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Abandoned Peatland Ecosystem Response to Secondary Succession

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Most of the organic soils in Denmark are drained and used for agriculture. Greenhouse gas (GHG) emissions from these soils alone account for approximately 6-7 % of the total Danish emission. Rewetting, a relatively new climate change mitigation practice, of organic soils and peatland (i.e. lowland) ecosystems has the potential to reduce the net ecosystem GHG emission and over time turn the ecosystem to a net GHG sink. However, our knowledge of the ecosystem's mitigation potential 50- or 100 years after abandonment is very limited and related to unknown interactions between soil biogeochemistry, vegetation type and growth and hydrology. Few studies have reported the GHG budgets of CO_2 and CH_4 for rewetted European peatland, and none includes the long-term response of these fluxes to rewetting. Continuous in-situ measurements of GHG emissions are complicated, time consuming and expensive which explains the data- and knowledge gap on long-term climate effects to some degree.

Within the Danish research project RePeat, one of our main study-aims is to investigate how the long-term (0 – 71 years) ecosystem development (from grassland to secondary succession of woody vegetation) after rewetting impact the soil CO_2 and CH_4 fluxes in relation to changes in soil and biomass carbon stocks and biogeochemistry. We hypothesize that 'rewetting and secondary succession of forest of farmed peatland will turn the ecosystem into a net carbon sink faster than if the ecosystem is maintained as extensively managed grasslands'. We expect that our research activities in 2021 and 2022 will allow us to test this hypothesis.

For this study, we have selected four abandoned/rewetted agricultural sites on organic drained soils that represent a chronosequence spanning 7 decades. Two of the sites have recently been rewetted or will be (site A in 2020 and B in 2021) and the other two sites (C, D) have been abandoned and left for secondary succession since 1994 and 1950, respectively. At each site, two subplots with 5 replicate collars serve to measure the net CO_2/CH_4 exchange by the static chamber approach and use of the Ultra-Portable Greenhouse Gas Analyzer model 915-0011 (© Los Gatos Research). Soil moisture- and temperature and groundwater depth are measured for each collar. Basic meteorological parameters (precipitation, barometric pressure, photosynthetically active radiation (PAR) and wind- speed and direction) are measured at- or nearby each site. In addition to the GHG, soil physical- and meteorological measurements, we will estimate above- and belowground biomass and collect soil- and groundwater samples for a biogeochemical characterization.

Our presentation will show the experimental setup and preliminary findings on CO_2/CH_4 fluxes and ecosystem hydrology for the four sites.