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Peatland GHG emissions estimated with redox potential

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Peat decomposition processes account for ~2% of the annual anthropogenic greenhouse gas emissions (GHG). The rate of microbial peat respiration is determined by temperature, the quality and abundancy of organic matter, moisture and electron acceptor (such as O_2, Fe[III], SO_4^{2-}) availability. The redox potential and pH reflect the chemical state of the soil and are an indicator for biogeochemical metabolic processes that occur within the soil. Here, we introduce a novel methodology to estimate peatland GHG emission (CO_2 and CH_4) by linking soil temperature and redox potential over time and depth with aerobic and anaerobic CO_2 and CH_4 incubation fluxes. Soil metabolic processes (at 0.1, 0.3, 0.5, 0.7 and 0.9 m depth) were classified based on the redox potential and pH. Individual rates of CO_2 and CH_4 emission (based on newly acquired and literature lab incubation data) were assigned to aerobic, anaerobic and methanogenic metabolic processes and were multiplied by a soil temperature factor relying on a Q_{10} relation. The estimated GHG emissions were compared with measured eddy covariance and automated transparent chamber GHG fluxes, both on short and long timescales for various agriculturally managed or semi-natural minerotrophic peatlands in the Netherlands. Our results indicate that seasonal patterns in GHG emissions are well captured by our approach. Moreover, estimations of short term (< 1 week) GHG dynamics matched measured GHG fluxes well for research locations with high methane emission. During our presentation we elaborate upon new results and discuss the suitability to indirectly determine peatland GHG emissions by measuring the soil redox potential.