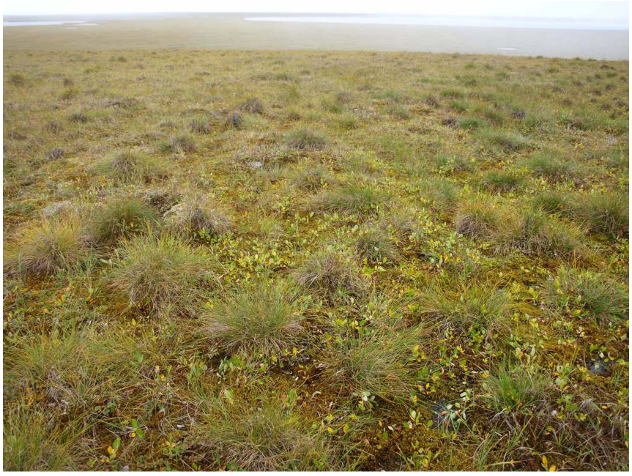

Figure 9-13: West facing slope with expressed cotton grass tussocks.

The lower part of the north facing slope is moister than the upper part. Well developed hummocks are present on the surface reaching diameters of 50 cm and heights of 30 cm on average (Fig. 9-14). The hummocks are occupied by Hare's-tail cotton grass (*Eriophorum vaginatum*) without forming pronounced tussocks. Dwarf shrubs only occur in the area between the hummocks. The vegetation height is 20 cm on average.

Figure 9-14: North facing slope.

The east facing slope differs from the other slopes by the vegetation composition, the slope inclination, the height of the slope and the drainage situation. Fresh bright green vegetation cover is composed of dwarf-shrubs, grasses, and herbaceous plants on a dense moss cover. The mean vegetation height is between 30 and 40 cm, grasses can reach 60 cm. The micro-relief is less developed than on the other slopes, but the whole slope is disturbed by several delly structures, which points to subsurface drainage.

All slopes are characterized by incised thermo-erosional trenches which occur every 50 to 150 m. Their bottoms are the wettest parts on the slopes. Therein, the dense vegetation cover consists of water sedge (*Carex stans*) and white cotton grass (*Eriophorum scheuchzeri*) with a mean height of about 50 to 60 cm. The surface of these drainage trenches is untextured, stepped or orientated along remnants of polygonal rims. Slopes of the structures are favorable for intense growth of willows and grasses due to their protected location.

Close to the slopes of the thermokarst depression low-center polygons occur with moist to wet sedge dominated centers. Regarding their morphology they are comparable to those of the second lake terrace (see above). On the lower parts of the southern and western slopes polygons appear terrace-like with distinct rims parallel to the slope and moist centers, sometimes with irregular ponds. They have orthogonal shapes and are up to 30 m long and 15 to 20 m wide. Their rims are up to 50 cm high (Fig. 9-15).

Figure 9-15: Polygons on the southern slope.

On the surrounding Yedoma uplands two different types of ice-wedge polygons could be distinguished:

The first type is represented by low-center polygons (15 to 25 m in diameter) with a well drained broad (2-3 m) and low rim (up to 40 cm) dominated by mosses and dwarf-shrubs and a moist to wet center with sedges (*Carex stans*) and some peat moss patches. These polygons are widespread on the Yedoma east of the investigated thermokarst depression. They are comparable to the moist low-center polygons inside of the depression. However, they have in general larger diameters and broader rims.

The second type is comparable to the well drained flat-center polygons within the depression. The vegetation is composed of mosses, dwarf-shrubs and sedges without a distinct differentiation between rim and center. Drainage takes place via water-filled polygonal troughs. These troughs can broaden and become a prominent relief feature. The transition between water filled polygonal trough and drainage channel is floating. The differentiation between these features is often not evident.

The bottom of the recently drained thermokarst lake is characterized by pronounced thermokarst mounds (4-6 m in diameter, up to 2 m high) (Fig. 9-16). The mounds are occupied by grasses and dwarf-shrubs. The areas between the mounds are always wet and occupied by a dense grass cover with a mean height of up to 1 m.

Figure 9-16: Bottom of a drained lake on the Yedoma surface with thermokarst mounds affected by mud flows.

The eastern edge of Kurungnakh Island is incised by several thermo-erosional ravines (ovrags) which have gently inclined slopes with thermokarst mounds in the section of the Ice Complex deposits and steep slopes in the section of the underlying fluvial sands (Fig. 9-17). These different slope areas also differ in their hydrological characteristics and vegetation composition. The gently inclined upper slopes are very moist with surface water and have either a dense vegetation cover consisting of tall grasses and sedges or are affected by gravimetric processes like mud flows or solifluction, particularly at the flanks of thermokarst mounds. The sandy deposits are well drained and have either a sparse vegetation cover (grasses and dwarf-shrubs) or they are barrens. The bottoms of the thermo-erosional ravines are occupied by braided rivers with a large amount of driftwood trunks transported here by the Lena River during spring floods.

Figure 9-17: Typical ovrag with gently inclined upper slopes and steep lower slopes.

The cliffs at the Olenyokskaya Channel are very steep and mostly barrens. Some wetter patches are sparsely to moderately vegetated (grasses and herbaceous plants), but also show mud flows. These areas seem to be initial forms of thermo-erosional ravines. In the area around the field camp, the overlaying Ice Complex deposits have retreated from the cliffs. Approximately 2 km north of the field camp, where the Ice Complex deposits range to the shore, no thermo-erosional ravines occur.

Active layer investigation

The mean active layer values as measured in August 2008 of the low-center polygons range between 25 and 55 cm. At small spatial scales they can differ greatly as thaw depths in the centers exceed those of the rims up to two or three times. The thaw depths of the well drained flat-center polygons are relatively homogenous, averaging 29 cm. Within the thermokarst depression the deepest active layer depth was measured at the wet low-center polygons of the lowest lake terrace of lake 1 (lacrustine floodplain). The greatest recorded depth was 85 cm, the individual means ranged from 36 to 82 cm with low values on the rim. The overall mean was 47 cm. The mean active layer depths of the drainage channels were slightly lower, ranging from 35 to 65 cm (measured below the water table).

The small slopes inside the depression show active layer depths of 26 to 57 cm under the hummocks and 15 to 37 cm in the inter-hummock areas. The greatest differences between hummock and inter-hummock areas occur at the steeper slopes (e. g. between the first and the second terrace of lake 1).

Table 9-2: Summary of a first statistical evaluation of all recorded active layer depths according to their relief unit membership (color scale from green – low depths over yellow – medium to red – deep active layer depths).

active layer values in thermokarst depressions	mean	min	max	N	sites
wet polygons on 1st terrace	47	23	85	151	29
low-center polygons (overall)	36	17	80	530	103
elevated rims only	29	17	47	273	
depressed centers only	44	26	80	257	
flat-center polygons	29	17	45	308	67
drainage channels, water-filled troughs (overall)	43	22	75	243	59
adjacent rims, polygonal remnants only	30	22	52	84	
channels only	49	30	75	159	
slopes within the depression (overall)	34	15	57	178	29
hummocks only	41	26	57	94	
interhummock areas only	26	15	37	84	
active-layer values on slopes	**mean**	**min**	**max**	**N**	**sites**
south facing slopes (overall)	38	15	60	88	13
hummocks only	46	32	60	47	
interhummock areas only	29	15	39	41	
west facing slopes (overall)	37	15	70	184	32
hummocks only	47	32	70	96	
interhummock areas only	27	15	47	88	
steep east facing slopes (overall)	49	21	86	35	8
hummocks only	55	34	86	24	
interhummock areas only	35	21	54	11	
moist north facing slopes (overall)	42	20	60	53	10
hummocks only	50	42	60	30	
interhummock areas only	31	20	42	23	
wet thermo-erosional trenches	43	22	70	62	10
pingo	50	20	80	171	149
moist slope-polygons (lower slopes)	36	17	70	107	21
active-layer values on Yedoma Plain	**mean**	**min**	**max**	**N**	**sites**
low-center polygons (overall)	40	18	65	65	13
elevated rims only	27	18	36	31	
depressed centers only	51	40	65	34	
flat-center polygons	32	20	45	36	9
recently drained lake	45	30	58	16	5
drainage channels, water-filled troughs	41	27	52	18	4
lakeshore	61	46	70	15	4

The slopes of the thermokarst depression show varieties of the active layer concerning their exposition. The south facing slopes have deep active layer depths under the hummocks (32 to 60 cm) and low depths in the inter-hummock areas (15 to 39 cm). The difference between thaw depths of hummocks and inter-hummock areas decline with increasing soil moisture. The north facing slopes have active layers of 42 to 60 cm under the hummocks and 20 to 42 cm in the inter-hummock areas. High thaw depths were reached in the thermo-erosional trenches and on the east facing slope.

The low-center polygons on the Yedoma surface have active layers of about 30 cm on the rim and 50 cm in the moist center. The drier flat-center polygons are as homogenous as those observed inside the thermokarst depression and have similar thaw depths of 32 cm on average.

The drainage channels are also comparable to those inside of the depression with thaw depths of 27 to 52 cm. The active layer of the drained lake averages 30 cm on the thermokarst mounds and 50 cm on the wet floor. Inside the ovrags it was impossible to determine the thaw depths, because they always exceeded 100 cm (the length of the steel pole).

9.4 Lake investigations

Anne Morgenstern, Irina Fedorova, Sebastian Roessler and Peter Ivlev

9.4.1 Background

Lakes are characteristic features of the 3rd geomorphological main terrace of the Lena Delta, although less numerous than on the other two terraces. They have been formed by thermokarst processes in the ice-rich sediments of the Yedoma Suite. Many lakes occur as remnants in partly drained larger thermokarst basins. Lake depth varies greatly, but mostly does not exceed 5 m. Lake shapes are mostly circular with regular shorelines and diameters of several hundreds of meters (Grigoriev, 1993, Morgenstern et al., 2008).

Previous studies on thermokarst lakes on Kurungnakh Island have been performed at two lakes at the southern end of the island (Fedorova et al. 2006). Their datings confirm that thermokarst development reaches back to the Early Holocene (oldest dating 9980 yr BP), which is supported by datings of thermokarst fillings at outcrops by Wetterich et al. (2008) (~8 kyr BP).

Besides these descriptions little is known in detail about the morphometry and evolution of thermokarst lakes on the 3rd Lena Delta terrace. Our investigations aim at the detailed characterization of morphometry and dynamics of thermokarst lakes in the very ice-rich deposits of the Yedoma Suite. Field investigations at the three large lakes of the partly drained thermokarst basin will be combined with remote sensing and Geographic Information System (GIS) analyses of all lakes and basins in Ice Complex sediments of Kurungnakh Island.

9.4.2 Bathymetrical surveys

To derive a comprehensive picture of the morphometry of the three largest lake basins in the thermokarst depression, we bathymetrically surveyed the lakes with several profiles each. Maximum recorded depth was 3.6 m for lake 1, 4.2 m for lake 2, and 4.0 m for lake 3. Preliminary analyses indicate that the lake bathymetries of all lakes show asymmetries with the deepest parts situated close to the slopes of the thermokarst basin: for lake 1 it is situated in the western lake part, for lake 2 in the northern lake part, and for lake 3 in the southern lake part. This is presumably caused by active thermokarst processes and shoreline erosion in the direction of the margins of the thermokarst basin. Lake 3 also shows a very steep profile close to the steep slope of the thermokarst basin, where the retrogressive thaw slump was observed, indicating the area with the most active thermal erosion of the thermokarst basin slope.

9.4.3 Lake sampling and temperature measurements

In the deepest parts of the lakes short sediment cores were taken from a rubber boat using an ÜWITEC gravity corer equipped with a 60 cm long and 6 cm wide PVC liner. All short cores contain two different sediment types: the upper parts are dominated by reddish-brown organic-rich sediments, the lower parts by light grayish mineralic sediments of small grain size. In between, these two sediment types show various mixed or intermediate stages. The depth of the short cores was quite low (max. 31 cm), because the density of the mineralic sediments at the bottom prevented further penetration of the PVC liner.

Figure 9-18: Lake sediment core KUR_A SK 3.

Table 9-3: List of short lake sediment cores.

Lake	Core	Latitude	Longitude	Water depth (m)	sediment depth (cm)
1	KUR_A SK 3	72.32489°N	126.18333°E	n. r.	0-22
1	KUR_A SK 4	72.32674°N	126.18223°E	2.4	0-26
2	KUR_S SK 1	72.32692°N	126.22822°E	4.0	0-31
3	KUR_F SK 1	72.31429°N	126.18651°E	3.6	0-26

At several lake shore locations sediment samples were taken in shallow water. The results of laboratory analyses of these samples will be compared to sediment characteristics at previous investigation sites in the vicinity of our study area to determine possible sources of the surficial lake sediments.

In every lake water temperatures were measured at every half meter depth. Water temperatures in all lakes and depths were in the range of 16-17 °C and varied only up to half a degree at different depths for each lake. Air temperatures at the times of measurement were between 17-18 °C. At the bottom of the lakes surficial sediment temperatures were measured. They were less than two degrees lower than the deepest water temperature. In addition, water samples were taken at the lake surfaces for hydrochemical analyses. They have not been carried out, yet, but field measurements of organoleptical water features for the three lakes showed differences between lakes' hydrochemistry. Lake 1 has more stagnant water, lake 3 is clearer. Eutrophication of the thermokarst basin increases from the central part to the lakes.

9.5 Studies of Thermokarst Sediment Sequences for Paleo-environmental Reconstruction

Mathias Ulrich and Anne Morgenstern

In order to study the genesis of thermokarst depression deposits on the 3rd Lena Delta terrace two exposures were investigated in detail and sampled.

9.5.1 Outcrop KUR_KAL_1

The outcrop position was chosen to get an insight into the sedimentation history within large thermokarst depressions. The location was on the eastern rim of a large thermokarst depression south of our main field site described in chapter 9.1.1. The formerly west facing slope is eroded by the delta channel and cut by a steep and deep thermo-erosional valley which drains the thermokarst depression. Thus, the flat floor of the thermokarst basin passes directly over an about 20 m high cliff into the delta channel. Therefore the outcrop was exposing deepest thermokarst basin deposits (Fig. 9-19).

Figure 9-19: Location of the outcrop KUR_KAL_1.

The profile is 3.20 m deep (Fig. 9-20) and the permafrost table bends at 1.15 m subparallel to the slope degree. The uppermost part down to 0.6 m shows brownish fine-sandy soil layers. From 0.6 m to 2.38 m depth the profile shows regular changes of fine grained dark-grayish and coarser yellowish layers with fine brownish and black schlieres. Below 2.38 m depth yellowish sand occurs with diagonally-arranged ice structures and darker schlieres.

9.5.2 Outcrop KUR_F UA

This outcrop is situated directly at the southern shore of lake 3 in our main study area. Here the lake shore forms a small cliff that exposed a 160 cm deep profile in two overlapping sections, which was accessible from the shallow water (Fig. 9-21). Sediment samples were taken from all distinct units of the profiles as follows. The first 10 cm beneath the vegetation cover consisting of mosses, grasses, and herbs represent a root-rich soil layer. Down to 30 cm profile depth dark brown, organic-rich sandy layers alternate with reddish brown layers, both 1-4 cm thick (sample 1). A section of fine, dark grayish sediments (sample 2) follows down to 60 cm including lenses of organic-rich material with visible plant remains (sample 3). A light grey layer of up to 4 cm thickness (sample 4) is situated at 50 cm depth in the right section of the profile and continues to 70 cm depth in the left section. Below, a section of dark grey sandy sediments (sample 5) including lenses of light brown sandy as well as organic material is bordered by a 2-3 cm thick dark organic-rich layer at 95 cm profile depth, followed by a 1-2 cm thick band of light grayish sandy sediments (sample 6). At about 100 cm profile depth, a 10 cm thick layer of organic-rich dark brown material with plant remains is situated (sample 7) followed by a reddish-brown section of organic sediments with plant remains (sample 8) including grayish mineralic sediments (sample 9). Below 130 cm profile depth a thin layer of hardly decomposed organic material (sample 10) is followed by a grayish sandy layer (sample 11) down to 140 cm depth. The lowest section is characterized by reddish dark brown organic material with visible plant remains (sample 12). At 160 cm permafrost was reached, water accumulated at 155 cm depth.

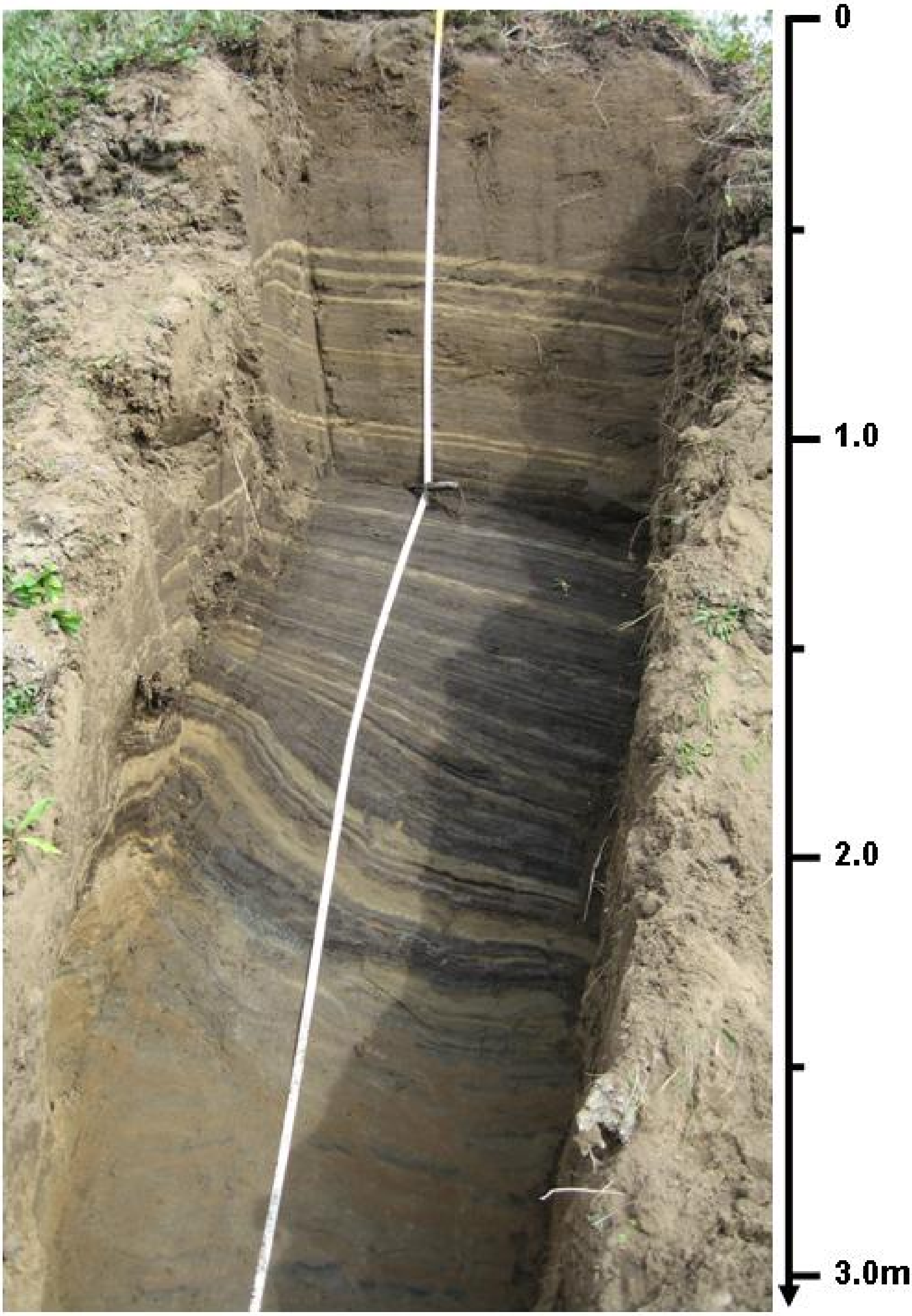

Figure 9-20: Profile KUR_KAL_1.

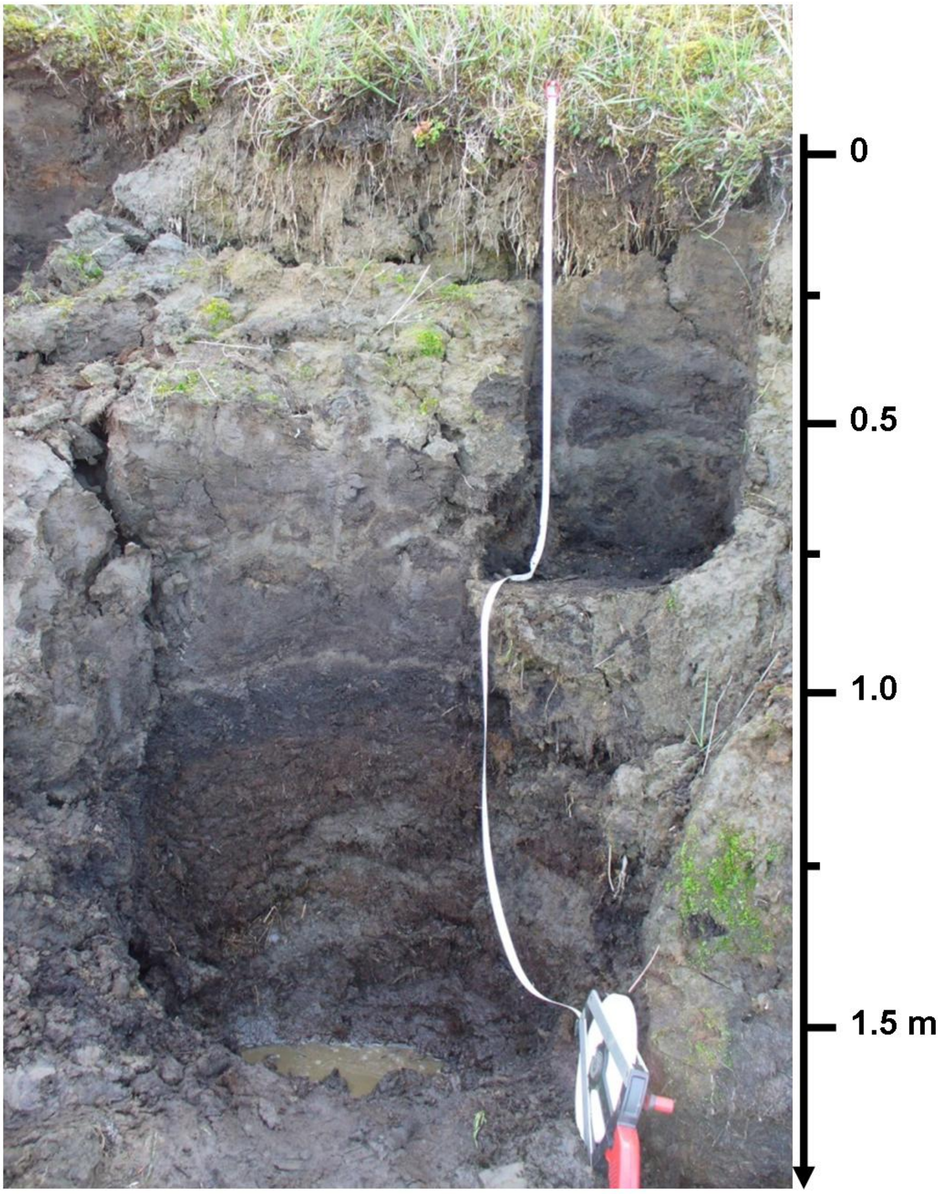

Figure 9-21: Profile KUR_F_UA.

