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Crop productivity on organic soils used for conventional agriculture with controlled drainage and for paludiculture in Northern Europe under climate change conditions

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Conventional agriculture on drained peat soil is current practice in many European countries, despite the known, negative impact on GHG emissions, water and soil quality and the associated high water management costs compared to mineral soil. Agricultural land use on peat is limited due to the ongoing degradation and oxidization-based loss of soil substrate. As a consequence, risks for yield losses increase due to soil hydrological problems like ponding, hydrophobicity, lowered field capacities and conductivities, potentially escalated by the anticipated change of climate conditions in the future. As an alternative to conventional agriculture, wetness adapted plants may be grown under hydrological conditions typical for peatlands (“paludiculture”), but necessary water management strategies need adaptation to deteriorated soil properties of previously drained sites.

The aim of this study is to assess the impact of selected climate change scenarios on agricultural yields on peat soils in Northern and Central Europe, with particular focus on changes in soil hydrological conditions and associated feedbacks on crop performance. We conducted a modelling exercise, where the soil hydrological and crop growth model SWAP-WOFOST was parameterized by three years of observations from a Finnish cropland and Danish grassland site with different climate and water management regimes. The Finnish site was conventionally managed and drained by subsurface drains, while the contrasting Danish site was used for paludiculture bioenergy plants (e.g. Phalaris arundinacea L.) under wet conditions. Regionalized climate projections of two emission scenarios (RCP4.5, RCP8.5) from a CMIP5 subset ensemble were used to project crop and biomass yield until the year 2100. The disentanglement of the multiple soil hydrological feedbacks on yields and thus optimizing strategies to increase groundwater levels with the aim of reducing CO_2 emissions are subject to the ongoing analysis and first results are presented.

This study will provide valuable insights to the future of agricultural land use on organic soil within Europe and provide scenarios for climate-smart crop growth and water management options.