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Greenhouse Gas Budgets of Bavarian Peatlands

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Nationwide data comparisons show that greenhouse gas (GHG) budgets vary not only due to land-use and water table but seem to reflect biogeographical regions. Therefore, the KliMoBay project pursues two main objectives pertaining to GHG: (1) collating all archival GHG data available for Bavarian peatlands to derive regional emission factors and as a foundation for spatial and temporal modelling of GHG budgets in different land-use and peatland types, and (2) closing gaps identified in step (1) via new eddy covariance and chamber-based GHG flux measurements in 2020 and 2021.

The Bavarian GHG peatland dataset currently consists of 163 annual budgets from 76 treatments in seven peatland regions. For our empirical modelling approach carbon dioxide and methane data for different land-use types are regressed against the mean annual water table. Due to its high variability no such dependence could be found for nitrous oxide; hence a land-use specific mean value is used instead.

Data gaps identified in Bavaria that were chosen for GHG measurements within the project are peatland forests (both natural and managed) on the one hand, and deeply drained grassland peat soils along with the transition period during rewetting measures in differently managed grassland peat soils on the other hand. For peatland forests we continued GHG flux analyses at two existing eddy covariance towers (one near-natural, one drained but left to natural succession after a windbreak in 2015). For grassland peat soils we compare two pre-Alpine locations with different drainage depths and management intensities with rewetting measures implemented at the deeply drained site in the fall of 2020.

First results suggest that out of all land-use categories only the near-natural forested peatland location is a persistent GHG sink. Both, using peatlands as arable land and high-intensity grassland management practices lead to very high GHG emissions; partly because these peatlands tend to be drained more deeply. However, comparing budgets from grassland peat soils managed with different intensities at the same drainage level shows that changed management practices can reduce carbon dioxide emissions by up to 500 g CO_2-C m^{-2} yr^{-2}. The drained peatland forest left to natural succession is still a GHG source five years after clear-cutting. Given that current tendencies continue, it is expected to show carbon uptake on an annual basis in the near future though. Comparing the 2020 and 2021 GHG measurements for grassland peat soils within the project clearly shows a heterogeneity between the different management practices. Yet, despite the

rewetting measures at the deeply drained location and a higher water table at both locations as a result of distinctly different weather conditions in the two years, there seems to be surprisingly little inter-annual variability in the GHG fluxes. We are currently still working on explaining these results by further studying auxiliary variables recorded at the measurement locations.

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