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Spatial variability of greenhouse gas fluxes in two drained Northern peatlands

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Peatlands store large amounts of organic carbon, which is subject to microbial decomposition and mineralization to either CO_2 or CH_4. Drained peatlands are characterized by large horizontal variability in soil water contents and saturation, with dryer parts closer to the drainage ditches. The greenhouse gas (GHG) production in these systems is expected to be sensitive to temperature, substrate chemistry, oxygen concentration thus on soil water contents. Methane production should take place in the wetter parts, while respiration should dominate in drier parts. The seasonality of weather conditions modulates the spatial variability. In this complex situation, we are interested in how the seasonal weather variability triggers the microbial processes in the different micro-topographical situations and how this affects the overall GHG budgets of such sites.

We investigate two neighboring, drained ombrotrophic bogs in Norway close to Trysil, Innlandet, 61.1N- 12.25E, 640 m a. s. l.. One site (South) on an upper slope is about 45 m higher than the other site (North) in a saddle like flattening. We use an automated chamber method to examine the seasonality of GHG production at microsites that cover some contrasting local situations with in the large range of small scale spatial heterogeneity. With eddy covariance CO_2 and CH_4 flux measurements, we integrate over a larger spatial scale, with, however, shifting footprints depending on weather conditions and wind direction. We present a comparative analysis of 1.5 years continuous measurements, where we examine shifting spatial patterns of GHG production at different scales and relate them to soil conditions.

While the CO_2 fluxes compared very well between the two investigated sites, the CH_4 fluxes in the lower and wetter of the two sites (North) was higher and their spatial variability was lower than in the South site. Only in the South site, the CH_4 fluxes correlated with the coverage of well drained versus less well drained areas. We will present results on how the spatial variability changed with the seasonality of soil temperatures and the water table.

The automated chambers (five chambers within each footprint of the eddy flux towers) showed higher spatial variability for CH_4 fluxes than for CO_2 with higher CH_4 emissions in the wetter plots

furthest away from ditches, i.e. CH_4 fluxes correlate well to ground water depth at both sites. N_2O emissions were observed in short events during the early summer season. Overall, there was a good alignment of fluxes measured with eddy flux and chamber technologies.

Information on factors that constrain the spatio-temporal variability are important for estimating areal GHG budgets and for predicting possible effects of peatland management, such as draining or re-wetting on the climate effects from these ecosystems. From the results, we expect higher effects of peatland restoration on GHG budgets in the South site.