Field sites

[Map showing locations in Greenland and Sweden]
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The end and the start. The year 2017 has been dominated by the activities reflecting the end of CENPERM I and the start of CENPERM II. As such we have been implementing as much as possible for the revised research plan for 2018-2022. The plan is now available on our website. The image to the left illustrates one of the new projects: a study on the effect of burning and addition of labelled ash on carbon and nitrogen cycles mimicking tundra fire. Interesting enough, a larger natural tundra fire occurred in Greenland this summer around 300 km south of the CENPERM experimental site at Disko in West Greenland.

We had the pleasure to welcome DNRF at Disko this summer. For professor and director Søren-Peter Olesen it was the first time to visit Disko and we had the opportunity to show and discuss our experimental sites, sharing the combination of field course and research with students, and explore the beautiful nature at Disko and the rough sea between Disko and the mainland, Greenland, see photo on page 27.

In 2017 CENPERM became truly “polar”, as the first major expedition was completed to Antarctica and involved fieldwork at South Georgia as part of the ACE expedition (Antarctic Circumnavigation Expedition). This allow us to explore similarities and contrasting conditions for biogeochemical cycles in both Arctic and Antarctic. This has already lead to extensive fieldwork planned for 2018.

One of the key components for the first 6 years of CENPERM has been the dynamics of landscape, the integration of landscape geomorphology in the context of assessing changes in Arctic ecosystems. Two PhD-projects have been focusing on landscape geomorphology, one specifically on permafrost-affected landscape formation and stratigraphy and the other project on more recent changes in landscape linked to changes in environmental drivers. Both projects are now completed and the results are currently being published. One study made it to Nature. A short presentation entitled, “Deltas are growing as climate is warming” is given by Mette Bendixen on page 10.

The year 2017 has yet again been characterized by extensive collaboration between CENPERM and the international research community from a broad range of research institutions. This collaboration is based on cooperation between many individual scientists, and we wish to extend our sincerest thanks for their contributions to the success of CENPERM in 2017. New collaborators include Department of Earth Science, University of Bergen, British Antarctic Survey at Cambridge and Department of Prehistoric and Historical Archeology, University of Vienna. Finally, I want to thank all CENPERM members and collaborators for the hard work commitment and interest in sharing the scientific approach behind CENPERM.

Copenhagen, March 2018

Bo Elberling
The vision of CENPERM is to integrate the consequences of permafrost thawing on arctic ecosystems and to feed that information into existing climate change models. Fulfilling this vision requires multidisciplinary and large-scale field manipulation and laboratory experiments linking physiochemical changes to biological adaptations and climatic feedbacks.

Ecosystems with underlying permafrost, defined as soil/sediment at or below 0°C for at least two consecutive years, cover ~25% of the ice-free land area in the Northern Hemisphere and store almost half of the global soil carbon. Future climatic changes are predicted to have the most pronounced effects in northern latitudes, and these sensitive arctic ecosystems are therefore subject to dramatic changes following thawing of permafrost, glacial retreat, and coastal erosion. The most dramatic effect of permafrost thawing is the accelerated decomposition and potential mobilization of organic matter stored in the permafrost, impacting global climate through the mobilization of potentially huge amounts of carbon and nitrogen accompanied by the release of greenhouse gases.

CENPERM will address the knowledge gap in biogeochemical element cycling related to the current and future thawing of permafrost. The temporal nature of processes in the arctic landscape varies from slow annual cycles to rapid pulse driven events. In CENPERM, year-round field measurements are conducted in order to quantify both seasonal background emission levels as well as all major pulses of greenhouse gas emissions from the landscape. Establishment of the CENPERM field sites allows, for the first time in the Arctic, the combination of in-situ measurements of greenhouse gas emissions and subsurface greenhouse gas production within climate transects relevant for predicting regional trends in greenhouses gas emissions.

The core funding for CENPERM comes from a Centre of Excellence grant (2012–2022) from the Danish National Research Foundation.

