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Impact of environmental factors on dissolved organic carbon concentrations in German bogs under grassland

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Peatlands cover about 5% of Germany's land area. Agricultural use combined with drainage increases the greenhouse gas emissions and alters the dissolved organic carbon (DOC) concentrations in the soil- and groundwater of these ecosystems. Cycling of DOC is influenced by a complex interaction of environmental factors such as peat characteristics, groundwater level, meteorological conditions, pH-value and ionic strength. Reasons for elevated DOC concentrations are debated in literature, but only a few studies on the dynamic of DOC in raised bogs in Germany have been conducted so far.

In Germany, raised bogs are mainly used as grassland. Therefore, five grassland study sites and one natural reference have been selected. The bog "Ahlenmoor" has a deep, medium to weakly decomposed peat layer. There, three study sites represent different land use intensities with a corresponding groundwater table (intensive grassland, extensive grassland, natural reference). The bog relict "Großes Moor" is characterised by a shallow amorphous peat layer, which is partly mixed with sand. There, three sites in an extensive grassland were chosen to study the effects of soil carbon concentrations (9 to 48 %) and groundwater levels.

At each site, nine suction plates (three replicates in each depth) and three tensiometers were installed in 15, 30 and 60 cm. Soil water was sampled fortnightly from June 2011 to December 2012 and analysed for electrical conductivity, pH-value and DOC concentration.

Compared to most literature values, DOC concentrations at our study sites were very high (on average, 197 to 55 mg/L). At the "Ahlenmoor", an increase in agricultural intensity and a lower groundwater table increases both the DOC concentrations and their variability in the soil water in order intensive grassland > extensive grassland > natural site. Surprisingly, soil carbon concentration and groundwater table gradients as investigated in the "Großes Moor" did only lead to minor differences in the DOC concentrations. At these sites, the highest DOC concentrations were measured in the zone of transition between peat and mineral layer. No consistent relationship between DOC concentrations and electrical conductivity or pH-value could be found. In the "Ahlenmoor", seasonal variations of temperature and water table position influence DOC concentrations. The highest values were measured in late summer after warm and dry periods. At the study sites of the "Großes Moor", the seasonal variation of temperature and groundwater table had no impact on DOC concentrations. Our results show that while it is difficult to unravel all factors controlling DOC concentrations, drainage and physical disturbance clearly increase DOC concentrations.