Project brief

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Effects of water management and grassland renewal on the GHG emissions of intensively used grassland on peat soils

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- **No reduction of GHG emissions at the fen peat site, probably as groundwater levels were only slightly raised by submerged drains and ditch blocking.**
- **Water levels were clearly raised at the bog peat site, but considerably higher CO_2 emissions occurred at parcels with submerged drains, probably due to optimum soil moisture in summer.**
- **Increased nitrous oxide emissions were measured after shallow ploughing.**

Background and aims

The vast majority of peatlands and other organic soils in Germany is drained, mainly for agricultural use as grassland. This contributes around 7% to Germany's greenhouse gas (GHG) emissions as peat decomposition and fertilisation cause high carbon dioxide (CO_2) and nitrous oxide (N_2O) emissions. Thus, mitigation options are urgently required for achieving emission reduction targets. Within the project "SWAMPS", the effects of submerged drains (SMD) and blocked ditches (BD) as well as of grassland renewal methods on GHG emissions were measured for four years at a bog and a fen peat site.

Methods

Control parcels were drained by ditches (fen peat site) and both ditches and free pipe drainage (bog peat site). Both sites were used as intensive grasslands for dairy production with, depending on meteorological conditions, 3 to 5 cuts per year and nitrogen (N) fertilisation rates of 167 to 355 kg N ha^{-1} a^{-1}. At the beginning of the experiment, grassland renewal took place using shallow ploughing and direct sowing. At both the bog and the fen peat site, we measured fluxes of CO_2, N_2O and methane (CH_4) using manually employed transparent and opaque chambers at six of the treatments: all water management controls, SMD with shallow ploughing and permanent grassland as well as BD with permanent grassland.

Key findings

On average, mean annual groundwater levels at the plots with SMD were 0.14 m (fen peat site) and 0.38 m (bog peat site) higher than at the control parcels. DB raised the water levels by 0.02 m and 0.39 m. Effects at the bog peat site were stronger due to lower water levels at the control parcels and due to the higher hydraulic conductivity of the less decomposed peat.

At the fen peat site, CO_2 emissions of the SMD parcels were spatially heterogenous, but, on average, slightly (13%) lower than those of the control parcels. Due to higher CH_4 and N_2O emissions, total GHG emissions were comparable. CO_2 and GHG emissions of the BD parcel were similar to those of the controls. Grassland renewal increased N_2O emissions for two years.

Although mean annual groundwater levels were high (-0.33 m), CO_2 emissions at the bog peat site were much (40%) higher at parcels with SMD than at the control parcels. Despite lower N_2O emissions, GHG emissions were still clearly (33%) increased by SMD. Again, CO_2 and GHG emissions of the BD parcel were similar to those of the controls, while effects of grassland renewal were less clear than at the fen peat site. The surprising results regarding CO_2 might be explained by an interaction of increased soil moisture in the topsoil and improved nutrient retention during phases of high soil temperatures facilitated by SMD and, at the same time, by limitations of microbial activity due to low soil moisture at the control parcels.

Further Information

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SWAMPS
Erhalt von Moorgrünland durch angepasstes Management

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Partners

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