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Effects of grassland renewal and different water management regimes on greenhouse gas emissions from an intensive grassland on fen peat

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Drainage is necessary to use peatlands for conventional agriculture, but this practice causes high emissions of the greenhouse gases carbon dioxide (CO_2) and nitrous oxide (N_2O). Currently different projects are running to explore the potential to reduce soil subsidence by different techniques such as submerged drainage. The 'SWAMPS' project focuses on both on maintaining the trafficability for conventional grassland use and on the reduction of greenhouse gas emissions by managing the groundwater level by submerged drains and blocked ditches. Here, we aim to evaluate the effect of grassland renewal and water table depth on the emissions of CO_2, N_2O and methane (CH_4).

Therefore, we set up a field experiment on intensively used grassland on fen peat in North-Western Germany. The experiment combines three water management regimes (submerged drains, ditch blocking and control, i.e. drainage by open ditches) with three grassland renewal treatments (shallow ploughing, direct sowing and control, i.e. permanent grassland). In autumn 2016, the drainage pipes and weirs for the different water management regimes were installed and the grassland renewal took place. The different water management regimes are fully operational since June 2017. We measure CO_2, N_2O and CH_4 at six of the treatments: all water management controls, submerged drains with shallow ploughing and permanent grassland as well as blocked ditches with permanent grassland. CO_2 measurement campaigns using transparent and opaque chambers and a portable gas analyser take place every third or fourth week depending on season. CH_4 and N_2O samples are taken for subsequent analysis by gas chromatography every second week and, in addition, on the first, third and eighth day after grassland renewal and fertilizer application.

Here, we will present results of the initial phase of our experiment. Due to constraints in the water management, the full potential of managing groundwater levels by submerged drains could only be realised during the second half of 2017. Therefore, measured GHG emissions reflect a transition period between antecedent and experimental conditions. N_2O emissions after grassland renewal were highest at the shallow ploughed sites followed by the site with direct sowing, but N_2O peaks occurred only when the groundwater table rose up to 0.2 m below the surface for the first time and the soil temperature fell to zero. Furthermore, CH_4 fluxes were low due to low groundwater levels. First results on CO_2 emissions will be presented as well.