CENPERM integrates multidisciplinary research of biogeochemical and physical processes in a “climate-vegetation-soil-microorganism-permafrost” approach in transects across the major climate zones of Greenland. New insights in permafrost dynamics will improve the quantification and predictions of changes in carbon and nitrogen pools and greenhouse gas fluxes from arctic ecosystems.

CENPERM is a truly multidisciplinary approach aiming for integrating biogeochemistry, plant ecology, microbiology, climate, soil/permafrost in a landscape approach. Actions include field, laboratory and modelling work linked in five main themes scaled from molecule to regional landscapes. The five themes are planned as an initial theme 1, followed by three simultaneous themes (2, 3 and 4) leading to theme 5.
Field work at South Georgia. Photo: Bo Elberling
CENPERM highlights of 2017 include intensive fieldwork combined with detailed analyses of remote sensing products. The following four papers published in 2017 highlight the benefits of working multi-disciplinarily and performing both up- and downscaling. Scaling matters. The studies comprised analyses made for the entire ice-free part of Greenland, for specific landscape units, at plot level, where manipulations can be made, and finally at biogeochemical process level where ecosystem functioning is investigated, also with the use of molecular microbial methods.

1. Vegetation phenology plays an important role in regulating ecosystem processes across arctic ecosystems, and particularly in relation to recent climate changes. As an example, the timings of onset and end of the growing season correspond to the start and end of the period in which plants take up carbon from the atmosphere, and as a result directly influence the carbon cycle, and water and energy exchanges with the atmosphere. Karami et al. (2017) characterized, as part of his PhD dissertation, the spatio-temporal variations of vegetation phenology along latitudinal and altitudinal gradients in Greenland in order to examine the role of local and regional climatic drivers. As an important step, time-series from the Moderate Resolution Imaging Spectroradiometer (MODIS) were corrected for the sampling biases caused by cloud cover. The resulting output indicates significant differences between West and East Greenland. The observed phenology; e.g. the date of the start of the growing season was significantly earlier (24 days), the length of the growing season was longer (25 days), and the time-integrated NDVI was higher in West as compared to East Greenland. This highlights the potentially biased result that is obtained if observations from one part of the Arctic uncritically are scaled to the rest of the Arctic.

2. Climate changes are pronounced in Arctic regions and increase the vulnerability of the Arctic coastal zone. For example, increases in melting of the Greenland Ice Sheet and reductions in sea ice and permafrost distribution are likely to alter coastal morphodynamics. The deltas of Greenland are largely unaffected by human activity, but the net result in terms of size due to increased freshwater runoff and sediment fluxes, decreasing sea ice, increased wave activity in ice-free periods and sea level rise has long remained unclear. In Nature Bendixen et al. (2017) document that southwestern Greenland deltas were largely stable from the 1940s to 1980s, but prograded (meaning growing in size) in a warming Arctic from the 1980s to 2010s. Results are based on the areal changes of 121 deltas since the 1940s, assessed using newly discovered aerial photographs and remotely sensed imagery. As a part of her PhD dissertation, she described how delta progradation was driven mainly by high freshwater runoff from the Greenland Ice Sheet coinciding with periods of open water (decreasing sea ice). The results improve the understanding of Arctic coastal evolution in a changing climate. Details of the study are found in this report on page 10-11.

3. Much attention has been directed toward methane (CH\(_4\)) dynamics in peatlands and wet ecosystems at high latitudes, which are considered net CH\(_4\) sources which intensify the greenhouse effect and lead to further warming. However, few studies have hitherto investigated CH\(_4\) fluxes in subarctic heath ecosystems, which likely exhibit both CH\(_4\) production and uptake. Particularly, climate-induced changes in CH\(_4\) exchange and the overall carbon balance are largely unknown. In a unique 16 year long field experiment, Pedersen et al. (2017) investigated the response of biological CH\(_4\) uptake to increased summer warming by open-top chambers and deciduous leaf litter input in a
wet heath subarctic ecosystem. The study was directly linked to Pedersens MSc thesis work at CENPERM. The study site is in Northern Sweden and represents a dominant ecosystem type found across the circumpolar region. The study demonstrates the sensitivity and a surprising capacity throughout the entire growing season of a wet heath ecosystem to function as a net CH$_4$ sink. The study further shows that leaf litter addition significantly increases CH$_4$ uptake rates due to a pronounced soil drying. Warming enhances CO$_2$ release, while CH$_4$ uptake is controlled by soil moisture. By integrating both CH$_4$ and CO$_2$ fluxes it was shown, that higher summer temperatures might shift the ecosystem toward a net carbon source due to an increase in CO$_2$ release, thereby enhancing the greenhouse effect.