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10. Palsas on Kurungnakh-Sise Island, the Lena River Delta

Anna Urban

10.1 Introduction

The Delta Lena region occupies the northeastern part of Russia. The surface morphology in the area is strongly controlled by permafrost and related processes, particularly frost heaving. One of frost heave manifestations is a frost mound of palsa type.

Geocryological conditions in the area are poorly known. Frost heave investigations initiated recently are important for understanding mechanisms for the formation of heave-related landforms, as well as associated permafrost characteristics, such as ground ice distribution, upper permafrost temperatures, and active layer dynamics.

10.2 Methods and Results

Characterization of palsas requires information on landscape and permafrost conditions, as well as on the type and properties of sediments. Landscape characterization included descriptions of the topography, vegetation, and surface hydrology. The study site is situated on Kurungnakh-Sise Island and represents a third terrace of the Lena River. Palsas occur within the alas depression located at a distance of about 1 km from the shoreline (Fig. 10-1).

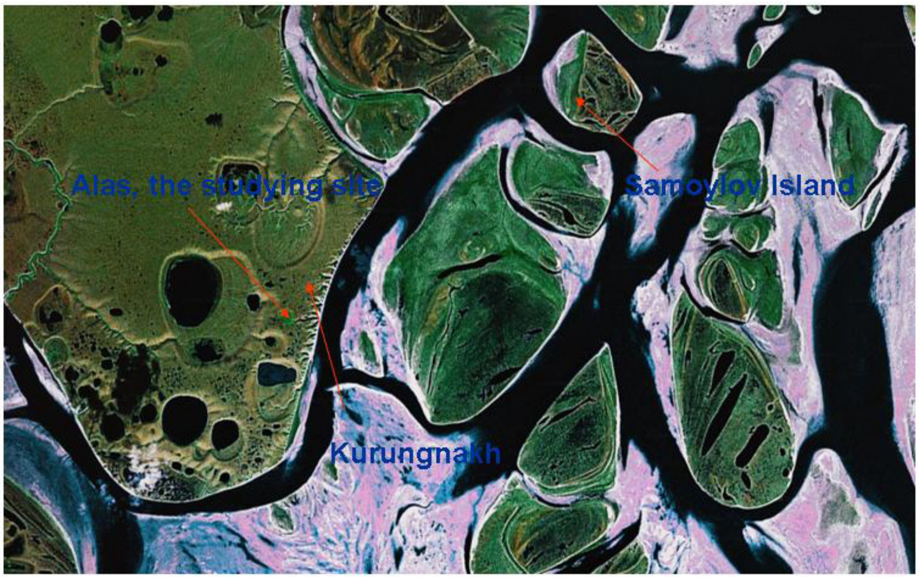

Figure 10-1: Overview of the studying site.

The alas is slightly elongated in shape. Its floor is 800 m long and 600 m in width. The floor surface is wet and is covered with forbs. The palsas are on average 1.5 m in height and 3 to 3.5 m in diameter. The inter-palsa surface is very wet. Summits of most palsas are bare and crossed by cracks.

Palsas develop in different alas settings. Some are confined to the right bank of a creek and are located 15 m from the channel. This creek, 0.6–0.8 m in width, flows in the southern part of the alas depression. The creek has steep banks composed of sandy silt; and heavily scoured by the stream (Fig. 10-2). The bank slope has a moderate angle and is covered with a dense herb cover. Overgrown detachment failures occur over the slope. The height of the slope is about 3 m.

The palsa studied in detail is 1.5 m high. The basal size is 2.6 by 3.1 m. The slopes are moderate-angled and overgrown by herbs. The top of the mound is bare; the bare part is 0.7 m high, about 1.4 m wide and 2 m long. The top is covered by small 0.02 m - wide cracks. The depth of thaw on the date of measurement was 0.35 to 0.44 m around the palsa and 0.76 m on the mound top.

Figure 10-2: Overview of the palsa group along the creek.

The upper profile of the palsa was determined by pit excavation (Figure 10-3 A):

0.0–0.11 m – brown sandy silt, weakly wet, inclusions of filiform plant roots; gravimetric water content is 18.6%.

0.11–0.38 m – grey sandy silt, locally oxidized, interbeds of brown sandy silt (up to 6 mm), rare inclusions of light brown sandy silt and filiform roots; weakly wet; gravimetric moisture content 14.9%.

0.38–0.68 m – poorly decomposed brown peat with inclusion of woody remains: gravimetric moisture content 59.5%.

0.68–0.82 m – gray sandy silt with inclusion of filiform roots; weakly wet; 2–3 mm-thick ice layers; below 0.76 permafrost with a layered cryostructure; ice content 19.8%.

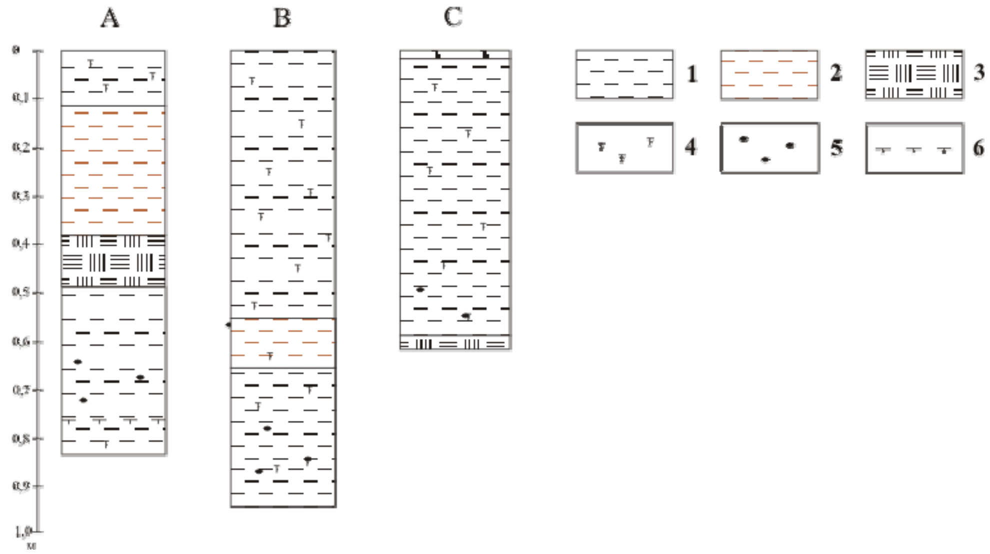

Figure 10-3: Profile of palsas on Kurungnakh Island. A – palsa on the creek bank; B – palsa in the alas centre; C – palsa in the northern part of the alas.

1 – gray sandy silt; 2 – brown sandy silt; 3 – peat; 4 – plant remains; 5 – ice lenses and layers; 6 – the base of the active layer.

A different form of palsa was identified in the central part of the alas depression. It is located on the left side of the creek at a distance of 70 m (Fig. 10-4).

The palsa is 1.2 m in height. The basal diameter is 9 m. The slopes are gentle and covered by herbs. A crack, 0.45 m wide and 0.1 m deep, was observed at the palsa foot. The crack is overgrown with herbs and is filled with water. The top of the palsa is bare and is covered by small cracks. The bare part is 1.6 m in diameter and 0.3 m in height. The depth of thaw on the measurement date was 0.3 to 0.38 m around the palsa and over 1 m on the top.

Figure 10-4: Palsa in the central part of the alas.

This palsa form has the following profile (Fig. 10-3 B):

0.0–0.29 m – weakly wet, gray sandy silt with inclusion of plant roots and occasional brown sandy silt. Sediments are oxidized. Moisture content is Natural moistering is 19.7%.

0.29–0.56 m – weakly wet, gray sandy silt with inclusion of peat (0.08 m). Peat is weakly wet, poorly decomposed. Sediments are locally oxidized. Moisture content is 51.8%.

0.56–0.66 m – brown sandy silt with inclusion of peat (0.05 m). Moisture content is 30%.

0.66–0.94 m – weakly wet, gray sandy silt with inclusion of filiform plant roots. Oxidation is stronger at depths below 0.67 m. Ice layers (3 mm) are observed at the depth interval 0.89–0.94 m. Moisture content is 23.4%.

In the north-western edge of the alas, another palsa form was studied (Fig. 10-5). Palsas are more widely spaced in this part of the study area than in the alas center.

The studied palsa is 1.7 m high and rounded in plan. The basal diameter is 14 m. The slopes are gentle and, like the summit, are overgrown with herbs. The depth of thaw was measured to range from 0.28 to 0.45 m around the palsa and 0.6 m for the top.

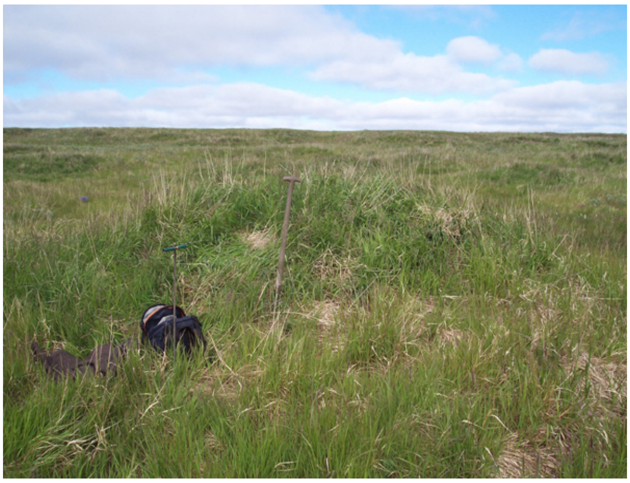

Figure 10-5: Palsa in the edge part of the alas.

The profile of this palsa is as follows (Fig. 10-3 C):

0.0–0.02 m – organic mat.

0.02–0.63 m – weakly wet, gray sandy silt. Roots and plant remains occur to a depth of 0.42 m. Very wet, brown peat layers are observed to a depth of 0.6 m. Sandy silt is oxidized across the profile. Ice layers, about 2–3 mm in thickness, occur below the depth of 0.55 m a. The moisture content of sandy silts varies from 26.8 to 44.2%.

Sediment samples were obtained from the palsas to determine physico-mechanical properties (Table 10-1).

Table 10-1: Palsa sediment characteristics.

№	Sample no.	Sampling date of	Location	Sampling depth, m	Moister content, %
1	Kur 1-1	29.07.2008	Kurungnakh, southern edge part of alas, left bank of creek, palsa	0.1	18.59
2	Kur 1-2			0.25	14.92
3	Kur 1-3			0.6	59.48
4	Kur 1-4			0.8	19.8
5	Kur 2-1	31.07.2008	Kurungnakh, central part of alas, on the right bank of creek	0.18	19.7
6	Kur 2-2			0.36	51.76
7	Kur 2-3			0.57	30.01
8	Kur 2-4			0.8	23.36
9	Kur 3-1	31.07.2008	Kurungnakh, northern-west edge part of the alas,	0.18	26.87
10	Kur 3-2			0,25	44,62
11	Kur 3-3			0,63	26,78

Future Work

To study frost heaving processes, it is necessary to obtain data on the litology of deposits, including grain size, mineralogy, chemical composition, degree of saturation, swelling, density, salinity, and ^{14}C- dates.

10.3 Conclusion

The investigations on frost heaving processes allow us to judge about its manifestations, as palsa on Kurungnakh Island.

Palsas are developed in the alas depressions where the surface is wetter then in the adjacent areas. The profiles presented in this paper indicate that frost heaving is more active in sandy silts containing layers and pockets of peat.

Further research will involve attempts to find the structural features that could help differentiate the heave-related landforms from bayjerkakhs (hummocks remaining after melting of ice-rich permafrost) which are common on Kurungnakh-Sise Island. To this end, a more detailed study of the sediments in the thermokarst depression, where palsa occurrences were investigated, will be undertaken.

11. Coastal Dynamics on the Western Coast of Bhuor Khaya Bay, Yakutia

11.1 Introduction

Paul P. Overduin, Mikhail N. Grigoriev, Conrad Kopsch, Birgit Heim and Waldemar Schneider

Investigations of the coastal dynamics on the western coast of Bhuor Khaya Bay in the summer 2008 included:

1. Coastline position change measurement
2. Collection of ground-truthing data to calibrate an algorithm for remotely sensed estimation of colored dissolved organic matter concentrations in the coastal waters
3. Seasonal dynamics of bottom water temperature and salinity
4. Seismic investigations of sub-bottom structure

The fieldwork was, for the most part, ship-based and operated from the Tiksi Hydrobase Ship *405* and from its skiff. Fieldwork took place between August 8, 2009 and August 20, 2009.

Coastline position change is a fundamental parameter for coastal dynamic investigations. Data at sites on the Bykovsky Peninsula and Muostakh Island include some of the longest records of observed position change in the Arctic Ocean, reaching back to the 19th century. Measurements provide direct ground-truthing for change detection via remote sensing, and are co-ordinated with a circumpolar project which examines changing Arctic coastal dynamics (Arctic Circumpolar Coastal Observatory Network – ACCOnet) and which grew directly out of the Second International Conference on Arctic Research Planning Change (ICARP II) held in Copenhagen, Denmark in 2005. Through support from the European Space Agency, as a part of their International Polar Year (2007-2009) program, these measurements are complemented by late acquisitions of high spatial resolution, satellite-borne, optical data. Results are integrated into the GIS geodatabase of the Arctic Coastal Dynamics project of the International Permafrost Association (IPA), International Arctic Science Committee and the Land-Ocean Interactions in the Coastal Zone (LOICZ) project. The Arctic Centre at the University of Groningen, Netherlands, supported the development of the coastal GIS database.

The monitored sites along the western coast of Bhuor Khaya Bay belong to the stratigraphic unit of the Ice Complex or Yedoma (Schirrmeister et al., 2002; Gavrilov et al., 2003). Yedoma is characterized by a high ground ice content, often exceeding 80% by volume, and coastal erosion proceeds through both the abrasive and mechanical action and through thermal abrasion and thermoerosion of the coastal bluff. These processes can deliver large volumes of particulate material into the coastal waters. In order to quantify the mass flux of terrigeneous material originating from coastal erosion, survey sites have been established. During the ice-free season, organic-rich melt-waters transport terrigenous organic carbon through the coastal zone of the IC. In addition, in Buor Khaya Bay, the estuarine waters are mixed with the turbid Lena river discharge.

To extract information on the spatio-temporal dynamics of the terrigenous export into coastal waters, time series of specifically processed optical satellite data will be analysed within the project 'OCoc-from Ocean Colour to Organic Carbon' funded by the German Research Foundation (DFG) (IPY-project 1176, joined ACCO-Net, IPY-project 90). The optically most important water constituents for water remote sensing of 'terrigenous input' are suspended particulate matter, SPM, and dissolved organic matter, DOC. The aquatic organic matter can be spectroradiometrically monitored by its absorbing activities in the spectral short-wavelength range. The optically visible fraction of the dissolved organic part is summarized as chemico-optical group named coloured Dissolved Organic Matter, cDOM. The cDOM / DOC ratio is assumed to be regionally specific. Suspended particulate matter, SPM, in the surface water layer is optically visible due to its scattering activities that lead to water-leaving reflectances also in the short near-infrared wavelength range. Operational SPM always includes organic and inorganic matter.

In-situ investigations of aquatic geo-optical characteristics are crucial for water remote sensing projects. Therefore, on the LENA08 expedition, water samples for optically visible water constituents, and simultaneous data on the spectral under-water light field were collected along with hydrographical parameters (electronic conductivity, pH, temperature, secchi depth transparency) in estuarine waters, nearshore waters of the IC coast and offshore waters of Buor-Khaya Bay. The Lena Hydrobase river-vessel '405' served as platform. The optically visible water constituents and the spectral underwater parameters will be investigated for the correct retrieval of Ocean Colour satellite parameters for these optically very specific coastal water types.

The hydrographical and geo-optical data from the LENA08 expedition will give us insight into:

- cDOM, DOC and sediment transport in the near and off shore zones
- comparison and evaluation of calculated remote sensing parameters (e.g., attenuation coefficient, SPM, cDOM, DOC)
- water chemistry, water column stratification and source as determinants for both sedimentation rates and bottom water temperature

The susceptibility of bottom sediments to re-suspension and subsidence is dependent on the presence of permafrost, often ice-rich, beneath the sea bed. The rate of degradation of this permafrost in the near shore coastal zone is controlled by the boundary conditions (especially temperature and salinity) at the interface between sea water and sediment. Ice dynamics play an important role in determining the seasonal cycle of these parameters, but also make them very difficult to measure throughout the year. One of the goals in 2008 was to recover CT dataloggers deployed in shallow waters (< 10 m) of the near shore zone off the Bykovsky Peninsula in August 2007 and to redeploy them further south, before the coast of Muostakh Island.

The fourth investigative goal was to detect change in the position of the ice-bearing permafrost in the sub-bottom profile, since drilling and probing performed in the 1980s, via a seismic survey of the same location. Since this was a pilot project, its goal was to assess the suitability of the device to the detection of the frozen-unfrozen sediment interface in the near shore zone (< 10 m water depth) in the sandy and silty sediments that derive from coastal erosion and deposition of the fluvial load in the Lena River's region of freshwater influence.

11.2 Coastline Position Monitoring

Paul P. Overduin, Mikhai. N. Grigoriev and Waldemar Schneider

Overduin et al. (2007) details over 20 locations where field based measurements of coastline position change have been recorded. Many of these measurements have been continued in the framework of the System Laptev Sea projects. Numerous methods are available, but the longest historical records usually begin with linear measurement made between a survey reference mark or series of survey reference marks and the top of the coastal bluff. To provide continuity, repeat measurements are made on, ideally, an annual basis. At the locations measured on this tour, annual measurements have been made for at least the last five years. A combination of remote sensing data of sufficient resolution to resolve survey reference mark locations with field-based measurements typically extends the record back to the advent of aerial photography surveys, usually in the 1950s and 1960s.

Table 11-1: List of the three location at which coastal retreat rates were measured, plus one measured in the western Laptev Sea.

Location	Observation date	Change Rate in 2007-2008
Cape Mamontov Klyk, western Laptev Sea	13.08.08	4.25 m a^{-1}
Muostakh Island, Northeastern Coast	10.08.08	10 m a^{-1}
Muostakh Island, Northern Cape	10.08.08	23 m a^{-1}
Bykovsky Peninsula, Mamontovy Khayata	09.08.08	7 m a^{-1}

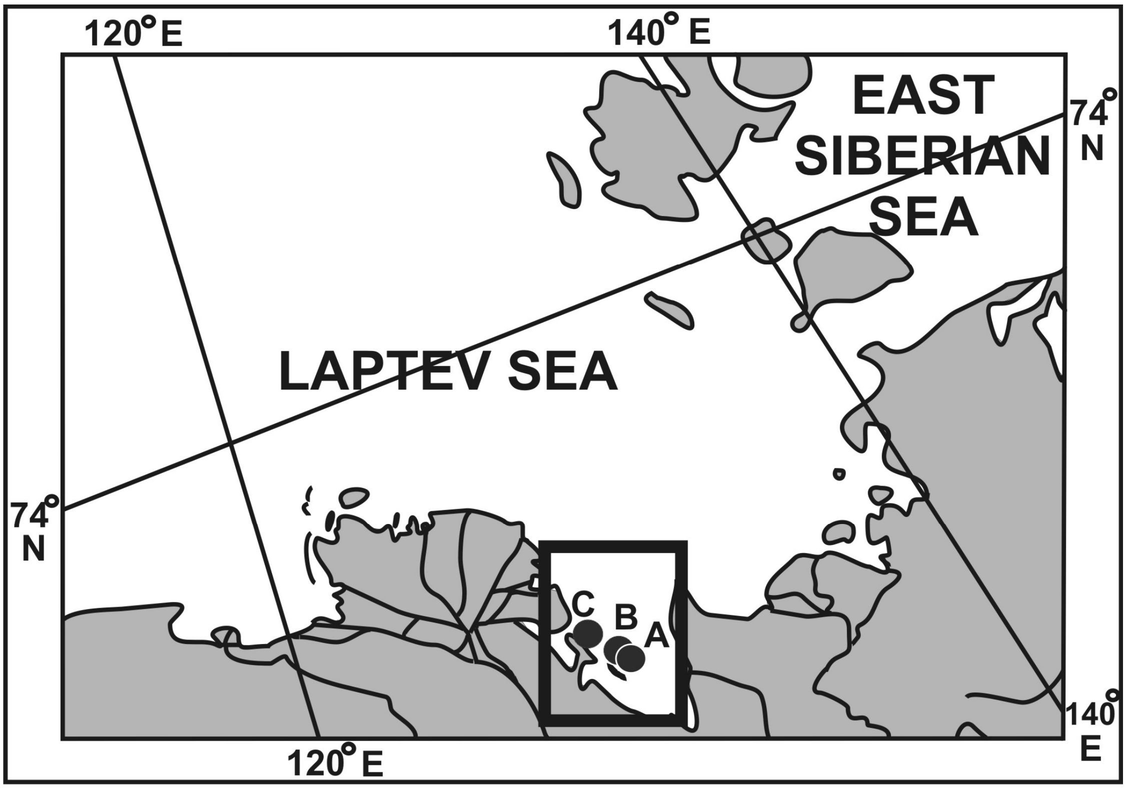

Figure 11-1: Location of the three coastal retreat rate observation points.

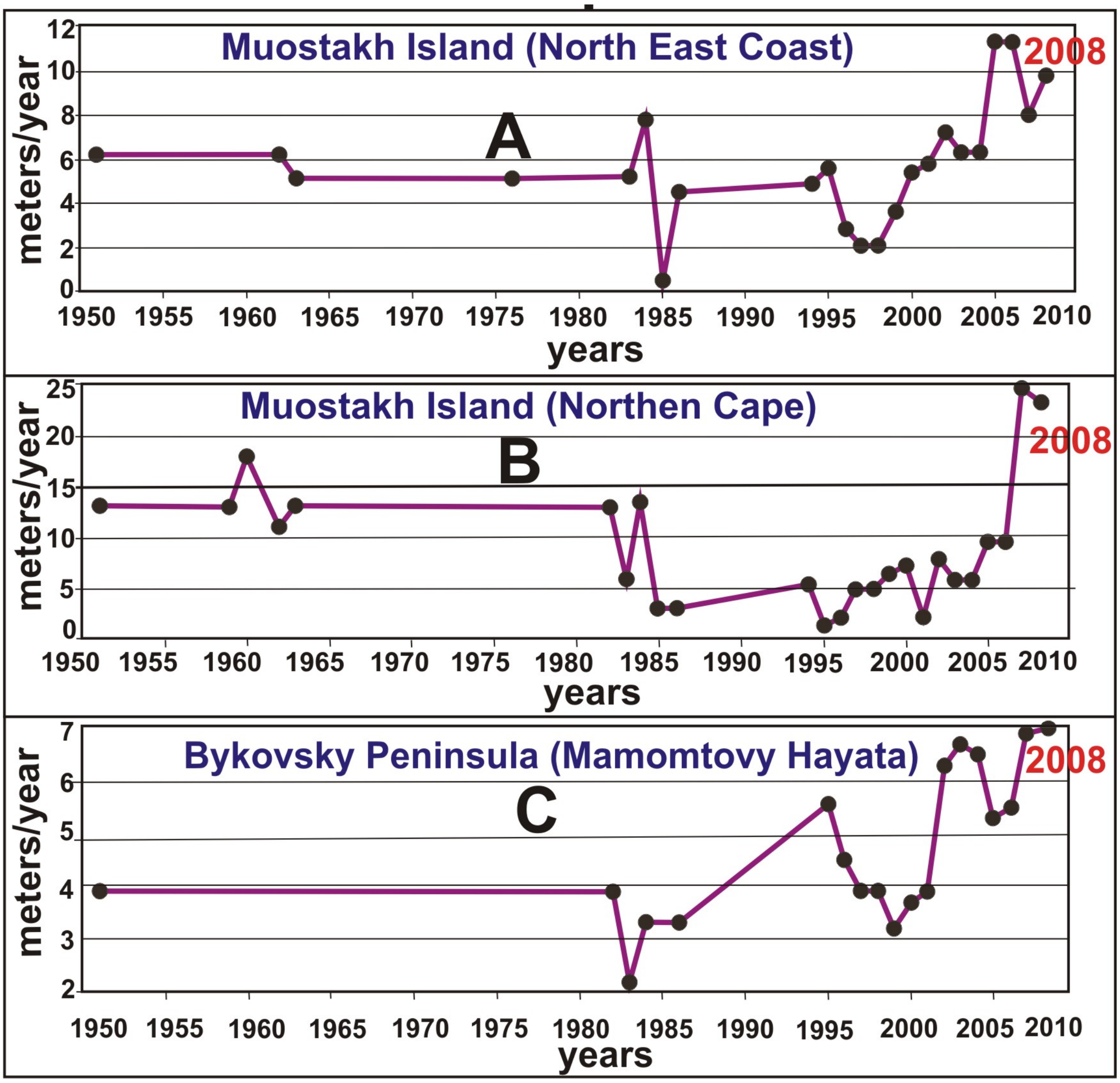

Figure 11-2: Changes in the mean annual erosion rate at the three observations points on the western shore of Bhuor Khaya Bay, Yakutia. Each point represents a mean annual retreat rate, but the number of years included in each mean varies, decreasing with time. The most recent values are annual values (not means).

