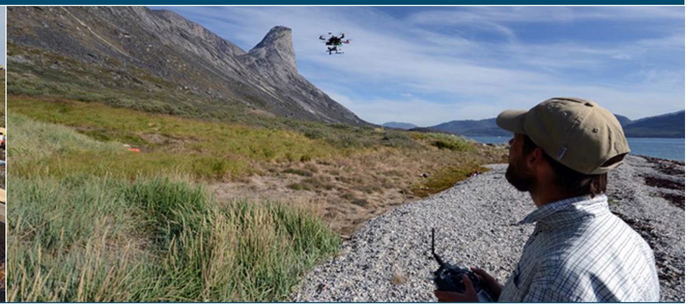
CENPERM HIGHLIGHTS 2020





Highlights 2020 is dedicated to the PhD-students of CENPERM. The students, despite Covid-19 and continued difficulties, have kept their motivation levels high and been able to continue their research, working intensively on specific projects, and for some defended online. Three multidisciplinary publications linked to PhD-projects are highlighted below: all integrate aspects from bioscience and geoscience, and show that we still can be surprised by the complex responses of the Arctic to climate change, with or without humans being present.

1. Soil water chemistry is an important component in soils for understanding climate feedbacks, plant growth, microbial turnover and net greenhouse gas emissions. In *Soil Biology and Biochemistry* Rasmussen *et al* (2020) assess the soil water chemistry in a low arctic Greenlandic mesic tundra heath and a fen. The sites have been subjected to factorial treatments of summer warming using open top chambers, snow addition using snow fences (which increase soil temperature in late winter), and shrub removal mimicking herbivory attack. Measurements were made over contrasting growing seasons (2013–2016). Ambient nutrient concentrations in the mesic tundra heath decreased throughout the growing season and increased during leaf senescence in the autumn. In contrast, nutrient concentrations were highest during peak growing season in the fen. Summer warming in the heath did not change the availability of nutrients, however changes in nutrients such as nitrate were observed in combination with shrub removal or snow addition treatments, highlighting the complexity of ecosystem responses to single and multiple climate effects. The study shows how soil water chemistry is vegetation-specific, and that treatment effects on nutrient cycling are surprisingly limited when comparing multiple years with contrasting precipitation patterns. The combination of multi-year and multi-site studies is therefore important for understanding future biogeochemical dynamics in Arctic landscapes.

2. In *Global Change Biology* Pedersen *et al* (2020) demonstrate a new and important climate feedback mechanism that may act to counterbalance CO_2 release from organic matter degradation. We show that warming in the Arctic can increase plant-available nutrients from both accelerated top-soil decomposition, as well as deep-soil permafrost thaw. Plants take advantage of nitrogen (N) made available by soil decomposition and permafrost thaw, and incorporate it into new above-ground biomass. Plant species-specific N uptake was measured immediately after N-release (autumn) and after one year. We found that high arctic plants actively foraged for N after the peak growing season. While some plant species (*Carex rupestris, Dryas octopetala, Kobresia myosuroides*) preferred top-soil N, the shrub *Salix arctica* acquired N from deeper soil layers. All plants were able to obtain N from the permafrost thaw front from approximately 1 m depth, both in autumn and during the following growing season. This demonstrates the importance of permafrost-released N as a new nutrient source for arctic plants. It can be concluded that thawing permafrost can release CO_2 from stored organic matter, but also kick start a positive feedback by making nutrients available for some plants to grow better and consequently counterbalance carbon loss from degrading permafrost via above-ground plant growth.

3. Climate change threatens both natural as well as many well-preserved archaeological sites in the Arctic. In *Archaeometry* Fenger-Nielsen *et al.* (2020) present the first Arctic multi-threat assessment focusing on the Nuuk region of Greenland. In this region, more than 300 archaeological sites are already threatened by exposure to impacts from microbial degradation, permafrost thaw, vegetation growth and erosion driven by climate change. Within the next 80 years, warming is expected to lead to increased desiccation, oxygen penetration, collapse, and microbial degradation of the sites. Additionally, plant growth and erosion also lead to destruction of the sites. Identification of threatened sites using remote sensing-based techniques represent an important first step towards protecting vulnerable archaeological sites under future climate change.

Danmarks Grundforskningsfond
Danish National Research Foundation

UNIVERSITY OF COPENHAGEN

CENPERM Center for Permafrost

cenperm.ku.dk