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The effect of cultivation with reed canary grass on methane emissions from different Danish wet agricultural peatlands and the correlation with biogeochemical soil properties

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Drainage of peatlands for agriculture causes substantial degradation and finally loss, including associated ecosystem functions, but also creates emission hotspots of carbon dioxide (CO_2). Mean CO_2 emission from drained temperate grassland on peat was reported by IPCC as 22.4 (18.3-26.7) Mg
CO_2-eq ha^{-1} y^{-1} (95% CI) while methane (CH_4) emissions were close to zero. Rewetting of peatlands reduces CO_2 emissions while at the same time favouring CH_4 emissions. From wet or rewetted nutrient-rich grassland, emissions of CO_2 and CH_4 were reported by IPCC as 1.8 (-2.8-2.8) and
9.8 (0-39) Mg CO_2-eq ha^{-1} y^{-1}, respectively (GWP CH_4 = 34). The uncertainties of the estimates reflect the large variation among the reported studies, which could be caused by different climate conditions, vegetation, groundwater table (GWT), peat composition and biogeochemistry. A mesocosm experiment was established to assess biogeochemical causes of variation in CO_2 and CH_4 flux dynamics under controlled GWT for peatsoils derived from five different Danish bogs and fens. A total number of 75 mesocosms were grouped into three treatments: GWT -40 cm, bare; GWT -5 cm, bare; and GWT -5 cm, cultivated with reed canary grass (RCG). GHG fluxes were measured using opaque chambers at biweekly intervals from July 2019 to 2020 and extrapolated to annual values. Preliminary results indicate significant differences regarding CO_2 and CH_4 fluxes across all sites and depending on soil biogeochemical and physical properties. Rewetting raised the contribution of CH_4 most on soils from Store Vildmose and Vejrumbro with 1.9 to 12.9 t CO_2eq ha^{-1} yr^{-1} and 0.1 to 5.7 t CO_2eq ha^{-1} yr^{-1}, respectively. On an annual average, these high emissions were with 69 % and 48 % mitigated by the cultivation of RCG in a paludiculture scenario. Further, the results show that CH_4 spikes of up to 37.5 mg m^{-2} h^{-1} at elevated GWT during warmer summer months may be mitigated by cultivation with RCG, with maximum peaks of 2.1 mg m^{-2} h^{-1}. Soil analyses highlighted distinct differences in the soil mineralogical composition across sites and soil depths.