11.3 Seawater Chemistry and Optical Water Properties

Birgit Heim

We focused on the coastal waters that are potentially influenced by input of terrigenous matter (dissolved and particulates) from the Ice Complex (IC), and sampled from the coast of the Bykovsky Peninsula and from the Island of Moastakh into offshore waters. We also investigated estuarine waters that are directly influenced by the fluvial input of the Lena River. A tundra lake (BK08-12) on a young Holocene Lena river terrace within the outlets of the Lena Delta was sampled as the terrigenous 'interstorage carbon' type, and melt waters from the Bykovsky Ice Complex (BK08-6) were sampled as potentially characterizing the terrigenous ‘old labile carbon’ type.

Spectro-radiometrical measurements within the water column were carried out using a RAMSES irradiance spectrometer (TRIOS). In the water column, the sensor measured in 0.5 m depth steps the upwelling in-water irradiance up to 0.5 m below Secchi depth when it becomes to dark for passive optical measurements. The downwelling irradiance above the water surface was measured directly before and after the in-water profiles of upwelling irradiance measurements using the same sensor.

The water samples were retrieved at 14 stations in the subsurface water layer (0,5 m water depth) and the turbid bottom layer and at 3 surface water stations. The water samples will be analyzed for water chemistry (cations/anions; isotopes, nutrients, DOC, methane); and optical analyses (cDOM). Fresh water samples were directly filtered onboard the ship for Suspended Particulate Matter (SPM). One litre was filtered through 0.45 µm-pore size pre-weighed cellulose-acetate (CA) filters for gravimetric SPM. Filtrates for DOC analyses were filtered through 0.7 µm-pore size GF-filters. For comparison with DOC we prepared cDOM filtrates where the subsamples were filtered through 0.7 µm-pore size GF-filters and 0.45 µm-pore size CA-filters either. cDOM spectra were directly measured after the LENA08-Expedition at the Russian-German Otto-Schmidt Laboratory in St. Petersburg (RU) using a Specord200 (Jena Analytik). Optical density OD spectra of the 0.45 µm and 0.7 µm filtrates were measured from 300 nm to 750 nm in 2 nm spectral steps using 10-cm glass cuvettes according the recommendations of the Ocean Optic Protocols (2000). Absorption [m-1] was calculated using 2.303 × OD / 0.1.

MERIS Reduced Resolution (RR)-LIB data of the study site were acquired from August 8^{th}, 10^{th},11^{th},12^{th},13^{th},15^{th}, and 16^{th}, 2008 and processed towards L2 parameters using Beam-Visat4.2© and the MERIS case2 regional processor for coastal application (C2R) (Doerffer et al., 2008). C2R uses neural network procedures for the retrieval of water leaving radiance reflectances from calculated Top-of-Atmosphere reflectances after ozone, water vapour and surface pressure correction, and neural network procedures to derive the optical properties from the water leaving reflectances. C2R output parameters are IOPs (total absorption coefficients, backscattering coefficients), apparent optical properties (AOPs) (water leaving radiance reflectance, attenuation coefficient ‘k’, attenuation depth ‘Z90’) and calculated concentrations of ‘chlorophyll’, ‘SPM’, and ‘cDOM’ (conversion by specified factors).

Initial comparisons with the Lena08-Expedition data show that the optical parameters 'total absorption' and the first attenuation depth, 'Z90', seem adequately to represent true conditions, whereas the secondarily derived (using conversion factors) ‘chlorophyll’ and ‘SPM’ are overestimated by up to an order of magnitude.

In all investigated near-shore and offshore (up to 70 km offshore) water types, the water surface layer and mixed water columns up to 5 m water depth were fresh (70 to 3000 µS cm-1). All waters are characterized by low Secchi depth transparencies. Therefore, despite the low bathymetry of Buor Khaya bay, the water leaving optical information will not be influenced by the optical bottom signal, due to the low water transparencies. Lena river waters had extremely high turbidity, with estimated Secchi depths of less than 0.5 m. The estuarine waters were characterized by high turbidity and measured Secchi depth transparencies of 1 to 1.5 meters, onshore waters of the Buor Khaya Bay (2 to 5 m water depth, mixed conditions) were characterized by Secchi depths from 0.8 to 1.5 meters, offshore waters (> 5 m water depth, stratified) by Secchi depths from 1.5 to 2 meters. Waters close to the IC-coast showed a moderate turbidity, however very low Secchi depths (0.5 to 0.8 m). Measured cDOM values are of high magnitudes, especially in the IC influenced near shorewaters. Ranges for the absorption of DOM at 440 nm (0.45-µm filter) are: estuarine waters: a_{442}cDOM: 1.3-2 m^{-1}; onshore waters: a_{442}cDOM: 1-2.5 m^{-1}; offshore waters: a_{442}cDOM: 1-2 m^{-1}; coastal waters close to the IC-coast show considerable high a_{442}cDOM: 3-7 m^{-1}.

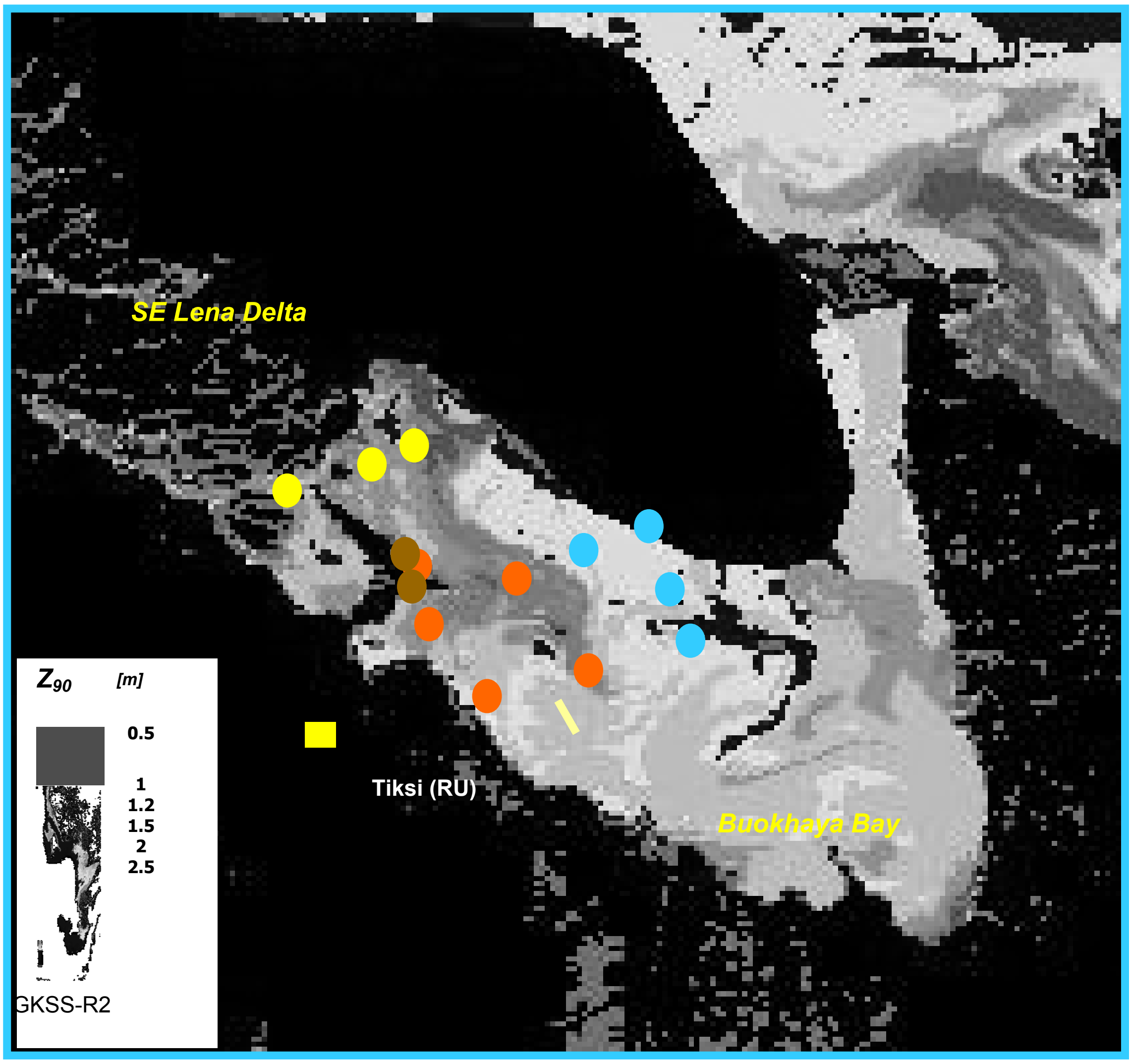

Figure 11-3: MERIS Reduced Resolution, RR, 2008-13-08, 11:38 local time, processed using GKSS Case2Regional processor, C2R parameter 'attenuation depth, 'Z90', (clouds masked in black). Lena08-expediton stations: near-shore waters of Ice-Complex (brown), on-shore (orange), offshore (blue), estuarine waters (yellow).

We conclude that in summer months the investigated Laptev Sea coastal waters are optically specific in terms of being influenced by organic-rich terrigenous input derived from the warmed-up ice-rich, organic-rich coastal system of the IC. The first remote sensing investigations (Heim et al., 2008) show that MERIS acquisitions of the Laptev Sea Region can successfully be processed towards aquatic-optical parameters.

Table 11-2: Water sampling sites and hydrographical parameters.

activity	date	latitude (WGS84) [decimal degrees]	longitude (WGS84) [decimal degrees]	location	water depth [m]	sample depth [m]	LF [µS/cm]	pH	Temp °	Secchi [m]
BK08-02	09.08.08	71.788028	129.418981	E of Bykovsky		0.50	471	7	12.5	0.51
					3	bottom	471	7	12.2	
BK08-03	09.08.08	71.825528	129.771944	E of Bykovsky		0.50	1713	7	10.6	1.71
					6.5	bottom	2200	6,9	11.7	
BK08-04	09.08.08	71.841109	129.427416	E of Bykovsky		0.50	1000	7,2	13	1.32
						bottom	2200	6,9	11.7	
BK08-06	10.08.08	71.827778	129.416805	melting water, Bykovsky		surface				turbid
BK08-07	10.08.08	71.784722	129.413889	Bykovsky coast	estim. 1.5	surface	456	7,2		
BK08-08	10.08.08	71.614778	129.949083	E of Moastakh		0.50	2000	7,3	10.8	1,3
					4	bottom	2000	7,4	10.6	
BK08-09	10.08.08	71.6720556	129.997605	E of Moastakh		0.50	1520	7,3	11.2	1,48
					7.5	bottom	1513	7,4	10.6	
BK08-10	10.08.08	71.5311944	129.552314	W of Moastakh		0.50	2110	7,4	11.3	1,4
					10.5	bottom	5330	7,3	10.2	
BK08-11	11.08.08	71.7086667	129.569567	W of Bykovsky		0.50	374	7.6	13.8	0,85
					3	bottom	515	7,3	13.8	
BK08-12	13.08.08	72.0595233	129.569567	tundra lake		surface	77	6.9	14.6	
BK08-13	13.08.08	72.0386333	129.78315	Lena estuarine waters	7	0.50	213	8,3	20.3	0,49
BK08-15	13.08.08	72.0058167	129.093983	Lena estuarine waters		0.50	129	8.1	18.4	1,35
					11	bottom	130	8,7	17.2	
BK08-16	13.08.08	71.88205	129.4713667	E of Bykovsky		0.50	219	8,1	16.1	1,65
					4	bottom	129	8,4	15.5	
BK08-17	13.08.08	71.7833	130.089733	Buor-Kaya Bay		0.50	1752	7,1	14.5	1,63
					11.5	bottom	33700	7,4	4.2	
BK08-18	14.08.08	71.7833	130.423067	Buor-Kaya Bay		0.50	2600	8,3	13.8	1,65
					11.5	bottom	33400	7,7	4.0	
BK08-19	14.08.08	71.7668667	130.751833	Buor-Kaya Bay		0.50	2900	8,3	15.2	1,7
					16.5	bottom	33800	7,9	3.5	
BK08-20	14.08.08	71.6599167	130.7488	Buor-Kaya Bay		0.50	2700	8,1	14	1,96
					16	bottom	35900	7,9	4.6	
BK08-21	14.08.08	71.5827833	130.750133	Buor-Kaya Bay		0.50	2700	8	15.5	2,05
					15.5	bottom	35000	7,3	3	

11.4 Seabed Temperature and Salinity Regimes

Paul P. Overduin, Conrad Kopsch and Waldemar Schneider

Few data exist on seasonal and annual scale variations in sea bottom temperature and salinity regimes in the near shore zone. Ice dynamics (scours, pressure ridges, ice push events, etc.) generally destroy or move any seabottom devices during storms in the ice formation periods Nov. - Dec. or during meltin the spring and early summer.

In 2007, four dataloggers measuring both parameters at hourly intervals were deployed in a transect roughly perpendicular to the coastline at Mamontovy Khayata (Overduin, 2008). In addition, a logger measuring bottom water salinity and pressure was deployed for the University of Dresden. By deploying smaller sensors at water depths exceeding 4 m, using a double anchor system, problems with ice movement were avoided, and all five loggers were recovered in august 2008.

Table 11-3: A list of CT and CTD datalogger deployment locations and periods.

Datalogger ID Numbers	Observation period [dates]	latitude (WGS84) [decimal degrees]	longitude (WGS84) [decimal degrees]	Location (Water depth) [m]
CT Logger 1				
Seriennummer: 56/300.108	21.08.07 -			E of Bykovsky Peninsula
AWI Anlagennummer: 102903	08.08.08	71 47' 19.0" N	129 25' 46.7" E	(4.2)
	10.08.08			
	onwards	not deployed		E of Moastakh Island
CT Logger 2				
Seriennummer: 56/300.110	21.08.07 -			E of Bykovsky Peninsula
AWI Anlagennummer: 102905	08.08.08	71 47' 58.7" N	129 32' 56.7" E	(6.3)
	10.08.08			
	onwards	71 37' 34.7" N	129 58' 2.7" E	E of Moastakh Island
Logger 3				
Seriennummer: 56/300.107	21.08.07 -			E of Bykovsky Peninsula
AWI Anlagennummer: 102902	08.08.08	71 48' 35.0" N	129 38' 30.2" E	(6.2)
	10.08.08			
	onwards	71 40' 17.5" N	129 59' 46.0" E	E of Moastakh Island
Logger 4				
Seriennummer: 56/300.109	21.08.07 -			E of Bykovsky Peninsula
AWI Anlagennummer: 102904	08.08.08	71 49' 33.9" N	129 46' 26.6" E	(7.5)
	10.08.08			
	onwards	71 36' 49.8" N	129 56' 53.3" E	E of Moastakh Island
	21.08.07 -			Tiksi Bay, SW of
TD Datalogger (TU Dresden)	09.08.08	71 31' 52.3" N	129 33' 32.8" E	Bykovsky

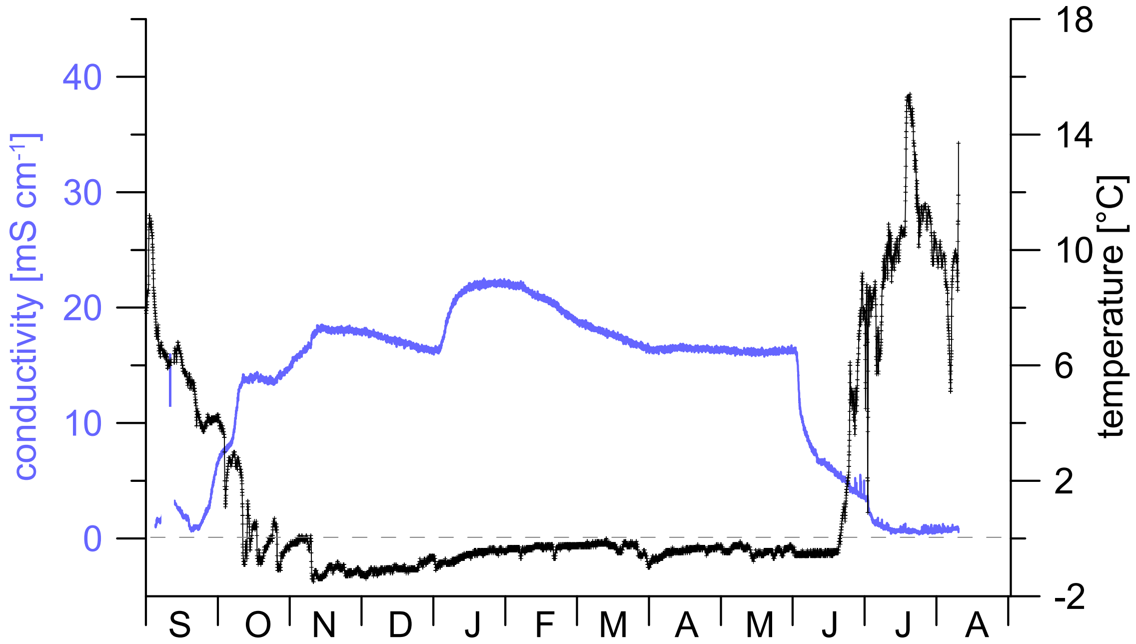

Figure 11-4: Preliminary data showing the electrical conductivity (lefthand scale) and temperature (righthand scale) of bottom waters at 4 m water depth.

The data show cooling and an increase in salinity due to ice formation in the fall. Variable salinity levels in the winter may be the result of ice break up events (common for the eastern Laptev in December), or of shifts in the relative influence of Lena and Laptev waters. Salinity falls during the springnival run off event, well before the temperature shows an increase. Summer temperatures in the 4 to 10 m water depth range exceed 14°C. This may reflect river water temperatures, the influence of high concentrations of effective absorbing materials in the turbid water and/or the influence of the water-atmosphere energy balance in the shallow near shore zone.

11.5 Shallow Seismic Investigations of the Seabed off Mamontovy Khayata, Laptev Sea

Paul P. Overduin and Conrad Kopsch

11.5.1 Introduction

A borehole transect drilled in 1983 in the near shore zone off Mamontovy Khayata on the Bykovsky Peninsula in the Laptev Sea resulted in a description of seabed temperature and the inclination of the top of the ice-bearing permafrost. The area is interesting due to the ice complex and the thermokarst features superimposed on the landscape. One of the goals of our work in the region in 2008 was to revisit this area in order to extend the results of borehole transect in three dimensions via geophysical methods in order to explore the effect of coastal erosion and near shore processes on the evolution of terrestrial surface landforms after inundation. Ideally, a combination of seismic and geoelectric techniques would be employed to observe both the depth of changes in sediment composition, primarily the boundary between ice-free and ice-bearing sediment, and the depth of penetration of the seawater salt front into the sediment. In this year, a 3.5 kHz seismic system was deployed from the coast out to around 13 km offshore. In total, over 100 km of seismic profile data were collected over a region including an offshore extension of the boundary between ice complex and alas deposits.

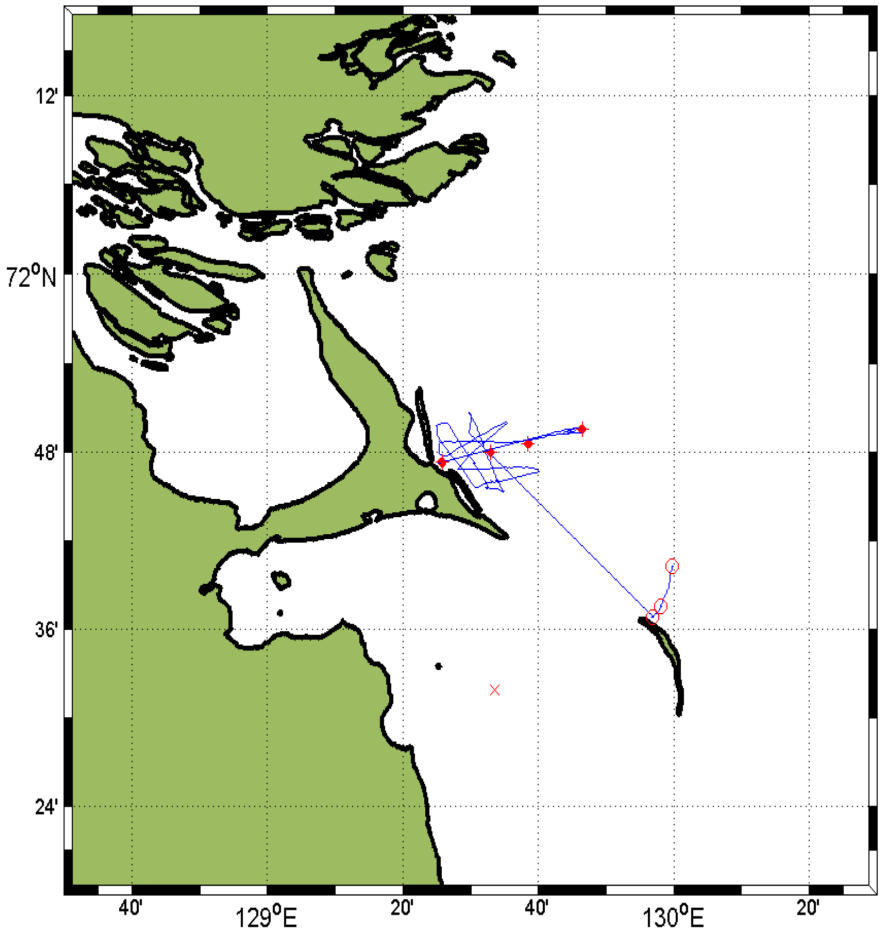

Figure 11-5: A map of the region around Tiksi, Yakutia shows the southeastern discharge of the Lena river (top left), the Bykovsky Peninsula and Muostakh Island. Blue lines indicate seismic profiles, red marks indicate datalogger (CT or TD) positions.

