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Laboratory evaporation experiments in undisturbed peat columns for determining peat soil hydraulic properties

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One of the key parameters controlling greenhouse gas (GHG) emissions from organic soils is water table depth. Thus, a detailed analysis of the hydrology is essential for an accurate spatial upscaling of the information of local GHG emission measurements to the regional and national scale. For the interpretation and numerical modeling of water table fluctuations, knowledge about soil hydraulic parameters is crucial. In contrast to mineral soils, the hydraulic properties of organic soils differ in several aspects. Due to the high amount of organic components, strong heterogeneity, and shrinkage and swelling of peat, accompanied by changing soil volume and bulk density, it is difficult to describe peat soil moisture dynamics with standard hydraulic functions developed for mineral soils.
The objective of this study was to determine soil hydraulic properties for various undisturbed peat columns (diameter: 30 cm, height: 20 cm). Laboratory evaporation experiments were conducted for peat soils from five different test sites of the German joint research project "Organic Soils". Due to different land use histories, the peat samples covered a broad range of degradation states, which is known to strongly influence peat soil hydraulic properties. Pressure head, moisture content, weight loss and water level were monitored during the evaporation experiment. In numerical simulations using HYDRUS-1D the experimental data were used for an inverse-estimation of the soil hydraulic parameters using “shuffled complex evolution” and “covariance matrix adaption” optimization schemes. Besides the commonly applied van Genuchten-Mualem parameterization, several alternative soil parameterizations are evaluated.