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Small scale soil carbon and moisture gradients in a drained peat bog grassland and their influence on CO_2, CH4 and N2O fluxes

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Due to the UNFCCC report requirements of each country on the emissions of greenhouse gases from key sources the joint research project "Organic Soils" was established in Germany. The project's objective is to improve the data set on greenhousegas emissions from organic soils in Germany. Within 12 German Project Catchments emissions from different types of organic soils, e.g. under different land uses and hydrological conditions, are measured. At the location "Großes Moor" near Gifhorn (Lower Saxony) the effects of small-scale soil organic carbon and groundwater level gradients on the GHG fluxes (CO_2, CH4 and N2O) are quantified.

The study area is located within a former peat bog altered by drainage and peat cutting, which is currently grassland under extensive agricultural use. The focus of the study is on the acquisition of CO_2, CH4 and N2O fluxes on six sites via manual closed chambers. In order to calculate the annual CO_2 exchange rate, values are interpolated on a 0.5 hour scale between measurement campaigns. In combination with continually logged meteorological parameters, such as the photosynthetic active radiation as well as air and soil temperatures, we calculate the daily CO_2 ecosystem exchange of the different sites.

During the 2011 campaign, CO_2 was determined as the most important greenhouse gas. The groundwater table was the dominant variable influencing gas emissions. Another important factor was the vegetation composition. In detail, highest CO_2 emissions occurred with a water table of 40-50 cm below ground level, temperatures above 10°C and low plant biomass amounts.

Due to the more complex formation of N2O by a number of processes, each being promoted by different soil conditions, the measurement of N2O fluxes in the field was complemented by a laboratory experiment. In this, the use of stable isotope tracer techniques enabled us to quantify the contribution of single biochemical pathways to the overall formation of N2O under controlled conditions.

This together with the prediction of the systems CO_2 exchange, gives valuable information on how degraded peatlands can be restored best or at least be cultivated in a way to achieve climate neutral conditions. Thus, our study improves the prediction, how peatland soils will react to changes of soil and climate conditions with respect to their greenhouse gas emissions.