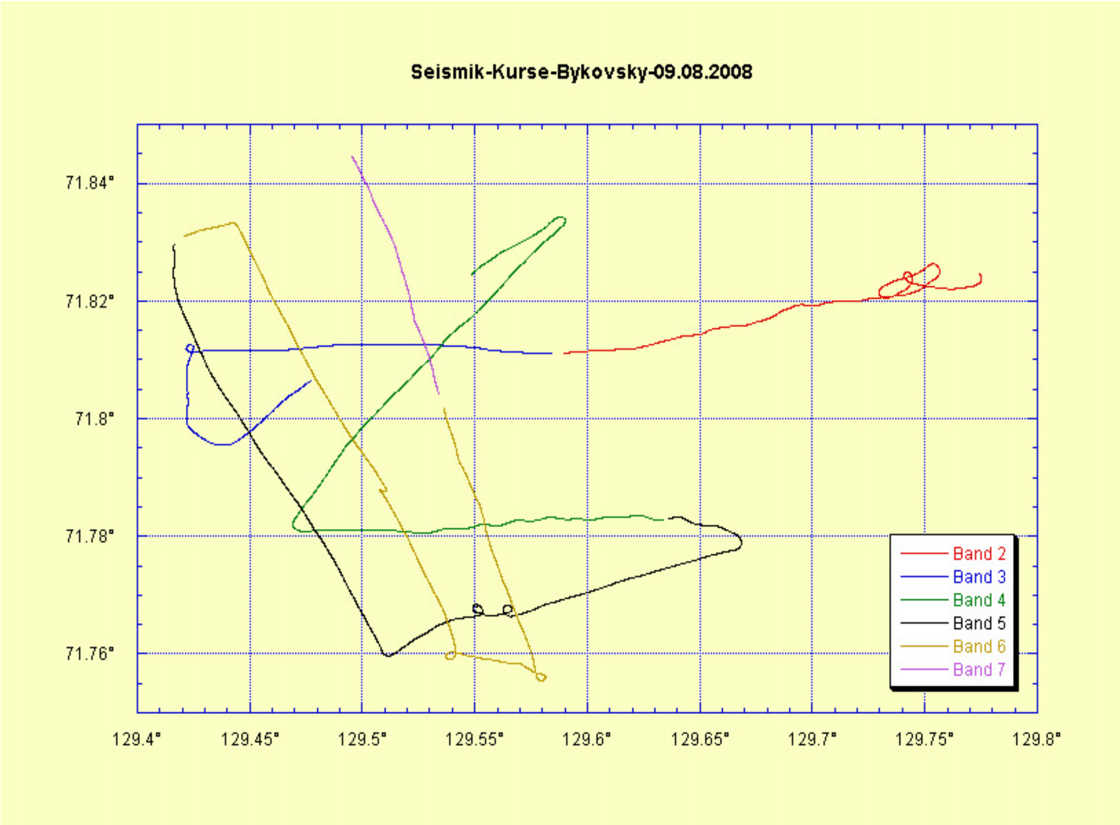

Figure 11-6: The seismic data collected east of Bykovsky Peninsula are divided into 6 profiles, shown in the following figures (Profile 1 in the next Figure, is not shown here).

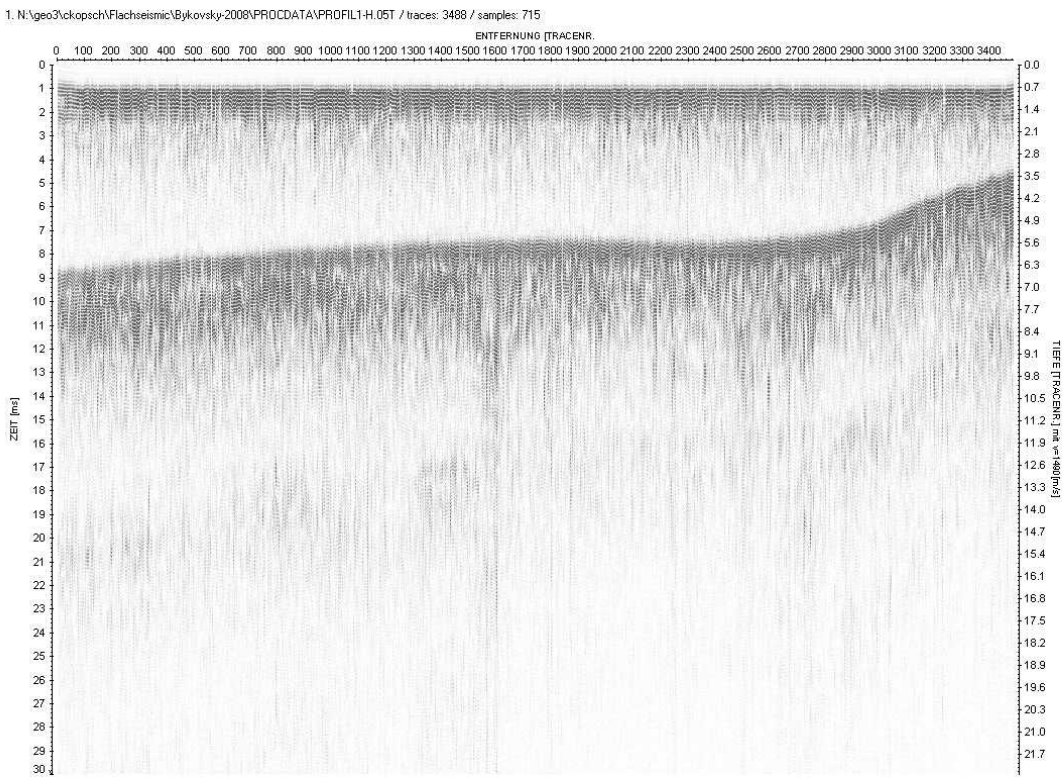

Figure 11-7: Seismic Profile 2 (see Figure 11-6).

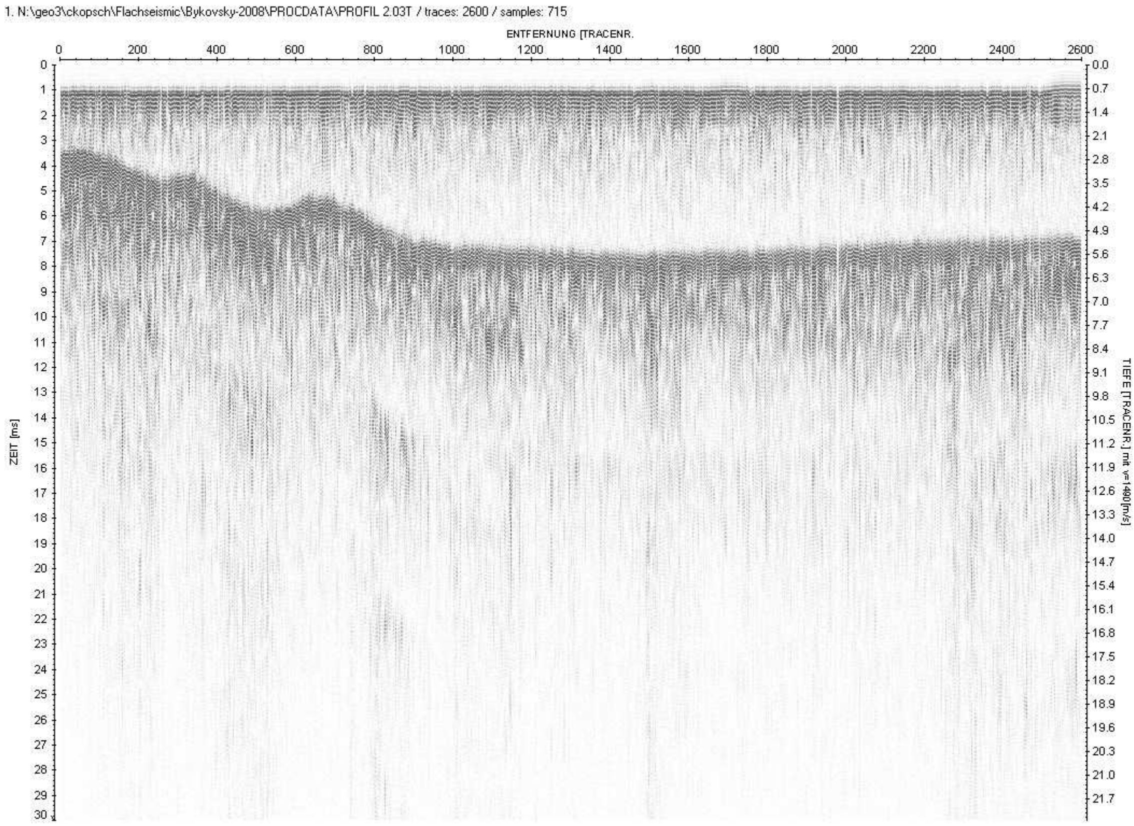

Figure 11-8: Seismic Profile 2 (see Figure 11-6).

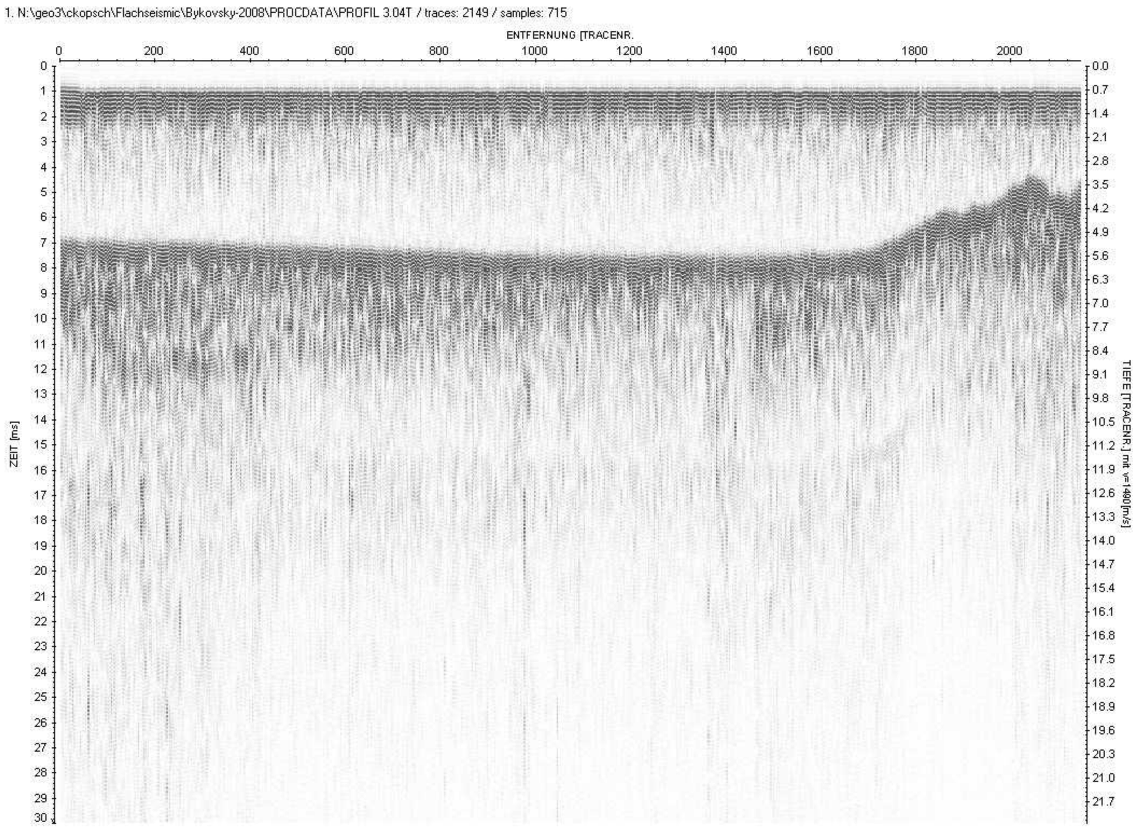

Figure 11-9: Seismic Profile 3 (see Figure 11-6).

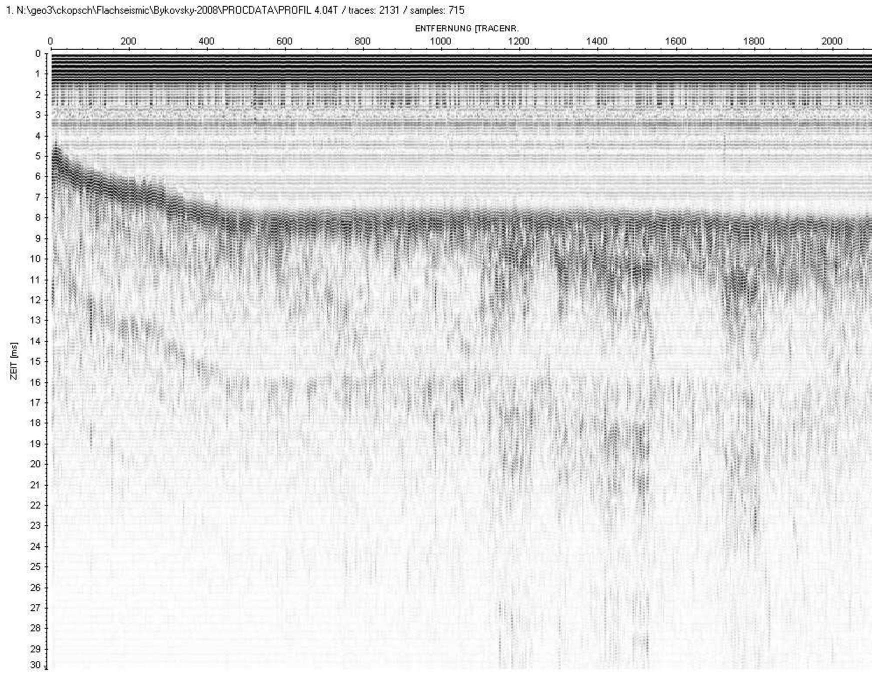

Figure 11-10: Seismic Profile 4 (see Figure 11-6).

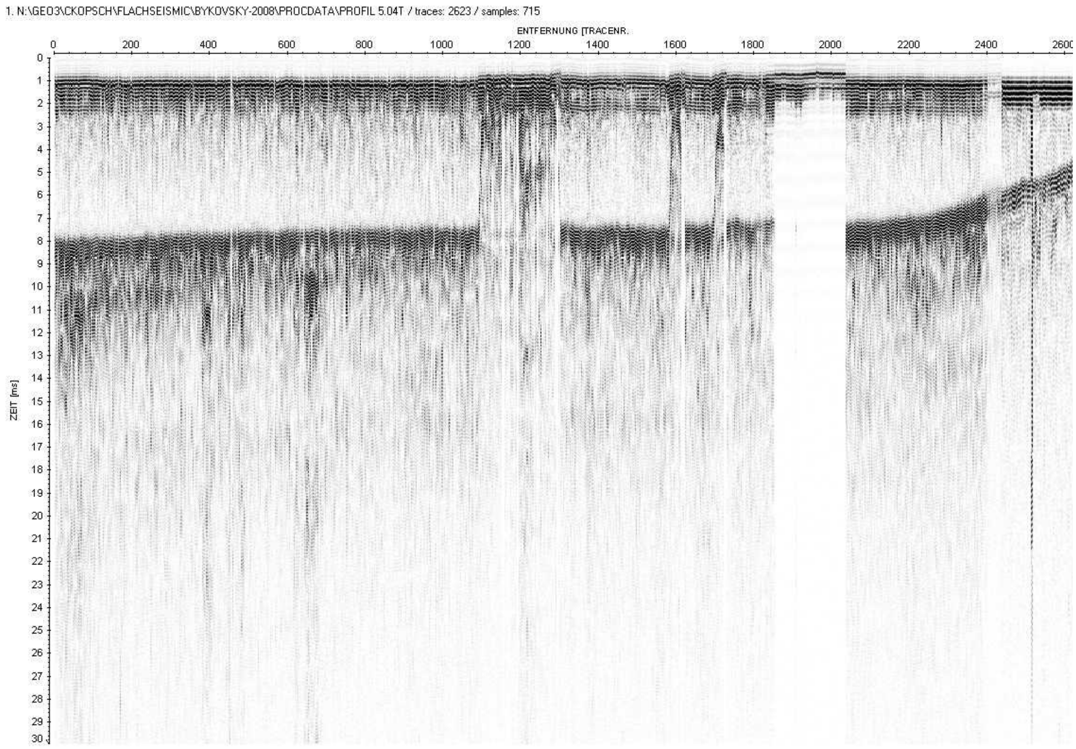

Figure 11-11: Seismic Profile 5 (see Figure 11-6).

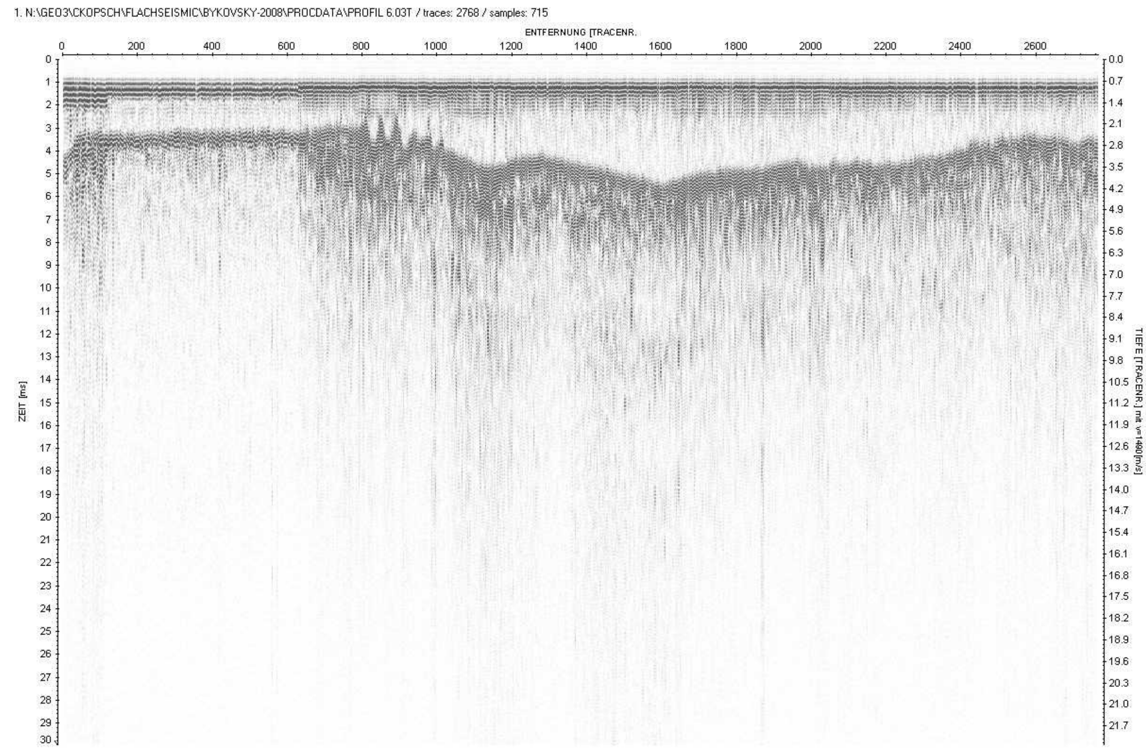

Figure 11-12: Seismic Profile 6 (see Figure 11-6).

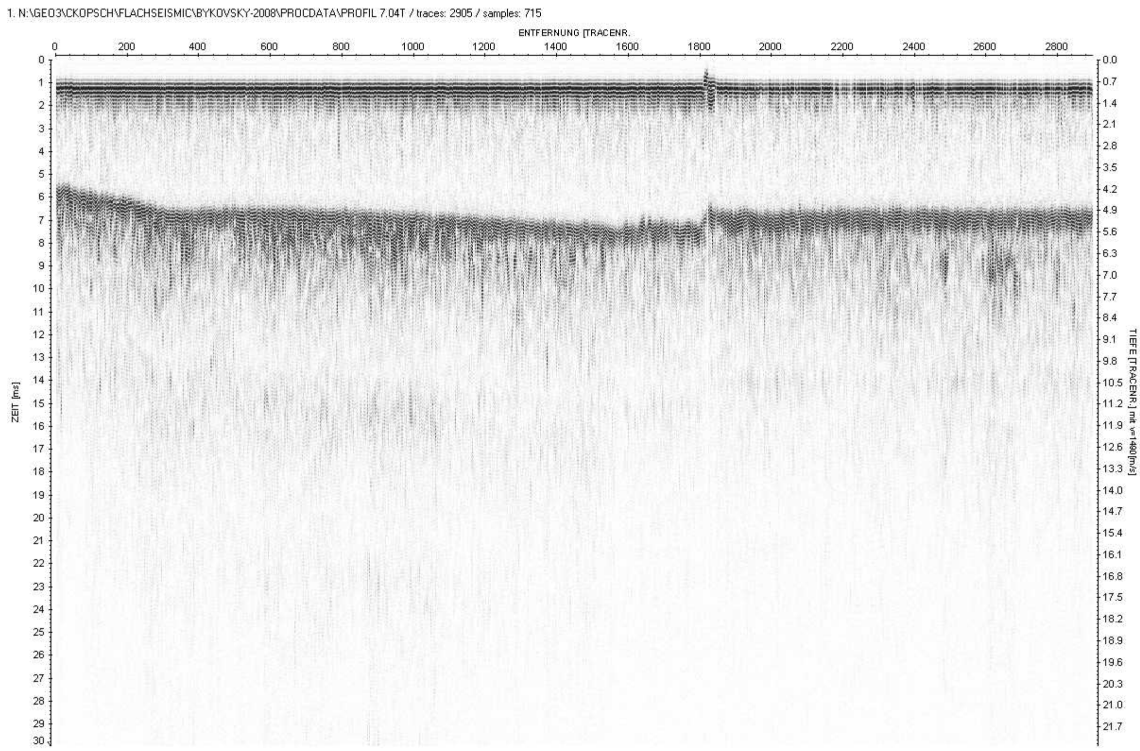

Figure 11-13: Seismic Profile 7 (see Figure 11-6).

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12. Geomorphological Route along the Kelimeer River

Dimitry Bolshiyanov and Aleksander Makarov

The main purpose of the route was to understand if the valley of Kelimeer River was previously occupied by main stream of the Lena River, as suggested by some investigators. The Kelimeer River is a right tributary of the Olenek River, but the head of its valley lies on the slope of Lena River valley. The route started from the mouth of Urukit River which is a right tributary of Kelimeer. Here in the mouth of Urukit River the terrace composed by basin sediments has been described. The height of the terrace is 81 m above sea level (25 m above the River).

