Exploring shoulder season greenhouse gas production along a permafrost thaw transect in sub-arctic Finnish Palsas

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Abstract

The future of terrestrial carbon found in permafrost is not yet well understood, but this soil carbon may be a potential significant contributor to positive-feedback loop of climatic warming. In the (sub) arctic, the annual freeze-thaw cycles and thick peat accumulation harbor ideal conditions for palsa formation. Although, a recent study at our site in Arctic Lapland found that the area of the carbon-rich palsa mounds have already decreased by -77 % to -90 % since 1960.
Here, we investigate potential greenhouse gas (CO_2, CH_4, N_2O) production from a palsa sampled along a transect with 60+ years of documented thaw. During the annual cycle of freeze-thaw, one of the largest unknowns in the life cycle of a palsa mound is the biogeochemical cycles during the shoulder season. This transition time between growing, and non-growing seasons that have previously been assumed to be times of relative dormancy for GHG flux in high-latitude wetlands. However, recent studies find that there is in fact a significant amount of GHG flux during this time.
We aim to isolate shoulder season variables (increased N from plant senescence, temperature change) and explore how they each affect the potential CO_2 and CH_4 production using ex-situ incubations, coupled with microbial community cell counts sampled in tandem. Here, we test whether N addendums increase the GHG, as n-poor habitat has been shown to respond with increased microbial activity to the release of this metabolic bottleneck. In addition to the N-treatments, the samples will also be separated into three incubation temperature groups (4 , 15, 20 C) to be able to link increasing temperatures with the N response. Overall, we aim to fill knowledge gaps on these habitats response to changing climatic conditions, and use our findings to better earth system models permafrost carbon predictions.