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Response of carbon cycling in a peatland subjected to long-term nutrient input and altered hydrologic conditions

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Peatlands store large amounts of carbon of high relevance for the global carbon cycle, but are particularly vulnerable to disturbance by human activities and global climate change. Thus, several studies addressed in experimental approaches on the plot scale peatland responses to anthropogenic nutrient inputs or altered hydrologic conditions. Up to now, only few studies have addressed such factors under *in–situ* conditions. The aim of this study was thus to investigate the effect of nutrient infiltration and altered hydrology along a transect in a peatland bordering a eutrophic water reservoir, spanning from near-natural to highly altered conditions. To this end, we monitored concentrations (two growing seasons)and stable isotopic signatures of dissolved inorganic carbon (DIC) and methane (CH_4) (one growing season) in pore-waters at four sites along the transect. This data was compared to predominant vegetation and peat quality.

A strongly altered, shrub dominated site showed lower DIC pore-water concentrations and more decomposed peat. CH_4 in the pore-water was ^{13}C enriched ($\delta^{13}C$–CH_4: –57.81 ±7.03 ‰) compared to the other sites while CO_2 was rather depleted in ^{13}C ($\delta^{13}C$–CO_2: –15.85 ±3.61 ‰), suggesting a higher share of CH_4 oxidation and differences in predominant methanogenic pathways. Another strongly altered, graminoid–moss dominated site in close vicinity to the reservoir, characterized by high CH_4 emission, was characterized by rather ^{13}C depleted CH_4, indicating only low mitigation of CH_4 emission by methanotrophic activity. Regarding methanogenic pathways as studied by stable isotopic signature of CO_2 and CH_4 at permanently water saturated depths, the contribution of acetoclastic CH_4 production apparently increased toward the reservoir, along with increases in shrubs or vascular plants and more decomposed peat. Further into the more natural part of the peatland, changes in isotopic signatures of CO_2 and CH_4 were predominantly driven by methanotrophic activity upon water table fluctuations.

In summary, we found differential responses of CO_2 and CH_4 production along the transect, likely driven by predominant plant functional types and input of nutrients from the reservoir. Our results thus indicate that there is no unique pattern how peatlands respond to disturbance by nutrient input and altered hydrology, but there are strong internal feedbacks by vegetation changes and changes in peat quality.