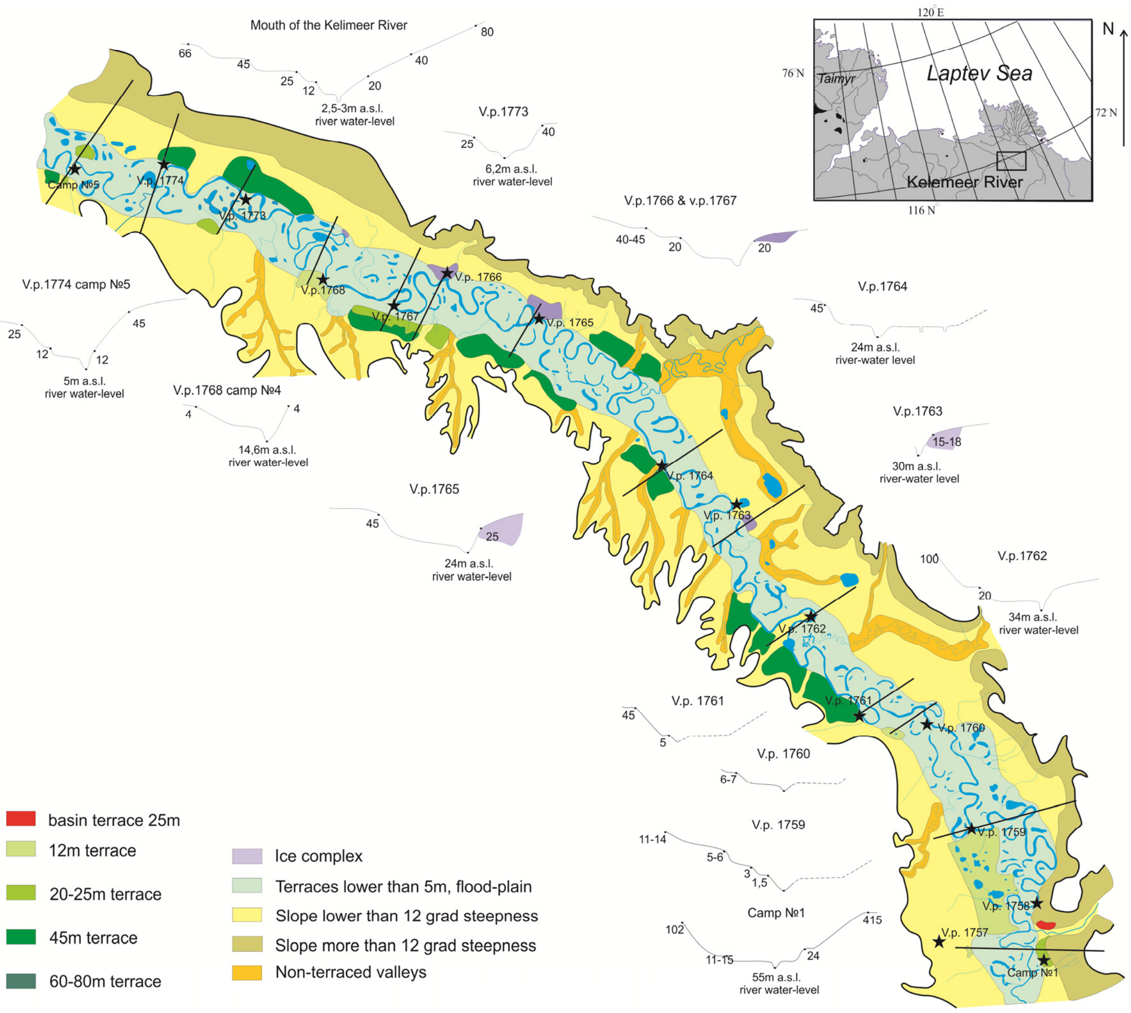

Figure 12-1: Geomorphologic map of the Kelimeer River.

The geomorphologic map of the Kelimeer River and geomorphologic profile along the valley has been constructed (Fig. 12-1, 12-2). Sediments from terraces have been taken for different analyses. There are 3 terraces in the valley. The first terrace is rising from 5-7 to 12-13 m toward the mouth. Second terrace is near 25 m above the bottom of the valley. In the middle of the route the second terrace is lowing up to 18-20 m. The third terrace is near 45 m. In the mouth of the River it is rising up to 50-55 m. Second and third terraces are compound. There is no much alluvium on them. The first terrace consists of silt and much of vegetative detritus especially in the mouth of the River.

Some sections of the Ice Complex sediments have been fixed along the right bank of the River. Ice Complex appears on 50 m above sea level at the point situated 47 km from the mouth. The upper part of the Ice Complex sediments is on the same height down the River. It means that sedimentation of the Ice Complex occurred in estuary during ingression of the Laptev Sea in to valleys in Late Pleistocene.

Main results of the route are:

- Lena River had never occupied the valley of the Kelimeer River
- sedimentation in estuaries took place sometimes in the valley both in Pleistocene and Holocene
- Ice Complex sediments formed in an estuary during ingression of the Late Sea

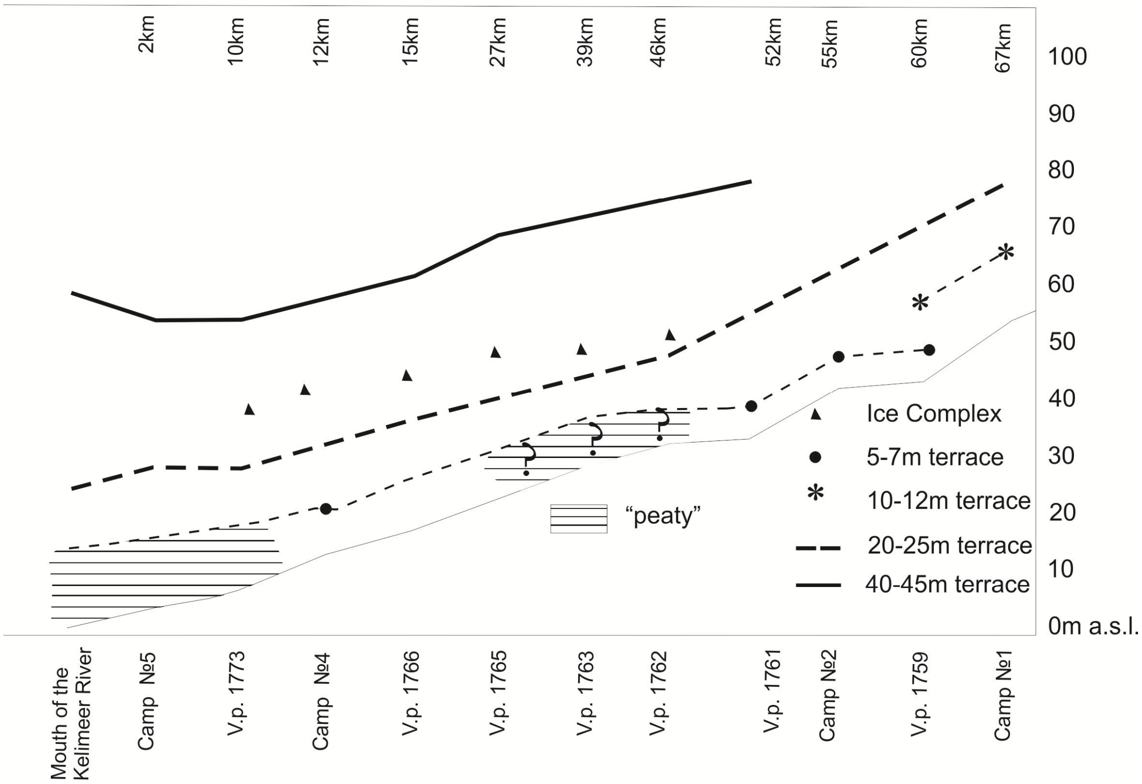

Figure 12-2: Geomorphologic profile along the valley of the Kelimeer River.

13. Lena Pilot Expedition 2008: Kick-off Platform for a Study of the Effects of Permafrost Warming and Sea Ice Reduction on Arctic Coasts

Maarten Boersma, Ingeborg Bussmann, Roland Doerfer, Phillip Fischer, Hans- Wolfgang Hubberten, P. Paul Overduin, Karsten Reise, Dirk Wagner and Karen Wiltshire

13.1 Expedition Background

Since 1985 the Lena Delta Reserve runs a base on Samoylov Island in the Lena Delta. As from 1998 the base has been run in close cooperation with the AWI. In 2005, the Samoylov Island was adopted as one of AWI's official polar stations. Thus far, this cooperation has been highly fruitful scientifically for both partners and the base serves as a starting point for many other institutes both from Russia and Germany and has resulted in an impressive publication list. Currently the main research interests of the AWI at Samoylov include the following topics:

- Carbon dynamics and microbial communities
- Observation of the tundra's energy and water budget across multiple spatial and temporal scales,
- Remote sensing and GIS on shoreline change and Tundra structures
- Hydrological studies in the Lena River Delta
- Studies on recent cryogenesis

A draft document describing past work at the station and a vision for future work is in preparation (Gukov and Hubberten, in prep.).

While these studies are mainly based on work in the Delta itself (a riverine and periglacially dominated sedimentary environment) it has been recognised that the warming of permafrost will have an impact on coastal dynamics and transport of particulate matter into coastal waters, either by shoreface erosion or input through riverine discharge. Both processes are expected to be intensified by global warming. How this could affect coastal morphology and productivity is unknown and can only be hypothesised. In the context of Arctic sensitivity to currently observed climate change, this approach is timely. In the AWI-GKSS research programme PACES: Polar Regions and Coasts in the Changing Earth System we have identified the need for the bundling of existing expertise at both GKSS and AWI in order to put forward socially useful hypotheses regarding the changing Arctic coast. This concept was persuasively presented to the AWI-GKSS peer reviewers and the Lena Pilot Expedition 2008 was initiated as the kick-off platform for a study of the effects of permafrost warming and sea ice reduction on Arctic coasts with particular emphasis on geomorphology and ecology.

13.2 Expedition Goals

The Pilot expedition had the following goals:

1. To introduce coastal scientists to the Lena Delta and inshore coasts of the Laptev Sea.
2. To introduce coastal scientists to the defining criteria of the Lena River.
3. To increase the communication between Arctic and coastal scientists.
4. To convey a rudimentary understanding of the Arctic coastal environment to the coastal scientists.
5. To increase understanding in Arctic partners of the interests and expertise of coastal scientists.
6. To develop working hypotheses and a plan of research action for the coasts affected by permafrost warming and sea ice reduction retreat.
7. To identify possible locations for an extensive arctic coastal expedition in 2011.
8. To identify the scientific tools appropriate to investigation of the area, which then must be prepared for an intensive field study.

13.3 Participants

The participant scientists were chosen for their broad expertise in the Permafrost and coastal fields and included:

H.-W. Hubberten (Mineralogist and Permafrost expert, AWI),

P. Overduin (Permafrost expert, AWI),

K. Reise (Coastal ecologist, zoobenthos expert, AWI)

I. Bussmann (Microbiologist, methane bacteria expert, AWI)

B. Heim (Remote sensing expert, AWI)

D. Mengedoht (Logistics, AWI)

K. Wiltshire (Hydrobiologist, AWI)

R. Doerffer (Hydrobiologist, Remote sensing expert, GKSS)

M. Grigoriev (Geomorphologist, Cryogenic Processes, Permafrost Institute, Yakutsk),

A. Gukov (Hydrobiologist, Lena Delta Reserve),

S. Evagrafova (Soil Microbiologist, Sukachev Institute of Forest, Krasnoyarsk),

I. Fedorova, Hydrologist (Dept of Hydrology, Uni. St Petersburg)

The expedition centred on the need for getting an overview of the Lena coastal system as cost and time effectively as possible and therefore was based on the Samoylov Island in the Lena Delta for ease of access. The delta and the coast were accessed using military helicopter, the Lena Delta Reserve RV-ORLAN and on foot at the various stops as listed below:

13.4 Itinerary

Melnikov Permafrost Institute in Yakutsk

Shortly after the arrival in Yakutsk the group was invited to the Melnikov Permafrost Institute by the director Rudolf V. Zhang. The importance of the collaboration between this Institute and the AWI was reinforced with this visit. The Melnikov Permafrost has a strong commitment to geological, applied geological and hydrological sciences. The possibility of extending the ongoing collaboration into biological fields was emphasised and supported. We were informed that at the University of Yakutsk there is also a Biological Department, which has the necessary expertise albeit mostly focussing on terrestrial biology. Prof. Shepelev emphasised that the most important aspect in extension of the Russian-German cooperation would be the support of young scientists. Director Zhang stressed that the Russian German cooperation is very important for his Institute. The cooperation Memoranda between the two countries are due to be extended in 2009.

Cape Mamontovy Klyk

Cape Mamontovy Klyk, located between the Olenok and Anabar rivers west of the Lena Delta, is the location of successful permafrost drilling on land and on the shelf carried out in 2003 and in the spring of 2005 from the sea ice. The ca. 80 m deep borehole on land is equipped with a thermistor string to continuously record the permafrost temperature and had to be visited in order to recover data from the loggers and to guarantee recording for the next 3 years. The objective of the visit for the pilot expedition was to get an impression of a typical coastal cliff of the “Ice Complex” (or Yedoma) in a coastal area with low freshwater influence. The flight to the site was used to introduce the geographical features of the transition from mountainous to deltaic landscapes south of the Olenok channel, and to demonstrate the variety of thermokarst processes active in the Lena Delta.

Samoylov Island

The bulk of our time was used for excursions on and from Samoylov Island. A half day excursion explored the features of a typically ice-rich permafrost island that formed during the Holocene in the middle of the Lena Delta. Processes leading to landscape transformation (thermokarst, lake drainage, coastal erosion, transport of organic material to the river, effect of flooding and destruction by river ice, etc.) were intensively studied. The numerous experiments installed over the last 10 years and currently underway on the island for measuring energy, water and gas exchanges and carbon turnover were visited. Explanations on methods and results were given by the students and scientists working at these sites. The logistic facilities of the station and its surroundings as well as the infrastructure for supply and transport were visited and discussed. Ideas for future use and change were elaborated.

Tit-Ary Island

Located at the southern inflow of the Lena River to the delta, Tit-Ary was originally the ultimate destination for Lithuanians and Finns exiled by the communists in the mid-20th century. Tit-Ary marks the transition between taiga and tundra and is situated on an elevated flood plain of the Lena River. The site was visited to understand the landscape and materials affecting the Lena before the river enters the delta and to gain an impression of the effect of the spring flooding of the Lena. The location characterizes the Lena River its transport upriver of the delta.

Sardakh Island

Sardakh Island is located in the second largest Lena branch in the delta, some miles north of Stolb Island. The older sedimentary deposits, mainly conglomerates containing the full range of rocks from the hinterland, demonstrate the transport energy of a river as large as the Lena, and its potential for material transport from land to the ocean.

Kurungnakh-Sise Island

Kurungnakh-Sise Island is composed of true ice complex deposits, also called “Yedoma”, which is the dominant sedimentary sequence of the coastal lowlands surrounding the Laptev Sea. During our visit to this location, a group of students from Potsdam and Hamburg working here for the summer explained their research goals and methods. The composition of ice-rich permafrost and the potential for organic material flux from land into the river (and perhaps ultimately the ocean) as a result of coastal erosion was shown.

Amerika-Khaya (mountain)

An ill-fated attempt on the North Pole led to the eventual demise of the American explorer, Commander George Washington De Long, and his crew in the Lena Delta. De Long’s grave gives this prominent exposure its name. From the top of this hill, an excellent overview allowed the demonstration of different processes in the delta, including the formation of polygonal landscape, shifting of river beds, accumulation of sandbars, and many others.

Nordenskiöld Station

The station, which is also operated by the Lena Delta Reserve, consists of several residential and work buildings. It is build on rock debris on the shore of the Lena River and is therefore not as suitable for climate change related studies of energy, water and carbon fluxes in a typical ice-rich permafrost area.

Bykovsky Peninsula

The first mammoth carcass was discovered at this location in 1799 emerging from Ice Complex deposits on the eastern coast of the Bykovsky Peninsula. The first coastal retreat rate observations for Yedoma coastlines were made here in the nineteenth century. Since 1998, this place has been visited by 3 AWI-Russian expeditions and is one of the best studied coastal sites in the Siberian Arctic. Currently, geophysical and thermal measurements are carried out offshore by AWI and Russian scientists. The site is proposed as a potential coastal site for intensive AWI-GKSS research within the PACES program.

Mys Muostakh

One of the most dramatic examples of coastal erosion of Yedoma deposits, Muostakh Island is a slender ca. 8 km long remnant of what is now the Bykovsky Peninsula. With an erosion rate of ca. 25 m/year the island is losing a huge amount of material each year, supplying the Laptev Sea with large amounts of sediment and organic material. Moustakh Island has been visited and studied by German-Russian expeditions almost every year since 1998.

Tiksi, Lena Delta Reserve Headquarters

In Tiksi, the offices and laboratories of the Lena Delta Reserve were visited and discussions of future cooperation were continued with the director, Dr. Alexander Gukov. For future Arctic coastal activities under PACES, the facilities may be used and will allow modern laboratory studies with the addition of some basic analytical facilities (microscopes, etc.). The guest apartment of the Lena Delta Reserve, used by our team while in Tiksi, may be used in future for longer periods during more intensive AWI-GKSS-Russian campaigns.

13.5 Recommendations for PACES

13.5.1 Introduction

The first impression which one reaches upon flying from Tiksi via Mamontovy Klyk and the coastal permafrost zone to the Samoylov station is that the sheer diversity and vastness of the Lena delta boggles all previous imagination, when one is not familiar with such landscapes. There are sheer coastal cliffs composed mostly of ground ice melting their way backwards, drawing the coastline with them, and releasing water and sediment into the shelf sea. There are tundra-covered mountains lifted up by plate tectonics. From the air, deltaic flood plains, bogs and rocks are covered in vegetation of varying hues corresponding to different degrees of wetness and surface soil depths and types. The landscape is dotted by millions of polygonal lakes often in checkerboard patterns, which when observed up close all contain different species assemblages and would be ideal for coastal limnological trophic studies. The expedition scientists spent many hours in the field in order to obtain a minimum understanding of the periglacial system in the delta, as well as optically assessing the type of vegetation and thickness of turf soils found on the top of the frozen layer. In this way, we got a picture of the huge scale of the erosion constantly taking place, mostly during the summer months. The sediment loading of the Lena is obviously very dependent on this erosion.

The Lena has an annual discharge of ca.760 km³ into the Laptev Sea and, with its length of 4400 km and drainage area of 2.49 million km², it is the major source of terrestrial suspended matter for the Laptev Sea. The Lena provides 65% of the total annual freshwater inflow into the Laptev Sea. The productivity of the Laptev Sea inshore (depths 10 m and less) coastal waters will be driven not only by sea ice and freshwater dynamics but by the input of Lena and coastal organic material. The % carbon in particulate matter in the Lena water is variable and seems to be low (compared to, for example, the Northern European Rivers; see Table 13-1). It is dependent on season and channel flow as well erosion rates. A value of the % carbon of inshore coastal waters is difficult to find in the literature and we thus far could find no numbers for the carbon dynamics and turnover. All evidence indicates that this is unusually low for a delta with a ROFI (= region of freshwater influence) of this size.

13.5.2 Development of working hypotheses

Both from our *in situ* observations (e.g. permafrost erosion, salinity and turbidity measurements, as well as observations on meiofauna and macrofauna in sediments) and discussions with local experts, we suggest a preliminary working hypothesis for the PACES Arctic Coastal Change Group (ACCG), below.

We have learned that the permafrost coast and delta comprise a zone without the usual high productivity and carbon turnover evidenced by other geomorphologically similar systems (e.g. the Mississippi, Ebro, and Wadden Sea). This zone lacks the potentially associated filter function of large deltas and estuaries between the land and the sea. This property is similar to other arctic estuaries, such as that of the Mackenzie and could be due to the extremely pulsed seasonal runoff (nival runoff regime) with high concentrations of mineralogical SPM, coupled with the very short growing season of this area and the short ice-free period (river and sea ice). The ROFI of the Lena-Laptev Sea region is potentially one of the biggest in the world and its productivity and carbon turnover unknown.

Thus, we pose the questions:

1. “How are climatically induced changes in hydrological and ice regimes (run-off, ground and sea ice) affecting carbon transport/ turnover and productivity in the Lena-Laptev region of freshwater influence?”
2. “What are the prospects of deltaic to open coast sedimentary and biogenic lowlands when underlying ice is thawing, flooding rate is increasing and wave action of arctic open waters is enhancing?”

The permafrost regions in the Arctic show evidence of increasing warming and in the Arctic Ocean decreasing sea ice cover has been well documented. Coastal retreat reaches a rate much higher than observed anywhere else in the world, particularly when the short erosion season and gentle shoreface profiles are considered. Because this erosion results in increased input of tundra soils and organic material to the riverine and coastal waters we could expect changed turbidity (= light limitation for phytoplankton) and different carbon cycling regimes with increased release of the climate gas methane to the system. Based on our current knowledge on the Lena ROFI as well as the continued climate change predictions of the IPCC we propose the following working hypothesis:

The low productivity Lena-Laptev ROFI will extend and the unique permafrost coasts will fade away.

We have identified five main areas of input thus far in order to start working on this topic: These include the following outline topics:

Permafrost erosional processes: Perennial ground ice and seasonal sea ice cover on the Laptev Sea distinguish its coastal dynamics from those in temperate or tropical coastal zones. Coastal erosion is favoured by large amounts of ground ice and silty sediments in the unconsolidated, permafrost shorelines, and the coastal bluff is affected by thermo-erosion. Yedoma deposits, which include buried periglacial ice up to 60 m thick, make the Laptev Sea coastline particularly sensitive to environmental forcing, even when compared to other arctic seas. The overall effect of permafrost coastlines is a higher erosion rate than observed at temperate (permafrost-free) latitudes (Are and Reimnitz, 2000). As a result, sediment, freshwater and organic carbon released into the Lena-Laptev ROFI must be considered to derive from both fluvial and coastal sources. A segmentation and classification of the coastline into 73 segments yields estimates of mass fluxes (Overduin and Couture, 2008). In the Laptev Sea, the coastal component of these fluxes is of the same order of magnitude as the fluvial, a consequence of the high erosion rates along high and ice-rich coastal bluffs (Rachold et al., 2000).

Bacterial activity and carbon cycles: The freight of suspended particulate matter (SPM) in the Lena River is quite high but in contrast to other rivers the % of organic matter is low. Also the amount of dissolved organic matter is rather high, however its chemical signature suggests that it is mainly determined by the input of soil derived, recalcitrant material (Rubén et al., 1998). Bacterial production in comparable arctic systems of Ob/Yenisei/Kara Sea and Mackenzie river/Beaufort Sea, decreased from high production in the rivers, estuaries towards low values in the open sea. (Galand et al., 2008). In these systems bacterial productivity was tightly coupled to primary production and was limited by the availability of organic carbon (Meon and Amon, 2004). First it has to be verified if this pattern is also applicable for the Lena–Laptev–ROFI. Data from (Saliot et al., 1996) for the Lena system show a different pattern.

Additionally, experiments to directly assess the influence of coastal melt water and water from erosive coasts on the bacterial production and population structure should be done. Further questions (and experiments) are the extent by which the bacterial production is transferred to higher trophic levels e.g. nanoflagellates. Furthermore, the impact of organic carbon (due to terrestrial permafrost degradation and coastal erosion processes) should be studied. The bacterial population between arctic river and the adjacent differs significantly (Galand et al., 2008).

