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Hydrological modelling as a basis for the assessment of greenhouse gas emissions from organic soils in Germany

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Although covering only around 5 % of the country, peatlands are the largest single source of greenhouse gas emissions besides the energy sector in Germany. Thus, the compilation of the national greenhouse gas inventory according to the UN Framework Convention on Climate Change requires the application of country-specific emission factors depending on climate region, soil type and land use as well as a complete set of activity data (e.g. management, soil type or groundwater level).
To develop scaling methods and emission factors for greenhouse gas emissions, hydrological models specifically designed for peatlands and other organic soils (Histosols) are required to deliver input data for gas exchange modelling. The implementation of both a hydrological monitoring programme and an adequate model is part of a large project with 11 catchments with more than 60 gas flux measurement sites all over Germany aiming at the improvement of the greenhouse gas inventory.
Greenhouse gas emissions from peatlands are very sensitive to changes in the – usually very shallow – groundwater level and soil moisture, which poses an enormous challenge when attempting to upscale hydrological and gas exchange models to the national scale. At the catchment scale, geohydrological models are used to develop modelling approaches for different peatlands types (bottom-up approach). At the same time, a conceptual model is developed for the national scale, which is based on a newly compiled Histosol map, official survey data, a digital elevation model and regional information from peatland inventories. Using this data, a rule-base system will be developed to identify hydrological peatland types and boundary conditions for which specific modelling approaches – e.g. for rain-fed bogs – will be applied (top-down approach). Monitoring data from the test sites as well as from conservation programmes will be used for calibration and uncertainty analysis. Finally, management scenarios will be implemented to support scientific policy advice.