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Quantifying methane flux dynamics in rewetted boreal peatlands: Impact of water table depth and soil temperature

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Peatland restoration starts with rewetting by blocking or filling the ditches. Successful rewetting is anticipated to start the restoration process towards the conditions of natural peatland. One of the major processes, affected by drainage and restoration, is hydrology and more precisely water table depth (WT). Drainage lowers the water table creating oxic conditions where rewetting aims to increase the WT and restore anoxic environment in the soil.

Most of the methane production in peatland happens in anaerobic waterlogged conditions by methanogenic Archaea during methanogenesis, and we know that the rate of CH_4 gas flux is influenced by factors such as soil temperature, water table depth, plant community and pH. At the same time, methane oxidation happens in the aerobic peat layer and the balance between production and consumption determines the methane flux to the atmosphere.

We measured methane gas flux at 27 rewetted, 6 natural and 7 drained, fertile peatland forests in Southern and Central Finland between 6/2021-11/2023. Sites were rewetted 3-30 years ago. We used the closed chamber method with portable gas analyzers. Flux measurements were done biweekly to monthly while water table and soil temperature were measured with automatic water and temperature loggers hourly. Vegetation mapping was done during the summer 2023. We will compare methane fluxes in drained, rewetted and pristine peatlands using this new material and old published data from Finnish peatlands.

We hypothesize to see an increase in methane emissions after rewetting from drained towards natural levels. We also expect to see higher seasonal methane dynamics in rewetted than in natural peatlands, as WT dynamics appears to be higher in rewetted than in natural mires.