Methane production and carbon in Lena ROFI: Large rivers are known to transport methane into coastal oceans, this will be especially true for the Lena draining from methane rich permafrost soils (500 -1000 nM methane in the Lena River have been measured in August 08). For the East Siberian Sea methane sources are thought to be rivers and bottom bound hot spots (Shakhova and Semiletov, 2007). However, new methane production in the riverine sediments is also possible. Interestingly, relative low methane concentrations have been found in the zone of maximal turbidity in the estuaries of several temperate rivers, indicating a intense oxidation of methane in this zone (Abril et al., 2007; Middelburg et al., 2002). For the Lena-Laptev-ROFI, zones of high methane concentrations and zones of high oxidation rates should be located, with special focus on the input from coastal melt water and water from erosive coasts. If methane may be an additional, readily degradable carbon source for bacteria, this carbon could be transferred to higher tropic levels as shown for other methane rich environments (Deines et al., 2007). The special isotopic signal of methane and methane oxidation could be traced to bacteriovorous eukaryotes. For methanogenic archaea (catalysing the final step of the anaerobic carbon decomposition) and methanotrophic bacteria (important bio-filters of methane) not much is known on their eco-physiology in respect to changes in salinity, low temperatures (freezing), effect of particles and inorganic nutrients (Morozova and Wagner, 2007). We already have a good overview of the methanogenic and methanotrophic populations in the tundra environments of the Lena Delta (Ganzert et al., 2007; Liebner et al., 2009). Thus it would be interesting to see if these populations are exported to the river (with coastal erosion) and how their composition and activity changed in the aquatic environment.

Phytoplankton productivity: One of the first items on the agenda when evaluating the productivity of a coastal aquatic system has to be the evaluation of phytoplankton productivity. This cannot be carried out merely by counting micro algae over seasons but rather integrative light and photosynthetic measurements should be carried out in regular intervals over transects over different depths from the point of ice break up until ice over in the ROFI. CHN and pigment measurements of the particulate matter as well as nutrient measurements of the water columns should be carried out. At the same time an evaluation of the major planktonic groups with indicative grazing and respiration experiments should be carried out in order to estimate the potential variability of the net production. The introduction of an automatic system measuring pH, CO2, O2 and fluorescence should seriously be considered for a Russian research vessel (ORLAN?) and at a stationary site. The Ferry Box system of the RV Uthörn could serve as a model. The aim of all these measurements should be to underpin and elaborate upon existing Russian data and should provide us with ground truth Data for remote sensing and model evaluations.

Secondary production: Previous studies have shown that autochthonous primary production in the north-eastern and western Laptev Sea might not be sufficient to fuel both pelagic and benthic secondary production, and, hence, input of allochthonous organic carbon is required to balance the overall carbon demand. Furthermore, a high proportion of primary production is channelled through the benthic trophic web, bypassing the pelagic trophic web in the Laptev Sea. In contrast, the primary production in the estuarine area seems to be sufficient for secondary production, where small-size copepods dominate the herbivorous mesozooplankton, with a large number of freshwater species in the coastal areas. Most likely, the increased turbidity will lead to a decrease in primary productivity especially in the coastal areas, which will be followed by a decrease in secondary production. At the same time the stoichiometry of the available algae should change as decreasing light and increasing run-off should lead to a decreasing C:nutrient ratio of the algae, which will influence the quality of the algae as food for zooplankton, possibly favouring those species that do not need to build-up large depositories of lipids.

Benthic consumption and fish: Benthic fauna within the Lena-Laptev ROFI is challenged by a 3-fold harshness: bottom-fast ice and ice scouring at shoals and shores <2 m in depth, disturbance by a strong and turbulent pulse of riverine discharge at the onset of summer, high suspended matter concentration with a low share of phytoplankton. The overall effect is an impoverished zoobenthos. Nevertheless, there may be locally some sheltered and deep limnic sections allowing opportunistic small bivalves (Sphaeriidae), oligochaetes and chironomid larvae to develop on which demersal fish can feed upon. Very few species occur in the brackish nearshore zone of the Laptev Sea above 10 m depth (Gukov, 2001; Petryashov et al., 1999), i.e., the sedentary bivalves *Cytodaria kurriana* and *Portlandia aestuariorum*, and highly mobile peracarid crustaceans such as *Saduria entomon, Pontoporeia spp., Gammarus wilkitzkii, Onisimus birulai*, a few annelid worms and meiofauna dominated by nematodes and foraminiferans. Biomass is extremely low in this shallow zone, and a benthic estuarine filter function is hardly in place. Still, for comparative purposes, a quantification employing a box corer and also mesh sizes <1 mm as well as the determination of biomass in g C m^{-2} needs to be accomplished. A variety of anadromous fish pass through the ROFI, feeding on planktic and benthic invertebrates. During migration period these (i.e., Whitefish *Coregonus spp.,* Siberian sturgeon *Acipenser baeri*, Arctic char *Salvelinus alpines,* Smelt *Osmerus eperlanus*) can be highly abundant but it is not clear to what extent the

ROFI provides a feeding ground or merely a zone of passage for upstream spawning. This question shall be addressed in 2011 by analyzing fish otholiths resp. fish tissue of the main migratory species with respect to the isotopes δ15N, δ34S or δ13C. As a quantitative measure of continental-marine coupling in complex coastal environments, we will specifically focus on the importance of the estuarine and freshwater feeding habitats for the Lena-Delta fish population.

Hydrology: A profound knowledge of the hydrology / hydrography of the Lena delta and its coast is of fundamental importance for all other investigations concerning bio-geochemical processes, erosion and transport living conditions for organisms. It includes a detailed bathymetry of the area, data about the Lena run off with gauge measurements at the entrance of the delta, ice coverage of the Lena, the branches in the delta and the pack ice coverage and transport in the coastal water, run off from island during the snow melting period, time series of local wind fields to determine waves and ice drift, measurements of currents in the river and the coastal water of the Laptev Sea. Some of these data are available in literature others must be retrieved from satellite observations. During the field phase in 2011 it is planned to install a FerryBox system on one of the Russian survey ships to make measurements of basic hydrographic and bio-geochemical variables along transects, which will be selected based on information retrieved from satellite data. These measurements will include e.g. temperature, salinity, current, light attenuation, SPM, chlorophyll, nutrients.

Remote sensing: Due to the vast extension of the Lena Delta area, remote sensing will become an important tool to map the spatial distribution and temporal development of some key variables. We plan to use radar images (e.g. ASAR of ENVISAT) to monitor ice distribution and waves, infrared radiometer (e.g. AATSR) to monitor temperature and spectral reflectance data (MERIS) to monitor suspended matter, organic matter , phytoplankton and the water transparency and snow coverage Satellite data will be collected for the next 2 years to prepare the field investigations in 2011. The results will be provided in form of maps of different seasons and will be used also for adjusting the SPM transport and primary production model. In addition remote sensing observations have to be supported by in situ observations (1) to adapt available algorithms to the properties of the area and (2) to validate the results derived from satellite data. In particular the high SPM concentrations require a special procedure.

Marine mammal's health status: The coast of the Lena reserve is home for walrus populations and other seals. This provides a unique opportunity to analyze the health status of these mammals as a basis for later observations when an increased stress due to coastal change and economic development might change the living conditions for these animals. Furthermore, these data can be compared to the health status of populations of other arctic areas, where living conditions are different.

Modelling of LENA ROFI: Numerical models will be an important tool to determine water level, currents, waves and the transport of water and suspended matter in the delta and coastal area. In addition to satellite data it will be used to delineate the extension of the ROFI and the turbidity zone. Of interest is e.g. the question of SPM re-suspension and transport during the ice free period when wave induced erosion processes cause an increase in SPM concentration. To establish and adapt the models to the Lena area data about bathymetry, water level at some gauges of the Lena and wind fields are required. For simulating the transport of SPM also the kind of sediment in the Lena and coastal water is important to know. An extension of the model will be used to determine the primary production potential as a function of nutrients, temperature and light climate. For the computation of the production measurements of the light – production relationships (PI-parameters) are necessary for the phytoplankton species, which are present in the area.

Logistic possibilities: For more than 10 years, AWI-Russian expeditions have been carried out on Samoylov Island in the Lena Delta and at islands and along coastlines surrounding the Laptev Sea. During this time very close partnerships were created for science and for logistics. The overall logistic partner is the Arctic and Antarctic Research Institute (AARI) in St. Petersburg (Dr. D. Yu. Bolshiyanov), who oversee research permits, customs formalities, visas, etc. The Yakutian partner is the Permafrost Institute in Yakutsk (Dr. M. Grigoriev), responsible for Yakutian affairs and specific local permits. In Tiksi, the director of the Hydrobase (D. Melnishenko) is responsible for such local logistics as transport, housing in Tiksi, energy supply, etc. The warehouse of the Hydrobase in Tiksi is partly used by the AWI-Russian expeditions. The operation of Samoylov Station is organized by the Lena Delta Reserve (Dr. A Gukov), which is the owner of the station and is represented by a ranger or station leader almost year-round. The station is an official Russian-German research station, as agreed by the representatives of relevant ministries during annual meetings for scientific cooperation in polar and marine science. The facilities of Samoylov Station are described in (Hubberten et al., 2006). Due to the erosion by Lena River, the station is currently in danger of being washed into the river. It is therefore necessary to move and/or rebuild the station further from the river shore.

We have tentatively agreed upon some baseline parameters (Table 13-2) and methods (Table 13-3) which could be important to the study and where all efforts should be made to obtain both Russian and international literature on the region. We should consider setting up a Lena ROFI data bank within PANGAEA also containing all the relevant literature. Every effort should be made to translate the definitive Russian books for the area.

Potential deliverables

Model SPM transport and dynamics

PP model

Scenarios of future development of Lena under climate change

Monitoring concept to monitor further development

Model of carbon dynamics of LENA ROFI

3 years time series of satellite data

Description of ROFI processes

13.5.3 Notes on sampling sites & logistics

First discussion indicates that we need information in the Delta itself, in the ROFI with high turbidity and in the coastal zones without direct or with moderate freshwater influence. These could be:

1. (Coastal Permafrost suspended matter) Mamontovy Klyk
2. Fluvial transported suspended matter & coastal Permafrost suspended matter (Bykovsky Peninsula)
3. Samoylov (as Delta base)

As yet it has to be discussed which form of logistics we require. However, summing up the needs identified to date would indicate that we require both shore bases for permafrost and runoff studies, as well as ship time with the possibility of obtaining good bathymetry and hydrography as well as the infrastructure for intruding sampling gear such as Calcofi nets, sampling rosettes and sediment sampling devices. The question as to whether and which lab space we need on land needs clear consideration as two of the emphases must be production measurements and foodweb dynamics requiring experiments.

Time frame

The first large scale campaign with all partners should be in July-August 2011. In 2010 all logistics with regard to ships, additional bases, and laboratory space need to be in place.

Apart from this we have set ourselves the following deadlines:

End Nov 2008: Identify necessary partners.

End May 2009: Identify necessary ship, lab, and laboratory resources and locations.

We have planned an internal workshop in Hamburg (ZMAW GKSS rooms) on March 5-6, 2009) 11:00- 20:00, 9:00-12:00. A maximum of 15 people should take part!

13.5.4 Notes on Partners

Perhaps the most challenging aspect of devising a plan for the Arctic Coastal Change Group (ACCG) is defining an operative concept with Russian partners on a 1:1 scientist basis. The latter is of utmost importance since the AWI does not have the background local know-how in the study areas and also because the AWI does not seek to dominate in Russian coastal science. We identify an urgent need to incorporate this concept in all future work in arctic Russia and also go as far as to suggest that any other German partners should also rigorously to stick to this 1:1 rule.

It is also very important that all collaborating European Partners come together on a regular basis to compare notes and experiences as well as coordinate the scientific programme. No institution should project a competitive stance regarding another institution as this causes dissent on the ground and in everyday logistic dealings with Russian Partners and thus, reduces effectiveness overall. Naturally every diplomatic effort should at all time be employed particularly at hosting institutes and in home base interactions to ensure that all can continue to produce excellent science with our Russian Hosts.

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Table 13-1: Heterogeneity of suspended particulate matter in channels of the Lena delta (2003).

Properties	Main channel		Channels		
	Delta's top	Stolb Island	Olenekskaya	Trofimov-skaya	Bykovskaya
dry weight, mg l^{-1}	10.6	7.3	7.1÷85.2 / 31.3	37.4	7.4÷44.3 / 24.1
C_{org}, %	7.3	8.7	2.9÷11.3 / 6.6	4.0	3.0÷11.0 / 5.1
*MP, %	85.4	82.6	77.4÷94.2 / 86.8	92.0	78.0÷94.0 / 89.8
C_{org}, µg l^{-1}	778	635	633÷2727 / 1290	1486	562÷1327 / 946
N_{org}, %	0.8	1.0	0.3÷1.4 / 0.8	0.4	0.3÷1.2 / 0.6
N_{org}, µg l^{-1}	82	72	74÷300 / 141	161	58÷154 / 102
C/N	9.5	8.9	8.0÷9.1 / 8.6	9.2	8.7÷10.3 / 9.4
$\delta^{13}C$ ‰	-26.62	-28.13	-30.45÷-26.71 / -27.87	-24.63	-28.24÷-24.53 / -26.43
$\delta^{15}N$ ‰	3.88	3.10	3.39÷5.69 / 4.31	4.28	2.08÷6.13 /3.78

* - mineral part of SPM

Table 13-2: Base-line parameters.

Sea ice distribution and retreat
Bathymetry
Runoff
waves
Coastal erosion
Turbidity
Salinity
Light climate
Time
Temperature
Nutrients
Carbon turnover
Bacterial activity
Primary and secondary productivity
Benthic consumption
Fish
Mammals?
Sea Birds?

Table 13-3: Potential Methods.

Remote sensing (ice coverage, waves, coastline, light, turbidity, chlorophyll, morphometry)
Optical parameters
Drilling
Seismic, geoelectric surveys, bathmetry
Long term logging physical parameters (Ferry box- Hydrobase/LDR)
Water chemistry
Carbon (H N) analyses of suspended matter/sediments
Winkler
Leucin & Thymidine incorporation
Methane consumption/ conc
Bacterial diversity (molecular genetics)
Algal productivity (winkler/ 14C)
Grazing experiments
Macro/Meso organismns (Benthic box corer)
Dry organic weight (0.1mg- 1g range)
Particle size

14, Appendix

14.1 Weekly Reports (in German)

Wochenbericht Sommer Nr.1, 14. Juli 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen,

am Mittwoch, den 9. Juli 2008 begann die 11. Expedition des Alfred-Wegener-Instituts (AWI) ins Sibirische Lenadelta. Ziel der Expedition ist die Russisch-Deutsche Forschungsstation Samoylov auf der gleichnamigen Insel im sibirischen Lena-Delta, bei etwa 72° nördlicher Breite und 126° östlicher Länge.

Die Station

Während des ersten Fahrtabschnittes, der bis Anfang August dauert, arbeiten diesmal folgende Kolleginnen und Kollegen an der Station:
Dirk Wagner, AWI-Potsdam, Geomikrobiologe
Katharina Koch, AWI-Potsdam, Geomikrobiologin (Doktorandin)
Moritz Langer, AWI-Potsdam, Hydrologe (Doktorand)
Waldemar Schneider, AWI-Potsdam, Geophysiker und Logistik
Günter (Molo) Stoof, AWI-Potsdam, Ingenieur
Niko Bornemann, Universität Potsdam, Diplomand Geoökologie
Christian Knoblauch, Universität Hamburg, Biogeochemiker
Claudia Fienke, Universität Hamburg, Bodenmikrobiologin
Tina Sanders, Universität Hamburg, Bodenmikrobiologin (Doktorandin)
Katya Ambramova, Lena Delta Reserve, Zoologin
Irina Grodnitzkaya, Sukashev Institute of Forest, Mikrobiologin
Anna Urban, Permafrost Institute Yakutzk, Geokryologin (Doktorandin)

Seit zwei Tagen sind wir nun auf der Insel. Es hat alles problemlos geklappt. Nur bei der Anreise mussten wir wetterbedingt zunächst nachYakutzk, da der Flugplatz in Tiksi wegen Nebels gesperrt war. 30°C in der Nähe des Kältepols der Nordhalbkugel ließen uns noch einmal so richtig Wärme speichern und den Sommer genießen. Für Tiksi waren dann Temperaturen knapp über dem Gefrierpunkt angekündigt. Mit 24-stündiger Verspätung wurde Tiksi erreicht. Alles Notwendige konnte in kürzester Zeit erledigt werden, und am Folgetag zur Mittagszeit landeten zwei Hubschrauber mit uns und einem Großteil unserer Fracht auf Samoylov. Die folgenden Stunden forderte dann wie immer von Jedem alles ab: Kistenschleppen, einräumen, Zelte aufbauen, Infrastruktur erstellen und zum Schluss die entspannende Sauna.

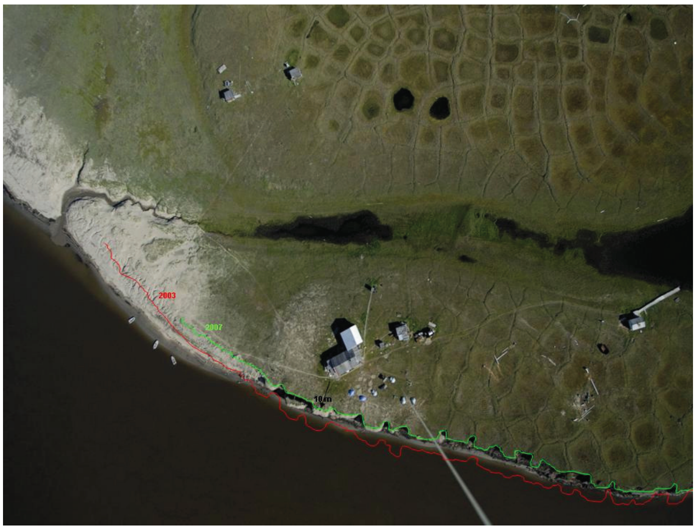
Das war Vorgestern, heute haben wir auf der Trauminsel bei leichtem Wind 25°C, ein Sommertag hinter dem nördlichen Polarkreis. Die Arbeiten wurden in vollem Umfang aufgenommen und das Stationsleben normalisiert sich, jeder kennt in der Zwischenzeit die Besonderheiten des Stationsalltages und findet auch schon mal die Zeit, sich an den Schönheiten Samoylovs zu erfreuen, denn überall bedeckt die Tundra ein farbenfroher Blütenteppich und die Tierwelt ist damit beschäftigt, seinen Nachwuchs großzuziehen.

Die wissenschaftlichen Arbeiten konzentrieren sich während der erstenZeit auf die Untersuchung der Kohlenstoff- und Stickstoffdynamik und der zugrunde liegenden mikrobiologischen Prozesse, der Energie- und Wasserbilanz sowie der Ökologie des Zooplanktons. Dazu werden die Langzeitmessungen zur Methanemission und der Mikrometeorologie, die bereits 1998 begonnen wurden, fortgesetzt. Der Einfluss von Klimaänderungen auf den mikrobiell gesteuerten Kohlenstoffumsatz wird an verschiedenen Permafrostböden auf der Nachbarinsel Kurungnakh untersucht. Außerdem werden Arbeiten zur Energie- und Wasserbilanz sowie zum mikrobiellen Stickstoffumsatz, die im Rahmen zweier Doktorarbeiten des AWI-Potsdam und der Universität Hamburg im letzten Jahr begonnen wurden, fortgeführt. Detaillierte Informationen zu den einzelnen Forschungsthemen folgen in den nächsten Wochenberichten.

Mit herzlichen Grüssen in die Heimat,
Katharina, Moritz, Waldemar, Molo, Niko, Christian, Claudia, Tina, & Dirk
und natürlich auch die besten Grüße unserer russischen Kolleginnen Ira, Anna & Katya

Wochenbericht Samoylov Nr. 2, 21. Juli 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen,



die erste Woche des diesjährigen Aufenthaltes auf Samoylov verging wie im Fluge. Vieles ist schon geschafft, manches muss noch begonnen werden. Der Großteil der Arbeiten läuft auf Hochtouren und manche neue Idee wird geboren. Das gegenseitige Miteinander bei teilweise sehr beengtem Arbeitsplatzangebot ist ausgezeichnet. Eigentlich sollten wir jetzt Hochsommer haben und Myriaden von Mücken (eigentlich wollten wir ja nichts mehr über die kleinen Plagegeister berichten, da uns in dieser Hinsicht ja sowieso niemand so recht glauben schenken mag…) uns plagen. Doch weit gefehlt, Schmuddelwetter bei Temperaturen im unteren einstelligen Bereich lassen zurzeit keine Badefreuden in der fast 20℃ warmen Lena aufkommen. Unsere gefiederten Freunde auf der Insel haben in der Zwischenzeit ihre Jungen großgezogen und mit der zweiten Brut begonnen, und nach wie vor können wir uns am allgegenwärtigen Blütenteppich auf Samoylov erfreuen.

Erste Messungen der Permafrost Auftautiefe ergaben, dass dieser im Vergleich zum Vorjahr bislang um 10% weniger aufgetaut ist. Die mittlere Tiefe lag am 14.07.08 bei 28,5cm. Der in der letzten Saison festgestellte verstärkte Landverlust der Insel vor der Station schreitet auch in diesem Jahr fort. Vor einigen Tagen musste die stationseigene Kurzwellenantenne umgesetzt werden da die südliche Verankerung sprichwörtlich den Boden unter den Füßen verloren hatte.

Alle wissenschaftlichen Programme laufen bereits auf Hochtouren. Einige müssen ihre Arbeit in 4 Wochen schaffen bzw. an die Kollegen des zweiten Fahrtabschnittes übergeben, andere haben für ihre geplanten Arbeiten 8 oder mehr Wochen Zeit. Während die Kollegen, die sich für die Hydrologie und Wärmebilanz interessieren noch eifrig an ihren neuen Messapparaturen schrauben, haben die Mikrobiologen bereits ihre ersten Proben unter in-situ-Temperaturbedingungen inkubiert.
Ein Teil der diesjährigen Expeditionsarbeiten beschäftigt sich mit der Stickstoff-(N)-Dynamik in den jährlich auftauenden Bereichen (active layer) der Permafrostböden. Während schon relativ viel über die C-Flüsse und ihre steuernden Prozesse in arktischen Tundren bekannt ist, gibt es zum größtenteils mikrobiell gesteuerten N-Kreislauf in kalten Böden noch interessante, offene Fragen. Voruntersuchungen zu diesem Thema wurden bereits auf der Expedition 2005 begonnen, letztes Jahr im Rahmen der Doktorarbeit von Tina Sanders fortgeführt und auf der diesjährigen Expedition von Tina Sanders und Claudia Fiencke vertieft. Die Untersuchungen sollen zur Aufklärung der N-Dynamik in den kleinräumig wechselnden Bodenparametern der polygonalen Permafrostböden und zur Anpassung der N-Organismen an die extremen Standortbedingungen beitragen. Mit den angelaufenen Messungen werden die potentiellen Aktivitäten von stickstoffumsetzenden Mikroorganismen, mit Schwerpunkt auf N-Mineralisation, Nitrifikation und Denitrifikation in unterschiedlichen Böden und Tiefen untersucht. Durch Hemmversuche soll geklärt werden welche Organismen, Bakterien oder Archaeen, bei den Umsetzungen, speziell der Ammoniakoxidation, beteiligt sind. Um Aufschluss über den Abbau der pflanzlichen Biomasse zu erhalten, werden in einem Langzeitversuch „Litter bags“ (Pflanzenbeutel) im Boden vergraben.

