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Wetter, but not wet enough – limited greenhouse gas mitigation effects of submerged drains and blocked ditches in an intensively used grassland on fen peat

Sebastian Heller[1], Peter Gatersleben[2], Sebastian Oehmke[1], Ullrich Dettmann[1,3], Melanie Bräuer[4], and Bärbel Tiemeyer[1]

[1]Thünen, Climate-Smart Agriculture, Braunschweig, Germany
[2]Chamber of Agriculture Lower Saxony, Oldenburg, Germany
[3]Institute of Soil Science, Leibniz University Hannover, Germany
[4]State Agency for Agriculture, Environment and Rural Areas, Flintbek, Germany

The vast majority of peatlands in the North German Plain are cultivated as grassland. Intensive drainage measures are a prerequisite for conventional agricultural use of peatlands, but this practice causes high emissions of greenhouse gases (GHG), mainly carbon dioxide (CO_2). Thus, raising the water levels is necessary to reduce or stop CO_2 emissions. Water management options such as submerged drains (SD) and ditch blocking (DB) are discussed as a potential compromise between maintaining the trafficability for intensive grassland use and reducing the GHG emissions. Furthermore, grassland renewal is regularly practiced to improve the fodder quality for dairy farming; however, this might cause additional release of GHGs, especially nitrous oxide (N_2O). Here, we present results of a four-year study on the GHG emissions from an intensively used grassland on fen peat equipped with SD and DB. Additionally, the effect of grassland renewal by shallow ploughing and direct sowing was evaluated.

The target groundwater levels were set to -0.30 m below ground. In the first year, the water management system was optimized. In the following years, mean annual water levels at the parcels with SD were -0.23 m and at the parcels with DB -0.37 m. The groundwater level at the SD parcels was around 0.18 m higher than at the conventionally drained control parcels. Thus, water management by SD enabled us to even surpass the target water levels. However, year two and three of the study were dryer than usual, the differences between the SD parcels and the control parcels are expected to be lower in wet years. DB, in contrast, raised the water levels only marginally.

During the first three years, control parcels with ditch drainage emitted 27-49 t CO_2-eq. ha^{-1} a^{-1}. This is within the typical range of emissions from grasslands on fen peat in Germany. On average, the parcels with SD showed slightly lower emissions than the drained control parcels, but these were highly variable (16-60 t CO_2-eq. ha^{-1} a^{-1}). Due to similar groundwater levels the emissions from the parcel with DB (23-43 t CO_2-eq. ha^{-1} a^{-1}) were comparable to the drained control parcels. Reasons for the high CO_2 emissions despite increased groundwater levels by SD remain so far

unclear. Both types of grassland renewal lead to higher N_2O emissions during the first year after renewal. Afterwards, effects became ambiguous.

Results from the fourth measurement year (2020) will be presented as well. So far, the data seems to support the results of the previous years.