4. Litter decomposition is a fundamental component of ecosystem carbon and nutrient cycles, with fungi being among the primary decomposers. To assess the impacts of seasonal climatic changes on litter fungal communities and their functioning, *Betula glandulosa* leaf litter was surface-incubated in two adjacent low Arctic sites with contrasting soil moisture regimes: dry shrub heath and wet sedge tundra at Disko Island, Greenland. Christiansen et al. (2017) investigated the impacts of factorial combinations of enhanced summer warming (using open-top chambers; OTCs) and deepened snow (using snow fences) on surface litter mass loss, chemistry and fungal decomposer communities. Enhanced summer warming significantly restricted litter mass loss by 32% in the dry and 17% in the wet site. Litter moisture content was significantly reduced by summer warming in the dry, but not in the wet site. Likewise, fungal total abundance and diversity were reduced by OTC warming at the dry site, while modest warming effects were observed in the wet site. These results suggest that increased evapotranspiration in the OTC plots lowered litter moisture content to the point where fungal decomposition activities became inhibited. By contrast, snow addition enhanced fungal abundance in both sites but did not significantly affect litter mass loss rates. It was concluded that although buried soil organic matter decomposition is widely expected to increase with future summer warming, surface litter decay and nutrient turnover can be restricted by the evaporative drying associated with warmer air temperatures.

*In situ* ecosystem methane fluxes measured with closed chamber technique in a wet heath ecosystem, Abisko, Sweden. Photo: Bo Elberling.
Højdepunkt 2017

Højdepunkterne for CENPERM i 2017 omfatter flere eksempler på hvor feltarbejde er blevet kombineret med brug og analyse af remote sensing. Følgende fire publikationer offentliggjort i 2017, belyser fordelene ved at arbejde tværfagligt og inkludere både en op- og nedskalering. Studierne omfatter analyser af hele den isfrie del af Grønland, konkrete landskabsområder, og konkrete undersøgelsesområder, hvor der foretages feltforsøg.


Deltas are growing as climate is warming

by Mette Bendixen, postdoc, CENPERM, University of Copenhagen

Deltas form where rivers meet the ocean and are shaped by the forces of rivers, waves and tides. Today, most deltas in the world are drowning because of a global rise in sea level. Large parts of the Arctic coasts are eroding because of a combination of thawing permafrost, decreasing sea ice and increased wave erosion. With historical aerial images and modern satellite imagery, we show that deltas in Greenland, unlike most other deltas, are growing.
In the work published in *Nature* in October, we show that the coasts of Greenland have an opposite response to a warming climate than the rest of the Arctic. As climate warms, the deltas of Greenland are growing.

Key data for this research come from an archive of historical aerial imagery taken by the American Army during World War II. The US military was searching for German weather stations and conducted an intensive aerial photo campaign of the Greenland coast. The film rolls were later handed over to the Danish National Survey. Combined with modern satellite imagery freely available from Google Earth, we compared the areal extent of 121 deltas from Disko Island in the central western part, around the southern tip, and up to the central eastern part of Greenland. By analyzing the area above the high-water line for each of the deltas, we were able to compare the change in delta sizes over time.

In the period from the 1940s to the 1980s, the deltas were stable. As the climate warmed and temperatures started to increase, the deltas significantly prograded between 1980s and 2010s, meaning they built out into the sea. The majority of the deltas prograded hundreds of meters towards the sea, and some deltas grew up to several kilometers out into the sea. As a result, new land has formed, as silt, sand and gravel no longer become flooded by the daily variation in the tides.