Nach einem sehr intensiven Arbeitstag, an dem viele Proben aufbereitet wurden, werden wir uns nun den jährlich wiederkehrenden unabdingbaren Feierlichkeiten widmen…welchen wir uns vor 2 Tagen zumindest schon zu 50% hingaben…

Mit herzlichen Grüssen in die Heimat,
Katharina, Moritz, Waldemar, Molo, Niko, Christian, Claudia, Tina, & Dirk
und natürlich auch die besten Grüße unserer russischen Kolleginnen Ira, Anna & Katya

Wochenbericht Samoylov Nr. 3, 28. Juli 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen!

Ende Juli, Hochsommer und Aprilwetter mit Schneeschauer bei Temperaturen knapp über dem Gefrierpunkt, so sieht es zur Zeit aus auf Samoylov, im Lenadelta, nördlich des Polarkreises im fernen Sibirien. Im Vergleichszeitraum des letzten Jahres lagen die Außentemperaturen um 13℃ über denen der vergangenen Woche in diesem Expeditionsabschnitt. Die letzte Messung der mittleren Permafrost-auftautiefe ergab am 23.07.08 einem Wert von 35,85 cm. Das sind 1,35 cm weniger als zum gleichen Zeitpunkt des letzten Jahres. Der einzig gute Tag der letzten Woche konnte zur Entnahme von Permafrostproben am Kliff der Nachbarinsel Kurughnakh genutzt werden. Eine weitere Fahrt musste heute wetterbedingt ausfallen. Weiße Schaumkronen schmücken den Seitenarm der Lena vor unserer Haustür, wofür ein mäßiger Westwind verantwortlich ist.
An den Vorräten ist zu erkennen, dass sich der erste Expeditionsabschnitt seinem Ende nähert. Beliebte Leckereien sind aus, Kaffee gibt es nur noch ein Päckchen und der Brotbackautomat muss nun des Öfteren in Betrieb genommen werden. Den nächsten Supermarkt gibt es halt nicht hinter der nächsten Ecke, und wer nicht rechtzeitig plant, muss sich hier später dann eben einschränken.

Die wissenschaftlichen Arbeiten schritten auch in der zurückliegenden Woche gut voran. Zur Routine gehört inzwischen die Gasprobennahme am Dauermessfeld zur Ermittlung der täglichen Methanemission, wofür in diesem Jahr Katharina verantwortlich ist. Ebenso zur Routine geworden sind die täglichen Messungen von Methan und Kohlendioxid der verschiedenen mikrobiologischen Experimente (mehr dazu im nächsten Wochenbericht). Dank des neuen Gaschromatographen, der von unseren Hamburger Partner zur Verfügung gestellt wird, laufen diese Messungen bisher ohne Beanstandung, sodass ein großer Probendurchsatz gewährleistet ist. Moritz und Niko, die sich in diesem Jahr mit den Energie- und Wasserbilanzen der Tundrenböden beschäftigen, haben inzwischen einige Wehre zur Messung der Abflussraten installiert, einige Lysimeter zur Bestimmung der Verdunstung vergraben und eine Infrarotkammera zur Messung der Wärmeverteilung eines typischen Polygons (typische Oberflächenstruktur von Tundren, die sich aufgrund der großen Temperaturunterschiede zwischen Sommer und Winter bilden – siehe Foto) aufgestellt.

Mit von der Partie ist dieses Mal auch wieder unsere russische Kollegin Katya Abramova vom Lenadelta-Reservat, die sich bereits seit einigen Jahren mit der Untersuchung des so genannten Zooplanktons (mikroskopisch kleine Tierchen, wie zum Beispiel der Wasserfloh) in den Seen Samoylovs beschäftigt. In Wasserproben werden dabei die Zusammensetzung, die Verbreitung und die zeitliche Dynamik der Zooplanktonpopulationen untersucht. Die Zusammensetzung der Fauna, aber auch der Flora, in den arktischen Seen ist ein sehr empfindlicher Indikator für den gegenwärtigen ökologischen Zustand der Gewässer und der möglichen Veränderungen im Zuge sich ändernder Umweltbedingungen. In den letzten Jahren konnte beispielsweise ein Anstieg der Artenzusammensetzung, der so genannten Diversität, beobachtet werden. Dieser Anstieg geht vermutlich auf den Einfluss der häufiger höher ausfallenden Frühjahrshochwässer der Lena zurück, die zu einer regelmäßigen Überflutung der Seen beitragen. Dabei konnten auch Arten bestimmt werden, die normalerweise gar nicht in den arktischen Regionen vorkommen, sondern weiter südlich verbreitet sind. Die Zusammensetzung und Anzahl dieser für die Arktis neuen Arten variiert in den Seen in Abhängigkeit von den hydrologischen Bedingungen und den Nährstoffbedingungen in den einzelnen Seen.

Abschließend bleibt festzuhalten, dass wir über den kühlen Sommer in diesem Jahr nicht traurig sind, da dadurch die Mückendichte gegen Null tendiert und ein störungsfreies Arbeiten im Freien erlaubt…

Mit herzlichen Grüssen in die Heimat,
Katharina, Moritz, Waldemar, Molo, Niko, Christian, Claudia, Tina, & Dirk
und natürlich auch die besten Grüße unserer russischen Kolleginnen Ira, Anna & Katya

Wochenbericht Samoylov Nr. 4, 4. August 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen!

Der letzte Tag des ersten Expeditionsabschnittes ist geprägt durch emsiges Packen. Diverse Proben müssen verstaut und die dazu gehörigen Listen erstellt werden. Während der vergangenen Wochen gewonnenes Gedankengut gilt es an die Nachfolger weiterzugeben, um einen reibungslosen und unterbrechungsfreien Messablauf über die Gesamtexpedition zu gewährleisten.
Die Woche begann mit Badefreuden bei Schneeregen und Temperaturen in bedenklicher Nähe des Gefrierpunktes. Die zweite Wochenhälfte brachte uns Temperaturen um die 15°C, wie wir sie zum Monatswechsel vom Juli zum August auf Samoylov kennen. Die Blütenpracht ist schon merklich zurückgegangen, was auf einen baldigen Herbst hindeutet.
Auf der Einganstür des Eiskellers ist ein Bachstelzenpärchen damit beschäftigt die zweite Brut der Saison großzuziehen. Zu Anfang der Woche gab es wetterbedingt reichliche Verpflegungsprobleme, so dass von den ehemals fünf jetzt nur noch drei Jungvögel die Köpfchen zur Nahrungsaufnahme in die Höhe recken.

Ein Höhepunkt der letzten Woche war die partielle Sonnenfinsternis vom Freitag, dem 1. August, bei der bei idealen Beobachtungsbedingungen, eine geschätzte Bedeckung von ca. 50% erreicht wurde. Beim Aufbruch zum außerplanmäßigen Saunagang stellte sich eine deutlich wahrnehmbare Dämmerung ein, und das allgegenwärtige Vogelgezwitscher verstummte. Die Beleuchtungsverhältnisse ließen den nahenden Herbst schon erahnen. Schweißerbrille und CDs waren begehrte Utensilien, um dieses spektakuläre Ereignis zu beobachten.

Nach gut 3 Wochen auf der Insel weiß jeder was er zu tun hat, sodass über die täglich anstehenden Arbeiten nur noch wenige Worte verloren werden. Moritz und Niko, von deren Arbeit in der nächsten Woche berichtet wird, wandern immer schwer bepackt ins Feld um die Auswertung ihrer laufenden Versuche zur Hydrologie- und Energiebilanz durchzuführen bzw. neue Messapparaturen aufzubauen. Katya, von der wir letzte Woche berichtet haben, schwärmt meistens abends aus um neue Zooplanktonproben zu nehmen, die dann den nächsten Tag über untersucht werden. Molo und Waldemar sind mit den Vorbereitungen des nächsten Fahrtabschnittes beschäftigt. Während der nächsten Phase wird unter anderem ein Zeltlager für sechs Kolleginnen und Kollegen auf der benachbarten Insel Kurungnakh benötigt. Außerdem muss das Boot für unseren Kollegen Dima Bolshiyanov und sein Team, die sich hauptsächlich mit der Hydrologie des Lenadeltas beschäftigen, vorbereitet werden.

Einer der Schwerpunkte in diesem Jahr waren auch wieder die Untersuchungen zum Methankreislauf in arktischen Permafrostböden. Dazu wird beispielsweise in jedem Jahr während der Vegetationsperiode die Freisetzung von Methan, das durch Mikroorganismen aus dem abgestorbenen Pflanzenmaterial (organische Bodensubstanz) gebildet wird, gemessen. Während des ersten Fahrtabschnitts war Katharina für die Arbeit zuständig. Sie macht sich jeden Mittag auf zum Dauermessfeld um die Methanemissionsproben zu nehmen, die am Nachmittag von ihr am Gaschromatographen im Stationslabor analysiert werden. Zusätzlich ist sie mit der „Anzucht“ von so genannten Biofilmen beschäftigt. Mikroorganismen wachsen häufig in enger Gesellschaft miteinander und sind dann von schleimigen Zellausscheidungen umgeben, die sie gegen Umwelteinflüsse schützen und die Nährstoffversorgung sicher stellen. Die Untersuchungen sollen Aufschluss darüber geben, welche Organismen unter kalten Bedingungen in Biofilmen wachsen und ob es Unterschiede zu dem „normalen“ Bewuchs im Boden gibt. Um Abschätzen zu können, wie sich die Freisetzung von Methan und Kohlendioxid aus Permafrostgebieten, im Zuge der bereits in der Arktis festzustellenden Klimaerwärmung und damit einhergehenden Tauprozessen des Permafrostes, entwickeln wird, wurden dieses Jahr vor allem Untersuchungen zu den beiden wichtigen Prozessen des Methankreislaufs durchgeführt. Diese Untersuchungen werden in enger Kooperation des AWIs mit den Partnern von der Universität Hamburg unternommen. Um überhaupt Vorhersagen zu den zukünftigen Spurengasfreisetzungen machen zu können, muss man zunächst wissen, welche Mikroorganismen überhaupt im Boden vorhanden sind und unter welchen Bedingen sie welche Gase bilden bzw. verbrauchen. Dazu wurde erstmals eine Methode angewendet (stabile Isotopenmarkierung), die es erlaubt die stoffwechselaktiven Bakterien von den quasi schlafenden Organismen zu unterscheiden. Dazu wurden Langzeitinkubationen angesetzt, die später in den Heimatlaboren weiterbehandelt und ausgewertet werden.

Die Bilanz am Ende des ersten Fahrtabschnittes der diesjährigen Expedition LENA 2008 fällt überaus positiv aus, sowohl was das Zusammenleben auf engstem Raum angeht als auch der Einsatz und die Produktivität jedes einzelnen auf seinem speziellen Aufgabengebiet. Bleibt noch zu sagen, dass diesmal sogar der Hausmeister mit dem Verhalten der sogenannten Jungforscher (so werden zumindest auf Samoylov die Diplomanden und Doktoranden von den Senioren unterschieden) durchaus zufrieden war!

Mit herzlichen Grüssen in die Heimat,
Katharina, Moritz, Waldemar, Molo, Niko, Christian, Claudia, Tina, & Dirk
und natürlich auch die besten Grüße unserer russischen Kolleginnen Ira, Anna & Katya

Wochenbericht Samoylov Nr. 5, 11. August 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen!

Am vergangenen Dienstag wurde es ruhiger auf Samoylov. Die Teilnehmer des ersten Fahrtabschnitts verließen uns mit dem Helikopter in Richtung Tiksi. Auch Waldemar war mit dabei, um zwischenzeitlich in Tiksi und Umgebung tätig zu sein. Es wurden unter anderem seismische Vermessungen in der Laptevsee durchgeführt, die in der Zwischenzeit abgeschlossen sind. In den nächsten Tagen wird Waldemar mit den Teilnehmern der Erkundungsexpedition auf Samoylov erwartet. Der Transfer erfolgt diesmal mit dem Schiff.

In den späten Nachmittagsstunden des Donnerstag war es dann so weit. Es sollte gerade die Ruhe genossen und über das bevorstehende Abendessen nachgedacht werden, als zuerst ein bekanntes, immer eindeutiger werdendes Geräusch zu vernehmen war. Ein Helikopter näherte sich unangekündigt aus Richtung Tiksi, und mit ihm die Teilnehmer des zweiten Fahrtabschnitts. Aus der erwarteten Ruhe wurde nichts und in Windeseile umdisponiert, die Sauna für die Neuankömmlinge angeheizt und erste Vorbereitungen für das Zeltlager auf Kurugnakh getroffen.
Freitag Nachmittag begaben sich dann drei voll bepackte Boote in Richtung Nachbarinsel. In der Zwischenzeit sind dort die Infrastruktur erstellt und erste wissenschaftliche Arbeiten durchgeführt worden. Auf Kurugnakh finden dieses Jahr umfangreiche Vermessungen zu Thermokarsterscheinungen statt. Des Weiteren werden intensive boden- und vegetationskundliche Kartierungsarbeiten durchgeführt.

Unsere russischen Kollegen bereiten sich und ihre Instrumente auf einen mehrwöchigen Feldaufenthalt für geomorphologische und hydrologische Kartierungen vor. Die bereits im ersten Fahrtabschnitt begonnen Arbeiten zu Methanflüssen werden durch Susanne fortgesetzt und durch weitere Methankonzentrationsmessungen ergänzt.

Auch die Arbeiten zur Energie- und Wasserbilanz der Permafrostböden werden fortgesetzt. Inzwischen wurden die bereits existierenden mikroklimatologischen Instrumente durch drei Bodenstationen, ein zweites Eddy-Kovarianz-System, eine Thermalkamera und diverse Lysimeter erweitert. Die neuen Stationen sollen Auskunft über die räumliche Variation der Energieflüsse liefern. Die Untersuchungen konzentrieren sich auf Unterschiede zwischen feuchten und trockenen Standorten, die aufgrund der polygonalen Oberflächenstruktur regelmäßig auftreten.
Soweit es die Witterung zulässt finden Luftbildbefliegungen statt, diese werden mit Hilfe von zwei Heliumzeppelinen durchgeführt. Diese Luftaufnahmen werden für eine Oberflächenklassifizierung des Untersuchungsgebietes genutzt und sind eine wichtige Grundlage für großräumige Energiebilanzberechnungen.

Neben den Aktivitäten im Lenadelta gab es in der vergangenen Woche eine weitere schiffsgestützte Kampangne in der Laptevsee. Hier nun derBericht dieses Fahrtabschnitts:

Die Laptev See Truppe, bestehend aus Birgit Heim, Conrad Kopsch, und Paul Overduin, kam problemlos am 7. August in Tiksi an. Nach einigen Vorbereitungen in der Perle des Nordens schipperten wir zusammen mit Waldemar Schneider, Mikhail Grigoriev und der Schiffsmannnschaft am 9. August in Richtung Norden, zur Ostküste der Bykovsky Halbinsel, wo 1799 das erste in Permafrost eingefrorene Mammut gefunden wurde. Unsere Ziele waren es, Untersuchungen zur Wasserchemie, und der darin suspendierten organischen Stoffe, durchzuführen. 5 Datenlogger die im vorigen Jahr auf dem Seeboden ausgebrachtt worden sind, um Temperatur, Tiefe und Salzgehalt des Wassers zu messen, mussten geortet und ausgelesen werden. Des Weiteren galt es seismische Profile zu vermessen. Innerhalb von drei Tage waren alle Ziele erreicht. Die Wasserchemie wurde an vier Stellen charakterisiert, alle Datenlogger sind geborgen und ausgelesen worden. Drei davon sind vor der Insel Muostakh wieder ausgesetzt worden, und über 100 km seismisches Profil sind gefahren worden. Am frühen Morgen des 11. August sind wir wieder in Tiksi angekommen. Birgit Heim ist am noch gleichen Tag mit dem Schiff weiter gefahren, um die Charaktisierungen des Laptev See Wassers fortzusetzen. Conrad Kopsch und Paul Overduin bereiten sich auf die Ankunft der Erkundungsexpedition in Tiksi und die Weiterfahrt nach Mammontov Klyk und auf die Insel Samoylov vor.

Mit herzlichen Grüssen in die Heimat,
Maren, Moritz, Susanne, Waldemar, Niko, Tina, & MOLO
und natürlich auch die besten Grüße unserer russischen Kolleginnen Ira, Sasha, Peter & Dima

Wochenbericht Samoylov Nr. 6, 18. August 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen!

Die vergangene Woche war eine der abwechslungsreichsten der gesamten Expedition. Die ersten Tage der Woche vergingen damit, die Expedition von Dima B. und Sasha M. auf den Olonyok vorzubereiten. Nachdem mehrmals umdisponiert werden musste, starteten die beiden am Mittwochmittag in ihr Untersuchungsgebiet. Mit dem gleichen Hubschrauber erreichte uns Svetlana E. vom Krasnoyarsker Institut für Forstwirtschaft, die im zweiten Fahrtabschnitt die CH4 Messungen ihrer Vorgängerin am Dauermessfeld weiterführt.

Der zweite Hubschrauber des Tages erreichte uns mit den Teilnehmern der Vorerkundungsexpedition. Wenn im Folgenden die Meinung aufkommen sollte, dass der Stammbesatzung durch eine zwanzigköpfige Gesamtbesatzung zusätzliche Schwierigkeiten bereitet wurden, so ist dem nicht so. Das Arbeitsprogramm wurde in vollem Umfang weitergeführt, und es gab zusätzliche, interessante und unterhaltsame Abende.

Anschließend einige Eindrücke der nun schon morgen auf Samoylov zu Ende gehenden Vorerkundungsexpedition:

Am Mittwoch den 13. August ist es mit der Ruhe auf Samoylov vorbei. Am Nachmittag fallen 8 Mitglieder einer Erkundungsexpedition auf der Insel ein und verdoppeln praktisch die Einwohnerzahl. Das Expeditionsteam besteht aus Karen Wiltshire und Ingeborg Bussmann von Helgoland, Karsten Reise von Sylt, Dirk Mengedoht von der AWI Logistik, Hans-W. Hubberten, Paul Overduin und Conny Kopsch von Potsdam sowie Roland Doerffer von der Küstenforschung der GKSS. Ziel dieser kurzen Kampagne ist die Strukturierung von Projekten im Rahmen des neuen AWI/GKSS-Forschungsprogramms PACES, in dem die bislang auf die Nord- und Ostsee ausgerichteten Küstenforschungs-Programme auf die Arktischen Küsten ausgeweitet werden sollen. Die seit 10 Jahren im Lena Delta und den Küstenregionen der Laptev-See vorgenommenen Untersuchungen der Potsdamer Permafrostwissenschaftler bieten dafür eine hervorragende Grundlage, die unter Einbeziehung russischer Partner die polare Küstenforschung in PACES als eine zentrales Kernthema der nächsten 5 Jahre kennzeichnen wird.

Nach einem langen Flug mit Umsteigen in Moskau, trafen 5 Teilnehmer am Sonntagmorgen etwas müde in Yakutsk ein. Nach kurzer Erholung im Hotel ging es zu offiziellen Kooperationsgesprächen in das Yakutsker Permafrost-Institut. In Vertretung der AWI-Direktorin Karin Lochte führt die stellvertretende Direktorin Karen Wiltshire die Gespräche über die zukünftige Zusammenarbeit im Lena Delta mit dem Institutsdirektor Rudolph Zhang und dem Vize-Direktor Viktor Shepelev.

Nach einer nicht so geplanten Übernachtung im Flughafen-Hotel in Yakutsk wegen Nebels in Tiksi, die aber für eine detaillierte Planung der Pilot-Expedition genutzt werden konnte, traf die Gruppe dann am Dienstag gegen 20:30 Uhr in Tiksi ein und wurde von Misha Grigoriev und Dima Melnischenko am Flughafen empfangen und in der Gästewohnung des Lena-Delta Reservats untergebracht. Am Tag darauf konnte auf einem Hubschrauberflug zu dem ca. 400 km westlich gelegenen Leuchtturm des Kaps „Mammut-Eckzahn“ ein erster Eindruck dieser großartigen Landschaft gewonnen werden. Ein zweistündiger Aufenthalt, der zum Auslesen einer zweijährigen Temperaturmessreihe in einem 70 m tiefen Bohrloch genutzt wurde, ließ die Neulinge zum ersten Mal mit Mücken, Grundeis und Matsche Bekanntschaft machen.

Nach der Landung am Abend richten sich die neuen Gäste in ihren Zelten häuslich ein und waschen in der Samoylov-Banja den Dreck von Tiksi ab – dort gab es kein Wasser. Die nächsten Tage waren bestimmt von der Erkundung der Landschaft und der ablaufenden Prozesse auf der Insel selbst, und bei Exkursionen mit dem kleinen Flussboot „Orlan“ des Lena Delta Reservats zu charakteristischen

Formen und sedimentären Abfolgen des komplexen Deltas mit seinem durch kryogene Prozesse geprägten Aufbau.
Inzwischen sind die in leuchtend roten AWI Jacken und gelben Gummistiefeln gekleideten neuen arktischen Küstenforscher ein gewohntes Bild für die wenigen Menschen und die Tierwelt des Deltas geworden. Alle sind begeistert beim diskutieren und konzipieren der potentiellen gemeinsamen Projekte. Von Molo (Günther) Stoof und Waldemar Schneider mit tollen Fischgerichten und Rentierbraten verwöhnt, und durch ungewöhnlich schönes Wetter begünstigt, nehmen wir am Dienstag nur ungern Abschied von der Trauminsel – die Stammbesatzung freut sich auf die wiederkehrende Ruhe.

Ein weiterer Bericht zeigt die Aktivitäten einer auf unserer Nachbarinsel tätigen Expeditionsguppe:

Das Kurungnakh-Team hat sich sehr gut im Camp eingerichtet und die Arbeit läuft in vollen Zügen. Das Camp wurde direkt am Fluss am Ausgang eines Thermoerosionstales auf einer kleinen Sandbank aufgeschlagen. In das Untersuchungsgebiet ist man etwa 1 Stunde zu Fuß über den Eiskomplex unterwegs, der die Insel bildet. Geübte Jungforscher schaffen den Weg bereits in 30 min.
Die Kurungnakh-Gruppe besteht aus sechs „Jungforschern" des AWI Potsdam (Anne M., Frank G., Mathias U., Sebastian R.) und der Uni Hamburg (Fabian B., Sebastian Z.). Das gemeinsame Untersuchungsobjekt ist eine ca. 2 x 3 km große Thermokarstsenke mit drei größeren und vielen kleineren Seen auf dem Eiskomplex der dritten Lena Delta Terrasse.
Die Potsdamer nehmen Daten und führen Messungen zur Erkundung der Morphometrie, Oberflächencharakteristik sowie der Strahlungseigenschaften innerhalb der Thermokarstsenke und der angrenzenden Bereiche, sowie verschiedener Periglazialstrukturen durch. Des Weiteren liegt ein Schwerpunkt in der Untersuchung von morphometrischen, thermischen sowie der Sedimenteigenschaften der größeren Seen innerhalb der Senke. Die Seetiefenprofile innerhalb der Thermokarstsenke und ein etwa 27m hoher Pingo wurden bereits detailliert vermessen und die Seesedimentbeprobung ist abgeschlossen.
Die Hamburger analysieren die Beziehungen zwischen Boden und Vegetation innerhalb der Thermokarstsenke, die eine vorbereitende Untersuchung für den Aufbau eines Eddy-Towers zur Messung und Bilanzierung von klimarelevanten Spurengasen darstellen. Nach der Auswertung der Daten werden eine detaillierte Bodenkarte und eine Vegetationskarte erstellt. Ein Transekt für den deskriptiven Teil der Arbeit bestehend aus mehreren Boden- und Vegetationsbeschreibungen von der Küste des Olenyok-Kanals bis in die Senke ist bereits beprobt und eine Bootsladung Bodenproben bereits nach Samoylov verfrachtet worden. Für die nächsten Tage sind Aufnahmen für den analytischen Teil der Arbeit geplant, die im Bereich der Senke durchgeführt werden.

