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Monitoring, Reporting and Verification (MRV) of drainage and rewetting of organic soils in national greenhouse gas inventories

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Drained organic soils are large sources of anthropogenic greenhouse gases (GHG) in many European and Asian countries including Germany. Therefore, they urgently need to be considered and adequately be accounted for when attempting to increase the carbon sequestration in agricultural soils. Here, we describe the methodology, data and results of the German detailed Tier 3 methodology for reporting anthropogenic GHG emissions from drained organic soils developed for, and applied in, the German GHG inventory under the UNFCCC and the Kyoto Protocol. The approach is based on national data and offers the potential for tracking changes in land-use and water management associated with intensification, peatland restoration or GHG mitigation measures in case time series of relevant activity data are available.
Drained organic soils were defined as soils with a mean annual water level of -0.1 m below surface or drier. The organic soil area was considered constant, neglecting a certain gradual conversion of shallow organic soils into mineral soils by subsidence, peat loss or anthropogenic disturbance. Activity data comprise high resolution maps of climate, land-use, the type of organic soil and the mean annual groundwater level. The groundwater map was derived by a boosted regressions trees model from data from > 1000 dipwells. These maps were sampled by a nested 250 m raster where each raster corner is represented by four sample points, balancing between spatial representativeness and effort to track small-scale variability and land-use changes.
Carbon dioxide and methane emissions were synthesized from a unique national data set comprising more than 200 GHG balances in most land-use categories and types of organic soils. The measurements were performed with fully harmonized protocols. Non-linear response functions describe the dependency of carbon dioxide and methane fluxes on the mean annual groundwater level, stratified by land-use and organic soil type where appropriate. Resulting “applied emission factors” for each land-use category take into account both the uncertainty of the response functions and the distribution of the groundwater levels within each land-use category. No functional relationships were found for nitrous oxide emissions. Emission factors for nitrous oxide were thus calculated as the mean observed flux by land-use category. IPCC default emission factors were used for minor GHG sources such as methane emissions from ditches and the losses of dissolved organic carbon (DOC). In Germany, drained organic soils annually emit nearly 50 million tons of GHGs, equivalent to 5% of the national GHG emissions. They are the largest GHG source from German agriculture and forestry. The described methodology is applicable as well to the project scale as to other countries where similar data is available.