These changes in the morphology of the coast can be caused by a changing input from land and by changing dynamics at sea. We were curious to find out which processes were responsible for the dramatic delta changes observed from the 1980s and onwards. Therefore, we created a model, that could incorporate all the processes possibly responsible for the observed changes in the coastal morphology. For each of the 121 deltas, we calculated the area covered by ice within each catchment, we looked at the changes in the land-water movements – the isostasy – as well as the specific lithology for each delta. At sea, we incorporated the distribution of sea-ice at each delta and how much the delta was exposed to wave activity. The results showed that as the temperatures rise, so does the melting of the Greenland Ice Sheet. With increased melting comes more freshwater which transports more material, such as clay, silt, sand and gravel to the coastal zone. As the discharge drops when the river meets the sea, the material is deposited in the delta, and the delta grows. The main drivers for the delta growth are therefore the increasing mass loss from the Ice sheet in combination with the increasing open water period at sea. We had expected that the delta growth would be counteracted by the increasing open water period, but instead as the sea is free of ice for a longer period of the year, the deltas can grow out into the sea.

The population of Greenland live along the coast and the sea is essential for the infrastructure and the fishing industry. The growing deltas affect the infrastructure as the increasing amount of material is deposited along the coast. This causes a sanding up of the nearshore zone and has large consequences for the harbors as the ships simply get stuck. In the municipality of Qeqqata, where Kangerlussuaq is located, a new harbor is currently in the planning stage. The new harbor will be located further seaward and thereby avoid the problems with the increasing amount of sand. When establishing future infrastructure, thorough planning is required, and these results constitute an important insight, which must be taken into account in future infrastructure planning.

With this work, we fill knowledge gap and change the current understanding of how a warming climate affects the coasts of Greenland.


transported to anoxic river delta sediments. *Microbial Ecology* 74, 6-9.


Technical report


Book chapters


Poster presentations at conferences, symposia, seminars etc,


CENPERM continued its series of weekly talks at the Department of Geosciences and Natural Resource Management. These seminars were also held for PhD students and postdocs to present specific parts of their work, to create a forum for sharing of knowledge, problems, and solutions within the Center. This process has enabled CENPERM members and contributors to share important research across academic levels and backgrounds.

Examples of outreach


Bendixen, M., Elberling, B. Presenting research areas in YouTube film prepared for the American Geophysical Union (AGU) fall meeting 2017. “Past, present and future climate change – Observations and modelling results on different time and length scales”, https://www.youtube.com/watch?v=tQZlbdjMjtY


Schurgers, G. “Use of supercomputing for climate and ecosystem modelling”. Podcast: Supercomputing in Denmark, Danish e-infrastructure cooperation (DeiC), e-science vidensportal. Jan. 18. http://streaming.kaltura.nordu.net/p/171/sp/17100/serveFlavor/entryId/0_bv78tn7a/v/2/flavorId/0_2fcgkr58/name/a.mp4


Press


Other


Elberling, B. "Plantevækst & Permafrost". Offentligt foredrag i Magisterforeningen, Nov. 23.

Fenger-Nielsen, R. "Klimaforandringer og Grønlands arkæologi". Foredrag på Folkuneiversitetet, Rockefeller NBI, Apr. 4.


Hollesen, J., Fenger-Nielsen, R. "Klimaændringer truer Grønlands arkæologiske historie". Foredrag i Selskabet for Arktisk Forskning og Teknologi (SAFT), København, Mar. 30.

Hollesen, J., Fenger-Nielsen, R." Arctic Archaeology in a changing climate". Presentation at Aarhus University, May 5.


CENPERM weekly seminars

Feb. 9.
Mette Bendixen, PhD student, CENPERM/IGN: Evolution of Sedimentary coasts in Greenland in a Changing Climate.

Feb. 16.
Wenxin Zhang, Postdoc, CENPERM/IGN: Using multi-objective constraints to model CO$_2$ exchange from a permafrost-thawing heath ecosystem at high Arctic.

