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Greenhouse gas balances of natural and drained peatlands – micrometeorological studies in the boreal zone

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Among terrestrial ecosystems, northern peatlands are one of the largest reservoirs of carbon that has been taken from the atmosphere comprising as much as one third of the carbon stored globally in soils. Extensive natural mires still exist in uninhabited areas of Eurasia and North America. They have been long-term continuous sinks of CO_2, thus reducing atmospheric CO_2content and hence its warming effect. Methane-producing microbes are usually found in the anoxic organic soil layer below the water table, resulting in significant CH_4 emissions to the atmosphere. Microbial N_2O production rates in natural mires tend to be low because these environments are usually too anoxic, acid and nutrient-poor for denitrification and nitrification bacteria. In populated regions, most wetlands have been drained for agriculture, forestry and energy production purposes. In Finland 5.7 million ha (60%) of peatlands have been drained for forestry and 0.7 million ha for agriculture. Draining, liming and addition of nutrients are common practices for making the soil more fertile changing the GHG budgets profoundly. Generally, drained peatlands are sources of CO_2 but small sinks of CH_4. Agricultural organic soils are significant sources of N_2O. However, emissions and uptake rates of GHGs vary greatly depending on land use and local environmental conditions and are highly dependent on vegetation, hydrology, nutrient status and temperature.

In this presentation, we will demonstrate which gases are important in natural northern mires and how their exchanges are modified by human intervention and land use change. We will present examples from sites at which CO_2 exchange have been measured using micrometeorological techniques, thus avoiding many problems related to studies that rely on chamber measurements. The study sites include a natural fen, an organic soil cropland, an afforested cropland and a drained pine bog all located in the southern or middle boreal zone in Finland.