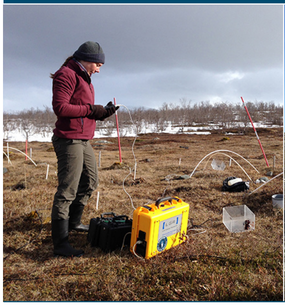
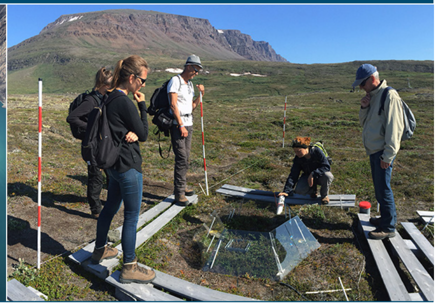
CENPERM HIGHLIGHTS 2017



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 south-western 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.

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.

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