Mar. 2.
Per Ambus, Professor, CENPERM/IGN: Lab Tour.

Mar. 9.
Nynne R. Ravn, PhD student, CENPERM: Arctic ecosystem CO$_2$ emission in a changing climate.

Mar. 16.
Samuel Faucherre, PhD student, CENPERM: Temporal dynamic of permafrost respiration in contrasting Arctic regions.

Mar. 23.
Bent Hasholt, Associate professor emeritus, IGN: Transport of sediment and solutes, Watson River, Kangerlussuaq, West Greenland.

Mar. 30.
M.Sc. students presenting and discussing their thesis work.

April 20.
Annelein Meisner, Postdoc, Dept. Biology, Lund University, Sweden: Microbial responses to drying-rewetting and freeze-thaw cycles.
May 4.
Birger U. Hansen, Thomas Friborg, associate professors, CENPERM/IGN: Presentations on Greenland Ecosystem Monitoring (GEM).

May 11.
Tao Li, postdoc, CENPERM/BIO: Plant volatiles in a changing environment: stress response, ecological and atmospheric implications.

Sep. 21.
Bo Elberling, professor, CENPERM/IGN: New activities for Disko: Ice coring.

Sep. 28.
Anders Priemé, professor, CENPERM/BIO: Microbiology in CENPERM II.

Oct. 5.
Guy Schurgers, associate professor, CENPERM/IGN: Modelling in CENPERM II.

Oct. 12.
Ellen E. Martin and Jonathan B. Martin, professors. Dept. of Geological Sciences, Univ. of Florida: Neglected fluxes: Understanding the evolution of weathering as the Greenland ice sheet retreats.


Nov. 2.

Nov. 9.
Per Ambus, professor, CENPERM/IGN: Fire in the Arctic.
Kyra St Pierre. PhD candidate, University of Alberta: Polar bears, rain and methane fluxes: 3 months in southern Greenland.

Nov. 16.
Elisabeth Biersma, Kevin Newsham, Peter Convey, British Antarctic Survey, Ludovica D’Imperio, CENPERM/IGN: Collaborations between the British Antarctic Survey (BAS) and CENPERM.

Nov. 23.
Anders Michelsen, professor, CENPERM/BIO: Nitrogen as a key element in arctic ecosystems - Some recent results from Disko, Zackenberg and Abisko, and towards CENPERM II.

Nov. 30.
Riikka Rinnan, professor, CENPERM/BIO: Biogenic volatiles in the Arctic – towards CENPERM II.
CENPERM’s activities in 2017 include a number of educational efforts. These include both arctic field courses and classic university courses at the basic and advanced levels at the University of Copenhagen. In addition to course taught, a number of M.Sc. theses have been supervised (see Ongoing research projects).

Field courses

“Arctic biology, field course”, Arctic Station, Disko, Greenland. Dept. of Biology, University of Copenhagen, summer, A. Michelsen.

“Arctic field course - Geo Course”, Arctic Station, Disko, Greenland. Dept. of Geosciences and Natural Resource Management, University of Copenhagen, summer, B. Elberling & P. Ambus.

“International bachelor permafrost summer field school”, University Centre in Svalbard, Norway, summer, A. Priemé.

Teaching at the B.Sc. level

“Almen mikrobiologi”, Dept. of Biology, University of Copenhagen, autumn, A. Priemé.

“Basic arctic biology”, Dept. of Biology, University of Copenhagen, spring, R. Rinnan, A. Michelsen.

“Biological experiments: design and analysis”, Dept. of Biology, University of Copenhagen, autumn, A. Michelsen.

“Fluviale, estuarine og marine processer og miljøforhold”, Dept. of Geosciences and Natural Management, University of Copenhagen, autumn, T.J. Andersen.


“General ecology”, Dept. of Biology, University of Copenhagen, spring, A. Michelsen, R. Rinnan, H. Ro-Poulsen.

“Jordbundsressourcer og jordbundens miljøgeokemi”, Dept. of Geosciences and Natural Management, University of Copenhagen, spring, P. Ambus.

