EGU22-10196
https://doi.org/10.5194/egusphere-egu22-10196
EGU General Assembly 2022


# Landscape-related ground ice variability on the Yukon coastal plain inferred from computed tomography and remote sensing

**Philip Pika**[1], George Tanski[1,2], Mathias Ulrich[3], Louis-Philippe Roy[4], Fabrice Calmels[4], Hugues Lantuit[2], Daniel Fortier[5], Michael Fritz[2], and Jorien Vonk[1]

[1]Vrije Universiteit Amsterdam, Netherlands
[2]Alfred Wegener Institute (AWI), Germany
[3]Leipzig University, Germany
[4]Yukon University Research Centre, Canada
[5]Université de Montréal, Canada

Warming in the Arctic causes strong environmental changes with degradation of permafrost (permanently frozen ground). Active layer deepening (gradual thaw) and permafrost erosion (abrupt thaw) results in the mobilization and lateral transport of organic carbon, altering current carbon cycling in the Arctic. Ground ice content is a crucial factor limiting our understanding and ability to determine the rates and dynamics of permafrost thaw and its impact on potential thaw subsidence rates, changes in lateral hydrological pathways and its driving mechanisms on a landscape scale.

In this study we investigate ground ice content and its characteristics across the most dominant landscape units of the Yukon coastal plain (Canadian Arctic), using two spatially and technically contrasting approaches. In our bottom-up approach, twelve permafrost cores were collected from moraine, lacustrine, fluvial and glaciofluvial deposits using a SIPRE corer (mean drilling depth of 2 m) in spring of 2019. Ground ice and sediment contents within polygon centers were analyzed and classified using computed tomography and image recognition software (k-means). Our top-down approach quantified ice-wedge volumes from remote sensing imagery tracing the circumference of polygon troughs over the same area. Preliminary results - extrapolated to the entire coastal plain - show that the ground-ice content in polygon centers vary significantly from massive ice in the polygon troughs (wedge-ice). Total ice volume was estimated around 80.2 vol.-%, of which 68.2 ± 18.1 vol.-% was attributed to ground ice in polygon centers, and 12 ± 3.1 vol.-% of the landscape is massive ice in wedge-ice along polygon troughs. Additionally, differences among and between landscape units are also substantial, with highest ice volume contents in moraines landscapes, where polygon centers contain 58.8 vol.-% ground ice and wedge-ice volume is 16.2 vol.-%), while the lowest ice contents are found in glacio-fluvial deposits (22.1 vol.-% resp. 9.1 vol.-%).

Our results reveal a higher average and a larger variability in ground ice contents than previously found, suggesting a need of both ground-based measurements and remote sensing imagery to further our understanding of the future landscape subsidence, but also to avoid a likely under- or

overestimation associated with the chosen approach. We conclude that due to the high ground ice contents on the Yukon coastal plain, substantial changes of the permafrost landscape will occur under current warming trends. These will include subsidence, abrupt erosion, changes in hydrology and organic carbon mobilization, degradation and export processes, which will differ between landscape units.