Geophysical Research Abstracts
Vol. 21, EGU2019-8425, 2019
EGU General Assembly 2019

Testing submerged drains as a greenhouse gas mitigation measure for intensively managed grassland on bog peat

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Intact peatland ecosystems are efficient sinks of atmospheric carbon dioxide (CO_2). Drainage for agriculture, forestry or peat mining triggers mineralization and turns peatlands into hotspots of greenhouse gas (GHG) emissions. For example, emissions from drained organic soils on only 5 % of the area are estimated to cause more than one third of the emissions from the sectors agriculture and land use, land use change and forestry in Germany. It is well known that water level depths and soil moisture have substantial influence on CO_2 emissions. Thus, raising water levels by submerged drains has been proposed as a method to reduce CO_2 emissions from agriculturally used peatlands.

Our project in the “Gnarrenburger Moor”, a managed bog peatland in North West Germany is the first field-scale study on the effect of submerged drains using the eddy covariance method. Two sites under intensive grassland use are investigated. The first site is kept under the regionally typical water management with open drainage tubes in a depth of approximately 70 cm connected to ditches. At the second site submerged drains were installed. They will be used for slight drainage during winter and active submerged infiltration of groundwater in summer. Thereby, we aim to ensure a constantly high water level of at least 30 cm depth. The opportunity of temporarily lowering the water level to e.g. 50 cm simultaneously ensures trafficability. At six plots at each study site, fluxes of nitrous oxide (N_2O) and methane (CH_4) are measured with manual chambers every second week and more frequently after fertilization. CO_2 is continuously measured by the eddy covariance method using a Licor LI-7200 enclosed path CO_2 and water vapor analyzer and a Gill HS-50 three axis anemometer.

Additionally, we will quantify the effects of submerged drains on water quality and losses of dissolved organic carbon (DOC). Water samples are collected from suction plates in three depths and from ditches on both sites. Samples from drainage tubes and groundwater, used for submerged infiltration, will also be taken. All samples are analyzed for electric conductivity, pH-value, DOC, nitrogen compounds and phosphorus. Measurements are accompanied by an extensive hydro-meteorological network comprising groundwater level, soil moisture sensors, tensiometers, discharge gauging, and common meteorological sensors. Our study is expected to reveal the effectiveness of using submerged drains as a potential mitigation measure for GHG emissions from intensively managed grasslands on bog peat.