“Plant ecophysiology”, Dept. of Biology, University of Copenhagen, spring, H. Ro-Poulsen, A. Michelsen, K. Rousk.

Teaching at the M.Sc. level

“Advanced bacteriology 2”, Dept. of Biology, University of Copenhagen, autumn, A. Priemé.
“Aerial and near-field remote sensing”, Dept. of Geosciences and Natural Management, University of Copenhagen, A. Westergaard-Nielsen.

“Arctic biology”, Dept. of Biology, University of Copenhagen, spring, R. Rinnan, A. Michelsen, A. Priemé.

“Climate change and biogeochemical cycles”. Dept. of Biology, University of Copenhagen, autumn, R. Rinnan, K. Rousk.

“Climate change - an interdisciplinary challenge”. Dept. of Biology, University of Copenhagen, autumn, R. Rinnan, T. Friborg, G. Schurgers.

“Coastal geosciences”, Dept. of Geosciences and Natural Management, University of Copenhagen, autumn and winter, A. Kroon.

“Ecological modelling”, Dept. of Geosciences and Natural Resource Management, University of Copenhagen, spring, G. Schurgers.

“General ecology”, Dept. of Biology, University of Copenhagen, spring, H. Ro-Poulsen.


“Experimental design and statistical methods in biology”, Dept. of Biology, University of Copenhagen, spring, A. Michelsen, R. Rinnan.

“Fluvial and estuarine geoscience”, Dept. of Geosciences and Natural Resource Management, University of Copenhagen, T.J. Andersen, V.B. Ernstsens.

“Molecular microbiology I”, Dept. of Biology, University of Copenhagen, autumn, A. Priemé.

“Molecular microbiology II”, Dept. of Biology, University of Copenhagen, autumn, A. Priemé.

“Stable isotope geochemistry”, Dept. of Geosciences and Natural Management, University of Copenhagen, spring, P. Ambus.

“Terrestrial ecosystem processes and global change”, Dept. of Biology, University of Copenhagen, spring, R. Rinnan, A. Michelsen, H. Ro-Poulsen, K. Rousk.

**Teaching at the Ph.D. level**


“Biogenic volatiles – exchange at different scales and interactions with ecosystem processes”, autumn. R. Rinnan, G. Schurgers.
In February, the PhD students held a WriteCamp outside Copenhagen. Like the previous years a special Master theses workshop was held in March with discussion and presentations of projects in progress. A number of the master students participated in the CENPERM fieldwork in Greenland and Northern Sweden.

**Project titles and starting dates**

**Postdoctoral projects**


Koranda, Marianne. Postdoc, May 2017 – ongoing, “Effects of bryophytes on soil microbial processes and N-cycling” (BryoSoil)”.

Rousk, Kathrin. Postdoc/ Assistant Professor, Jan. 2014 – ongoing, “Abiotic controls of nitrogen (N) fixation: Implications for plant-bacteria associations and ecosystem N-cycling”.

“ Nitrogen fixation as a key function in contrasting ecosystems: Climatic and molecular controls”.


Tang, Jing. Postdoc, Dec 2016 – ongoing, “Modelling Arctic Biogenic Volatile Organic Compounds emissions (MABVOC)”.


Zhang, Wenxin. Postdoc, Aug. 2015 – ongoing, “Merging the data and models to simulate the ecosystem C dynamics at Disko in Greenland”.

**Ongoing PhD projects at CENPERM 2017**

Baggesen, Nanna: “Emissions of biogenic volatile organic compounds (BVOCs) from a subarctic heath ecosystem, using a PTR-MS that allows for diurnal measurements on a fine time resolution”. Supervisor: Riikka Rinnan.

Cable, Stefanie: “Holocene landscape history and ground ice distribution in Svalbard and NE-Greenland - Linkages between geomorphology and cryostratigraphy in two mountainous permafrost landscapes”. Supervisors: Hanne H. Christiansen and Bo Elberling.
Faucherre, Samuel:

Fenger-Nielsen, Rasmus:
“Predicting and mapping environmental threats to archaeological sites in Greenland under current and future climate conditions”. Supervisors: Bo Elberling, Jørgen Hollesen and Aart Kroon.