Mit herzlichen Grüssen in die Heimat,
Maren, Moritz, Susanne, Waldemar, Niko, Tina, & MOLO

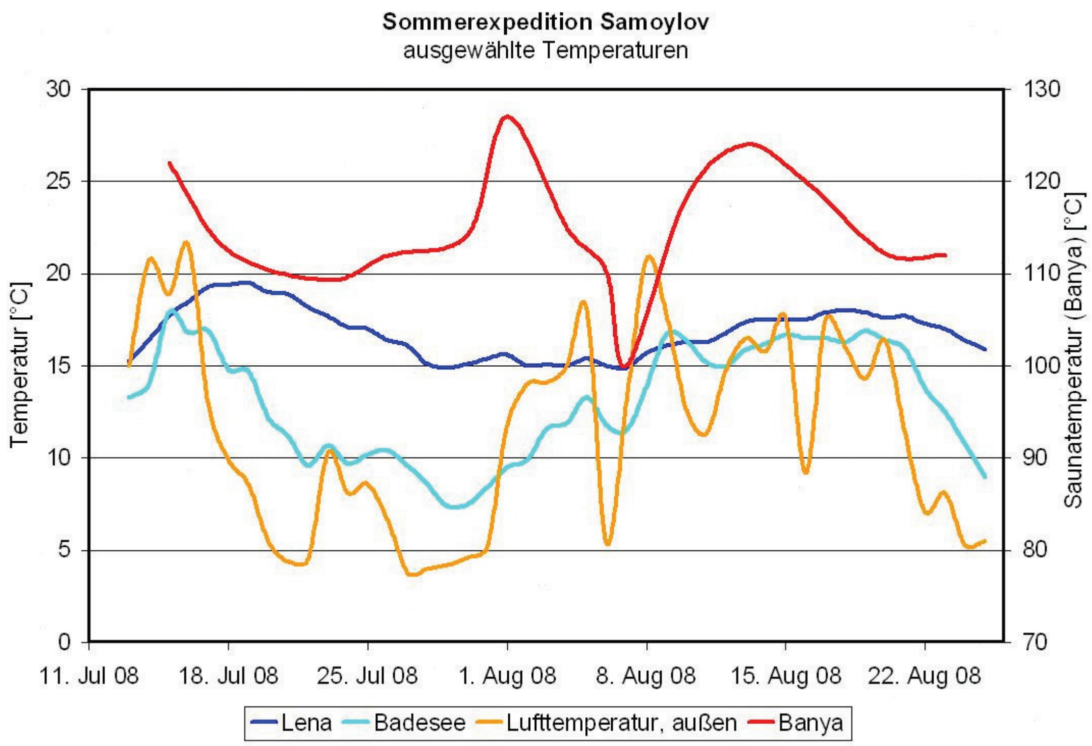
und natürlich auch die besten Grüße unserer russischen Kolleginnen,
Ira, Sasha, Svetlana, Peter & Dima

sowie von den Teilnehmern der Vorerkundungsexpedition,
Karen, Ingeborg, Karsten, Dirk, Hans-W., Paul, Conny und Roland

Wochenbericht Samoylov Nr. 7, 25. August 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen!

Herbst ist es in der Zwischenzeit auf Samoylov geworden, und allmorgendlich wird im Ofen ein Feuerchen entfacht, was die Zeltbewohner besonders zu schätzen wissen. Mit der Abfahrt der Erkundungsexpedition verabschiedete sich auch das außergewöhnlich gute Wetter, und der Windgenerator begann das uns sehr vertraute Lied vom Sturm zu singen. Von Osten ziehen dunkle Regenwolken heran, und die Zugvögel verlassen ihre Brutreviere in Richtung Süden. Für die meisten von uns beginnt nun die Packphase. Es gilt das gewonnene Probengut sicher für den Transport in die Heimat zu verstauen.



Nur Maren und Moritz instrumentieren noch fleißig weiter, um unserer Trauminsel noch das letzte bislang ungeklärte Rätsel entreißen zu können. Die Beiden möchten hier noch den beginnenden Winter erleben, zu einer Zeit, zu der es dem Rest der Stationsbesatzung hoffentlich noch vergönnt sein wird, den europäischen Spätsommer zu genießen.

Wie schon im letzten Jahr ist auch in diesem Jahr die ETH Zürich mit einem wissenschaftlichen Programm auf Samoylov vertreten. Susanne Liebner aus der Gruppe von Josef Zeyer (siehe Zeyersche Polygonfluchtnachweisvorrichtung vom letzten Jahr) vom Institut für Biogeochemie und Schadstoffdynamik der ETH beschäftigt sich dabei in Kooperation mit dem AWI mit den mikrobiellen Prozessen der Methanbildung und -oxidation sowie mit Methanflüssen in den Böden der polygonalen Tundra. In diesem Rahmen wurden bereits im ersten Fahrtabschnitt von Dirk Wagner und Christian Knoblauch Inkubationen mit stabilen Isotopen (13C) angesetzt, um die aktive Methan bildende und Methan oxidierende Gemeinschaft zu markieren. Überdies werden Methanflüsse im Boden bestimmt und mit Hilfe von Optoden Sauerstoffmessungen durchgeführt.

Die Arbeiten zur Stickstoff (N) Dynamik gehen nun langsam ihrem Ende entgegen und es konnten einige schöne neue Erkenntnisse gewonnen werden. Gleichzeitig wurden aber fast genauso viele neue Fragen aufgeworfen, die es nun zu beantworten gilt. Die Untersuchung der potentiellen Nitrifikation wurde nicht nur an den Böden der low-center Polygone durchgeführt, sondern ebenso mit den Böden des Strandes und der Überflutungsebene als auch mit dem relativ trockenen Sandboden, auf dem die Station gebaut ist. Bei der ersten Auswertung der Ergebnisse ist deutlich zu erkennen, dass gerade die Proben von Strand und der Überflutungsebene eine hohe Aktivität zeigen. Als besonders interessant stellten sich Proben des Samoylovkliffes heraus, die nach einer über einmonatigen Lagphase das zugegebene Ammoniak in nur wenigen Tagen zu Nitrit oxidierten. Spannend deshalb, weil diese Proben in Tiefen von 1,5 und 2,5m genommen worden sind, die erst in diesem Jahr aufgetaut sind und sich vorher dauerhaft im Permafrost befanden. Diese ersten Hinweise müssen nun im Labor in Hamburg überprüft und weiterentwickelt werden. Eine Aufgabe wird es sein, die bestimmten Aktivitäten Mikroorganismengruppen zuzuordnen. Es liegt also noch Arbeit vor uns.

Seit Montagabend sind nur noch fünf Jungforscher auf Kurungnakh. Anne ist bereits auf dem Heimweg zu ihrer Familie. Wir vermissen Dich Anne! Der Wolf setzt auch diese Woche seine nächtlichen Besuche in unserem Zeltlager fort. Zum Glück hat er bis dato nicht herausgefunden, wie er an unseren Expeditionsschinken und Käse herankommt. Gesehen hat ihn jedoch noch keiner, nur die großen Pfotenspuren sind jeden Morgen im Sand deutlich zu erkennen. Auf Kurungnakh hat nun ein feucht kalter Herbst Einzug gehalten. Der Nieselregen scheint einfach nicht aufzuhören, was aber die Pilze prächtig gedeihen lässt. Frank und Sebastian Z. kommen selten ohne eine Tüte voller Birkenpilze zurück zum Camp, von denen andere jedoch Übelkeitsanfälle bekommen. Trotz dieser herbstlichen Stimmung setzt die nun reine Männergesellschaft ihre Arbeiten fort. Die Arbeiten der Hamburger zur flächenhaften Bodenbestandsaufnahme und Vegetationskartierung im Untersuchungsgebiet sind im vollen Gange und zu 80% abgeschlossen. Die nächste Ladung Bodenproben wurde am Samstag während des Banjabesuches nach Samoylov gebracht sowie eine Ladung neue Aufnahmebögen gedruckt. Dort wird Susi auch die unter vollem Körpereinsatz mit einer selbst gebastelten Vorrichtung eingefangenen Gasbläschen am Gaschromatographen untersuchen.

Die Potsdamer Frank und Mathias stecken immer noch mitten in der tachymetrischen Vermessung der Thermokarstsenke und es werden wohl noch einige Überstunden nötig sein, um die gesamte Senke zu erfassen. Nebenbei ergibt sich aber auch hier und da die Möglichkeit die Geomorphologie der Senkenbereiche zu erörtern. An den Hängen der Senke verbreitete Seeterrassen deuten auf verschiedene Wasserstände der Seen. Zudem lässt eine erste Auswertung der Messwerte vermuten, dass die Migration des größten der drei Thermokarstseen der Neigung der Inseloberfläche folgt. Sebastian R. ist nun häufig alleine im Untersuchungsgebiet unterwegs um Auftautiefen in Transekten aufzunehmen, Albedomessungen durchzuführen und die geomorphologischen Besonderheiten zu erfassen wie Größe und Ausprägung verschiedener Eiskeilpolygone, die im Zusammenhang mit den verschiedenen Seeterrassen zu stehen scheinen. Unser großer Dank gilt Sergej, dem Lena Delta Park Ranger, der dafür sorgt, dass wir schnell und mehr oder weniger trocken zum wöchentlichen Banjabesuch nach Samoylov kommen sowie alles nötige von der „anderen" Insel erhalten.

Liebe Grüße an alle von den Kurungnakh Beachboys,
Fabian, Frank, Mathias, Sebastian R., Sebastian Z.

Ebenfalls herzliche Grüsse in die Heimat von
Maren, Moritz, Susanne, Waldemar, Niko, Tina, & MOLO

und natürlich auch die besten Grüße unserer russischen Kolleginnen
Ira, Sasha, Svetlana, Peter & Dima

Wochenbericht Samoylov Nr. 8, 1. September 2008

Werte Leser, liebe Angehörige, Kollegen und Lieblingsmenschen!

Die Zeit des Abschiednehmens und sich auf zu Hause Freuens ist gekommen. Wenn die Wetterbedingungen stimmen, beginnt morgen die Rückreise in die Heimat. Die Kisten sind gepackt und die Infrastruktur ist auf ein Minimum zurückgefahren, so das Maren und Moritz für den Fortgang der Herbstkampangne ausreichende Arbeitsbedingungen haben.

Zur Zeit ist die Station wieder reichlich überbesetzt. Am Mittwoch vergangener Woche brachte Waldemar unsere beiden Extremexpeditionisten Dima und Sasha vom Olonyokdelta zurück nach Samoylov. Die beiden führten hydrologische Messungen im mit dem Schlauboot noch befahrbaren Bereich des Olonyok bis zu seinem Delta flussabwärts durch. 193mal musste das Boot über Sandbänke gezogen, entladen und beladen werden. Bei den beiden hat das Wort Expedition seinen ursprünglichen Charakter noch nicht verloren.

Am Sonnabend bauten die Beachboys von Kurungnakh ihr Camp ab und waren dann auch rechtzeitig zur Samstagssauna wieder auf der Trauminsel. Zurückgeblieben sind die aus Strandgut zusammen gezimmerten Tische und Sitzgelegenheiten aus dem Küchenzelt, welche sich das nächste Frühjahrshochwasser wieder zurückholen wird.

Anschließend der Bericht der Jungs von der Nachbarinsel: Unsere Zeit auf Kurungnakh ist nun zu Ende. Bereits am Samstag haben wir die Zelte auf unserer kleinen, sandigen Halbinsel abgebrochen und sind für die letzten Tage vor dem Heimtransport nach Samoylov gezogen. Was unseren Campstandort angeht, wurde es auch höchste Zeit, denn die Lena und der Ausfluss eines Thermoerosionstales holen sich in raschem Tempo zurück, was sie einmal abgelagert haben. Zum Ende kam das Wasser den Zelten bereits bedrohlich nah. Eine bedrohliche Erfahrung musste ein im Lager gebliebenes Mitglied unserer Gruppe machen, als er im Zelt ein bellen und jaulen vernahm. Kurze Zeit später stellte sich jedoch heraus, dass die Sorge unbegründet war, da nicht der Wolf unserem Lager einen Besuch abstattete, sondern ein dem Lena-Flussdampfer entlaufener Hund. Sergej konnte ihn am nächsten Tag wieder einfangen. Unsere Anlockversuche mit leckerer Kartoffel-Wurst-Suppe hatte er zuvor eher skeptisch und ängstlich abgelehnt.
Das Wetter der letzten Woche hat den Abschluss der Arbeiten noch einmal etwas unangenehm gemacht, denn bei Dauernieselregen und eiskaltem Ostwind hatten wir Probleme, die Klamotten trocken zu kriegen. Nur das„Russenzelt" mit seinem kleinen Bollerofen bot die Möglichkeit, die Kleidung etwas anzutrocknen.
Die Arbeiten konnten jedoch durch kleinere Überstunden erfolgreich abgeschlossen werden. Unsere Thermokarstsenke ist nun mit etwa 2600Meßpunkten, die den Rahmen des Tachymeterspeichers gesprengt haben, detailliert vermessen. Die geomorphologischen Besonderheiten innerhalb der Senke wurden beschrieben und aufgenommen sowie die Thermokarstseen beprobt und bathymetrisch vermessen. Mit den großflächigen Aufnahmen von Böden und Vegetation, ergibt sich ein umfangreicher Datensatz zur Charakteristik der Thermokarstsenke sowie der darin liegenden Thermokarstseen. Von den Auswertungen der Daten erhoffen wir uns nähere Erkenntnisse zur Entwicklung und Veränderung von Thermokarstprozessen in eisreichen Sedimenten.

Damit liebe und letzte Grüße an alle von der Lena Delta Insel Kurungnakh,
von Fabian, Frank, Mathias, Sebastian R. und Sebastian Z.

Diesen Grüßen schließen sich an:
Maren, Moritz, Susanne, Waldemar, Niko, Tina, & MOLO

und natürlich auch die besten Grüße unserer russischen Kolleginnen
Ira, Sasha, Svetlana, Peter & Dima

Wochenbericht Samoylov Nr. 9, 8. September 2008

Liebe Leser, Angehörige und Kollegen,

am 2. September haben die meisten Expeditionsteilnehmer der kleinen Insel Samoylov für dieses Jahr den Rücken gekehrt und sich mit viel Gepäck, Untersuchungsergebnissen und Proben auf den Weg in Richtung Heimat gemacht. Wir wünschen allen ein schönes Ankommen und Wiedereinleben.
Zurückgeblieben sind wir drei; Sergej der Ranger des Lena-Delta-Reservats, Moritz und Maren. Die plötzliche Ruhe nach Abflug des Helikopters war in den ersten Stunden noch etwas eigenartig, aber inzwischen haben wir uns daran gewöhnt. Die Stille wird nur durch das Summen des Windgenerators und das Kreischen der Möwen unterbrochen, die beharrlich auf unsere inzwischen gering anfallenden Essensreste warten.
Scheinbar wurden auch versehentlich die wärmeren Temperaturen in den Helikopter geladen. Nur noch selten steigt das Quecksilber über vier Grad und die Sonne lässt sich zu Lasten der durch Solarenergie versorgten Messinstrumente nur noch sporadisch blicken. Auf der Station ist es Dank des Ofens immer angenehm warm und sichert uns warme Füße und heißen Tee nach der Arbeit im Feld. Die nimmt auch im 3.Fahrtabschnitt ihren gewohnten Gang. Die täglich anfallenden Messungen werden fortgesetzt und seit Samstag werden Temperatur- und Bodenfeuchtemessungen an zwei frischen Bohrlöchern in der Nähe des Fishlakes durchgeführt. Den Name verdankt der See seiner ungewöhnlichen Form, welche den Umriss eines Fisches nachzeichnet. Der Fishlake ist mit ca. 5m der tiefste Thermokarstsee der Insel und friert selbst im sibirischen Winter nicht bis zum Grund durch. Unter Wasserkörpern dieser Größe entwickeln sich dauerhaft ungefrorene Bereiche, so genannte Taliks, welche sich auch auf den Bodenwärmehaushalt des Seeufers auswirken. An den neuen Bohrlöchern sollen die thermischen Auswirkungen des See-Taliks gemessen werden. Die Bohrlöcher erreichen dabei eine Tiefe von 4,10 m und 3,40 m und sind 20 m bzw. 5 m vom Seeufer entfernt. Die ersten Messungen zeigen, wie erwartet, wärmere Bodentemperaturen in Seenähe.
Der Sonntag brachte Abwechslung in den Stationsalltag. Mit dem alten, aber scheinbar noch fahrtüchtigen Boot von Sergej machten wir uns auf den Weg die Sehenswürdigkeiten der näheren Umgebung zu erkunden. Stolp, ein Zeugenberg unweit von Samoylov, eröffnete uns nach einem kurzen Aufstieg einen sagenhaften Blick über das Delta. Traditionsgemäß brachten wir dort ein Opfer in Form von Süßigkeiten dar und baten somit um eine heile Rückkehr zur Station.

Herzliche Grüße von Maren, Moritz und Sergej

Wochenbericht Sommer Nr.10, 15. September 2008

Liebe Leser, Angehörige und Kollegen,

eine weitere Woche ist auf der kleinen Insel Samoylov ins Land gezogen und inzwischen hat sich auch der sibirische Herbst von uns verabschiedet. Dieser brachte zuvor noch eine in bunten Farben gescheckte Tundra und eimerweise Beeren.

Seit Samstag schneit es hier ohne Unterlass und der Schnee bleibt bei Temperaturen um den Gefrierpunkt erst einmal liegen. Begleitet wird er von einem starken Westwind, der bewirkt dass die Schneeflocken waagerecht fliegen und der Wellengang der Lena dem der Nordsee gleicht. Selbst Sergej zieht es vor, Arbeiten an der Station zu verrichten und nicht mit seinem Boot rauszufahren.

Winteranfang auf Samoylov

Die Arbeit im Feld ist aufgrund des Wetters etwas unangenehm und einige im Boden versenkte Messinstrumente verstecken sich erfolgreich vor suchenden Blicken. Wir hoffen, dass der Wind in den nächsten Tagen nachlässt und dadurch die Arbeit leichter von der Hand geht.

In der vergangenen Woche waren wir hauptsächlich damit beschäftigt die Stromversorgung verschiedener Klimastationen für den Winter sicherzustellen und fehlerhafte Messinstrumente zu reparieren. Natürlich wurden nebenbei auch die alltäglichen Messungen fortgesetzt. Das Wetter am Mittwoch war zur Abwechselung mal windstill und ermöglichte dadurch, wohl zum letzten Mal, die Durchführung einer Zeppelinbefliegung. Auch in dieser Woche werden wir weiterhin damit beschäftigt sein Messinstrumente abzubauen und winterfest zu machen.

Herzliche Grüße von Maren, Moritz und Sergej

Wochenbericht Sommer Nr.11, 22. September 2008

Liebe Leser, Angehörige und Kollegen,

die einsame Zeit auf der Insel ist seit Freitag vorbei. Wir haben durch Anna Abnizova von der Universität York in Toronto Verstärkung bekommen. Sie wird in den letzten Tagen, die uns auf der Insel verbleiben, Wasserproben aus verschiedenen Polygonseen nehmen und sie mit ihren Untersuchungen aus einem kanadischen Polargebiet vergleichen.
Begleitet wird sie von einem Kamerateam, bestehend aus Andreas Hartmann und Philipp Schneider, der Filmhochschule Babelsberg. Die beiden drehen einen Dokumentarfilm zum Thema wissenschaftliches Arbeiten in der Arktis und begleiten uns bei den täglichen Arbeiten. Die drei hatten am Samstag die Möglichkeit die nähere Umgebung mit Sergej zu erkunden und kamen mit zahlreichen Eindrücken und Filmaufnahmen zurück.

Gruppenbild des letzten Expeditionsabschnittes

Seit Ankunft der neuen Expeditionsteilnehmer hat sich ein weiteres Mal ein Wetterumschwung vollzogen. Die winterlichen Temperaturen haben sich von uns verabschiedet und der weiße Schnee musste dem Braun der Tundra weichen. Bei Rekordtemperaturen von 6°C fällt die Feldarbeit erheblich leichter und die Liste mit ausstehenden Arbeiten wird zusehends kürzer.
Inzwischen sind Messsysteme, wie die Thermalkamera, die Pegelstationen und das mobile Eddy-Kovarianz-System abgebaut und eingemottet. Doch die Arbeit ist mit dem Abbau noch nicht getan. Bevor wir am 29. September die Insel verlassen, sollen noch zwei weitere Messstationen eingerichtet werden. Diese werden über den Winter die Schneedeckenhöhe und –temperatur erfassen. Wir genießen nun die letzten Tage auf unserer kleinen Insel und wünschen bis zum nächsten und damit letzten Wochenbericht alles Gute.

Herzliche Grüße von Maren, Moritz, Anna, Andreas, Philipp und Sergej

Wochenbericht Sommer Nr.12, 29. September 2008

Liebe Leser, Angehörige und Kollegen,

der dritte Expeditionsabschnitt 2008 ist nun auch bald vorbei und während wir diesen letzten Wochenbericht schreiben, befinden wir uns schon nicht mehr auf Samoylov, sondern bereits in Moskau. Abgeholt wurden wir mit der Orlan, dem Schiff des Lena-Delta Reservats. Aufgrund schlechten Wetters und anderen Umständen wurde der Abfahrtstermin immer wieder verschoben, so dass wir letztendlich drei Tage auf gepackten Seesäcken saßen. Das Warten hat sich aber gelohnt. Samoylov verabschiedete sich in der letzten Nacht mit einer Aurora borealis und die Überfahrt verlief bei strahlendem Himmel und spiegelglatter See.

Polarlicht über Samoylov

Trotz der kurzen Zeit konnte Anna genügend Proben im Feld nehmen und das Kamerateam hatte einige Möglichkeiten spannende Bilder über Land, Leute und wissenschaftliches Arbeiten einzufangen. Die Station befindet sich nun wieder im Winterschlaf. Die über den Winter weiter messenden Instrumente, wie das Eddy-Kovarianz-System, die Wetterstation und zahlreiche Bodenstationen, wurden alle nochmals überprüft und ausreichend mit Energie versorgt. Andere wurden wieder abgebaut und sorgfältig in Kisten verstaut.
In Tiksi hatten wir genügend Zeit um die üblichen administrativen Aufgaben zu erledigen und uns auszuruhen. Anna hat am Mittwoch vor einer Schulklasse einen Vortrag über Permafrost in der kanadischen Arktis gehalten und wurde dabei von Andreas und Philipp mit den Kameras begleitet.
Wir sind gestern mit einigen Stunden Verspätung in Moskau gelandet und mussten uns hier von Anna trennen, die in einigen Tagen weiter nach Toronto fliegen wird. Wir machen uns derweil auf den Weg nach Berlin und werden heute, dem 3. Oktober, gegen vier Uhr dort landen.
Der Abschied von der kleinen Insel fällt uns allen schwer, egal ob der Aufenthalt zehn Tage, zwei Monate oder drei Monate gedauert hat. Dennoch sind wir alle froh bald wieder nach Hause zu kommen.

Herzliche Grüße von Maren, Moritz, Anna, Andreas und Philipp

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