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How do peat type, sand addition and soil moisture influence the soil organic matter mineralization in anthropogenically disturbed organic soils?

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Drained peatlands are hotspots of carbon dioxide (CO_2) emissions from agriculture. As a consequence of both drainage induced mineralization and anthropogenic sand mixing, large areas of former peatlands under agricultural use contain soil organic carbon (SOC) at the boundary between mineral and organic soils. Studies on SOC dynamics of such “low carbon organic soils” are rare as the focus of previous studies was mainly either on mineral soils or “true” peat soil. However, the variability of CO_2 emissions increases with disturbance and therefore, we have yet to understand the reasons behind the relatively high CO_2 emissions of these soils. Peat properties, soil organic matter (SOM) quality and water content are obviously influencing the rate of CO_2 emissions, but a systematic evaluation of the hydrological and biogeochemical drivers for mineralization of disturbed peatlands is missing.

With this incubation experiment, we aim at assessing the drivers of the high variability of CO_2 emissions from strongly anthropogenically disturbed organic soil by systematically comparing strongly degraded peat with and without addition of sand under different moisture conditions and for different peat types.

The selection of samples was based on results of a previous incubation study, using disturbed samples from the German Agricultural Soil Inventory. We sampled undisturbed soil columns from topsoil and subsoil (three replicates of each) of ten peatland sites all used as grassland. Peat types comprise six fens (sedge, Phragmites and wood peat) and four bogs (Sphagnum peat). All sites have an intact peat horizon that is permanently below groundwater level and a strongly disturbed topsoil horizon. Three of the fen and two of the bog sites have a topsoil horizon altered by sand-mixing. In addition the soil profile was mapped and samples for the determination of soil hydraulic properties were collected. All 64 soil columns (including four additional reference samples) will be installed in a microcosm system under a constant temperature of 10°C. The water-saturated soil columns will be drained via suction plates at the bottom of the columns by stepwise increase of the suction. The head space of the soil columns will be permanently flushed with moistened synthetic air and CO_2 concentrations will be measured via online gas chromatography. First results will be presented.