Karami, Mojtaba:
“Upscaling and modelling ecosystems in permafrozen soil environments”. Supervisors: Birger Ulf Hansen and Bo Elberling.

Kramshøj, Magnus:

McConnell, Alistair:
“Arctic carbon budgets and ecosystem modelling”. Supervisors: Thomas Friborg and Bo Elberling.

**Defended PhD theses 2017 (5)**

Bendixen, Mette:

Hauptmann, Aviaja Lyberth:
“Microbial community interactions in Arctic environments using a metagenomics approach”, defended Apr. 2017. Supervisor: Thomas Sicheritz-Ponten, DTU.

Ravn, Nynne R.:

Schostag, Morten Dencker:

Svendsen, Sarah Hagel:

**M.Sc. projects supervised at CENPERM**

**M.Sc. projects ongoing (13)**

Adamsen, Malene Snedker: “Spatial patterns and variation of black carbon deposition on snow surface at Qeqertarsuaq, Greenland”. Supervisors: Guy Schurgers, Bo Elberling.


Landl, Balduin: “CO$_2$ exchange of subarctic tundra heath climate change simulation plots comprising warming, willow and birch litter addition treatments”. Supervisors: Anders Michelsen, Sophie Zechmeister-Boltenstern, Wien, Austria.


Naursgaard, Mads Peter: “Volatile and non-volatile organic compounds in bryophytes”. Supervisors: Riikka Rinnan, Tao Li, Thomas Holst.

Nielsen, Malene Bille: “Quantification of carbon emissions along a height gradient at Disko, Greenland”. Supervisor: Per Ambus.


Skardhamar, Mira Nordsmark: “Climate change impacts on tundra litter BVOC emission”. Supervisors: Riikka Rinnan, Sarah Svendsen.


**MSc Projects completed in 2017 (7)**


**DNRF visit to CENPERM research site at Disko in West Greenland**
Research activities at CENPERM continue to be linked to a number of well-established international arctic networks. These cooperation agreements are supplemented by a strong affiliation to internationally recognized researchers.

**External experts and Center evaluation**

CENPERM is extremely grateful to the external group of experts for its support and guidance in the process of formulating the CENPERM II research plan.

Edward Arthur George Schuur, Professor, Northern Arizona University, Center for Ecosystem Science and Society, USA.

James M. Tiedje, Distinguished Professor and Director of the Centre for Microbial Ecology at Michigan State University, USA.

Paul Grogan, Associate Professor, Department of Biology, Queen’s University, Kingston, Ontario, Canada.

Vladimir Romanovsky, Professor of Geophysics, Permafrost Laboratory, University of Alaska Fairbanks, USA.

**International Networks**

CENPERM has extended an existing strong international Arctic network, which is linked through several projects. CENPERM also participates in the pan-Arctic networks as INTERACT, the Permafrost Carbon Network and ICOS (Integrated Carbon Observation System – Research Infrastructure).

**Danish and Greenlandic cooperation**

Cooperation in a national and Greenlandic context is ensured within Danish and Greenlandic networks as Greenland Ecosystem Monitoring (GEM) and through ongoing projects with the Geological Survey of Denmark and Greenland (GEUS), University of Aarhus, Danish Meteorological Institute (DMI), the Centre for Arctic Technology – Technical University of Denmark (ARCTEK), the National Museums in Denmark and Greenland, Agricultural Consulting Services (Upernaviarsuk research station), Greenland Survey (Asiaq) and Greenland Institute of Natural Resources.

**International research partners and co-operators**

Adam Mickiewicz University, Poznan, Poland: A. Buchwal.

Alfred Wegener institute, Germany: H. Matthes, A. Rinke, A. Mirseid. Regional extreme, Arctic Cyclone.

Agriculture and Agri-Food, Ottawa, Canada: E. Gregorich. Shared fieldwork, North Greenland.

