

## Spatial and temporal variation in potential soil CH<sub>4</sub> consumption rates in a northern boreal watershed

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Soil can be sources or sinks of methane (CH<sub>4</sub>), depending on the presence of competent microbial communities (methanogens and methanotrophs) and environmental conditions (i.e., redox potentials) that render these processes energetically viable. In this study, we investigated the former by surveying how the potential for the soils to produce or consume CH<sub>4</sub> varied in space (location and soil depth) and time (season) in a northern boreal watershed. To do so, we established a ~2 km hilltop-to-wetland transect between the Kenttäröva and Lompolojänkä ICOS stations in Northwestern Finland. We collected soil samples from seven plots along this transect, which cover major vegetation types and relief positions in the Lompolojänkä catchment (spruce/birch and pine forests; hilltop, hillslope, and hillfoot position; drained and undrained peat). Samples were collected from three replicate soil pits at each plot at the beginning, mid, and end of the growing season. We separated soil profiles into >3 generic soil horizons (where possible) or depth increments reaching to at least 25 cm depth at each site. In total, >300 soil samples were collected and >1000 individual incubation experiments were conducted between June and September 2019. Here, we present initial results from high- and low-affinity CH<sub>4</sub> incubations assays conducted with soil samples collected in June and July 2019. For these, CH<sub>4</sub> consumption rates at field moisture were measured under aerobic conditions with a starting CH<sub>4</sub> concentration of 8 (high affinity) or 8000 (low affinity) ppmv. Methane oxidation rates were normalized to soil volume. High affinity methane oxidation varied strongly throughout the dataset, ranging <0.5 to 15  $\mu\text{mol CH}_4 \text{ dm}^{-3} \text{ d}^{-1}$ . The highest potentials were found in the hilltop and open wetland endpoint of the transect, whereas hillslope and forested peatland site exhibited lower potentials. Within soil profiles, the highest potentials were found in the organic and/or top mineral soils, whereas deeper soil layers exhibited CH<sub>4</sub> oxidation potential only at the open wetland site. We did not detect an overall change in the CH<sub>4</sub> oxidation potential between the early and mid-summer time points, but several sites exhibited a shift of the CH<sub>4</sub> potential towards more shallow soil horizons in at the later sampling event. Low affinity CH<sub>4</sub> oxidation potentials up to 6  $\text{mmol CH}_4 \text{ dm}^{-3} \text{ d}^{-1}$  were detected at the wetland endpoint, while only minor potentials were detected at other sites. Again, we found a shift towards CH<sub>4</sub> oxidation in more shallow soil layers in the mid compared to the early growth season.