Bonn University, Germany: S. Weijers. Climate impacts on Cassiope tetragona growth and isotopic composition.

Delft University of Technology, The Netherlands: Computer vision lab.

Eidgenössische Technische Hochschule Zürich, Schweiz: T. Crowther.


Gothenburg University, Sweden: R. Björk. Permafrost samples and scientific publications.

Helmholtz Zentrum München-Institute for Biochemical Plant Pathology, Germany: J.-P. Schnitzler. Experimental collaboration and Phytotron study with tundra mesocosms.

Los Alamos National Laboratory, USA: C. Andresen, Permafrost impacts on hydrology.

Pacific Northwest National Laboratory, Biological Sciences Division, Richland, WA, USA: J. K. Jansson.

Northern Arizona University and OEB Harvard University, USA: Analyzing phenocam images. Scientific publication.

Russian Academy of Science, Russia: M. G. Akperov. Arctic cyclones. Scientific publications.

Stanford University, USA: A. Ahlström. Modelling large-scale C cycle.


UiT Arctic University of Norway, Tromsø, Norway: E. Cooper. Snow fence studies Svalbard.


University Centre in Svalbard (UNIS), Norway: P. Bronken Eidesen and H. H. Christiansen. Permafrost cores and scientific publications.


University of Anchorage, Alaska, USA: Jeff Welker. Climate impacts on Cassiope tetragona growth and isotopic composition.

University of Bergen, Norway: L. Øverås.

University of Boulder, Institute for Arctic and Alpine Research (INSTAAR), Colorado, USA: I. Overeem, K. Barnhart. Coastal changes in Greenland.
University of Eastern Finland, Department of Environmental Science, Finland: M. Kivimäenpää. Sample treatment, light and scanning electronmicroscopy.

University of Edinburgh, School of GeoSciences, UK: I. Myers-Smith, S. Angers-Blondin. Pan-arctic shrub growth meta-analysis.

University of Helsinki, Department of Forest Sciences, Finland: K. Karhu. Climate impacts, soil geochemistry.

University of Lund, Sweden: B. Smith, P. Miller, M. Berggren. Biogeophysical feedbacks on pan-Arctic regions. Model development, Model code, scientific publications.


University of Oslo, Department of Geosciences, Norway: B. Etzelmuller, S. Westermann. Permafrost modelling. O. Humlum; Field work (and data analyses) of geomorphology at Disko, W. Greenland.

University of Montana, USA: F. Gilman. Disko soil microbial studies.

University of Sherbrooke, Canada: J.P. Bellenger; Nutrient limitation of nitrogen fixation in the boreal biome. Robert Bradley; Effects of N and metal pollution on N fixation.

External funding

Researchers within the Center have attracted major research grants in 2017. Such external funding opportunities have been pursued through national and international research foundations. These external funding allows CENPERM to further strengthen research and educational activities.

Danish public funding


Private Danish funding


International funding

EU Horizon 2020 Marie Curie Program Individual Fellowships: “Modelling Arctic Biogenic Volatile Organic Compounds emissions (MABVOC)”. Grant holder: Jing Tang. 2016-2018. DKK 1,500,000.


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Ravn Nynne R. PhD student
Schostag Morten Dencker PhD student
St Pierre Kyra PhD student, visiting
Svendsen Sarah H. PhD student
Wang Peiyang PhD student, visiting

Technical staff
Jacobsen Pia Laboratory technician
Madsen Mathias Electronics technician
Moser Vagn Laboratory technician
Nielsen Esben V. Laboratory technician
Stockmarr Pernille Laboratory technician
Sylvestre Gosha Laboratory technician
Wahlgren Maja Holm Laboratory technician

Administration
Bjerre Karen E. Center administrator
The Danish National Research Foundation (DNRF) is an independent organization established by the Danish Parliament in 1991 with the objective to promote and stimulate basic research at the highest international level at the frontiers of all scientific fields. The Center of Excellence (CoE) program is the main funding mechanism, but also a number programs and initiatives have been launched specifically targeted at increasing the level of internationalization of Danish research communities.

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