EGU21-12098
https://doi.org/10.5194/egusphere-egu21-12098
EGU General Assembly 2021

Impact of Land Management on Available Water Capacity of Peat Soil

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In Central Europe, about 90% of fen peatlands have been drained for agriculture and forestry leading to greenhouse gas emissions and soil degradation. Soil available water capacity (AWC) is one of the most important soil properties regulating the water balance at a given site and plays, thus, a pivotal role in plant growth. Compared with that of mineral substrates, our understanding of the AWC of peat is limited. In this study, we aimed to deduce possible alterations of the AWC of peat following soil degradation. We analysed a comprehensive database (674 measurements from boreal and temperate peatlands) to seek relations between bulk density (BD) and total porosity, field capacity, wilting point, and AWC. Bulk density was used as a proxy for peat degradation as it is closely correlated with the soil organic matter content. The AWC increases gradually with BD up to a value of 0.2 g cm^{-3}; a further increase in BD leads to a considerable decrease in AWC. The increase in AWC occurs within the first 15 to 30 years of land drainage, depending on the initial soil BD before drainage. The function between BD and AWC enables us to upscale the AWC to a regional scale. The average AWC of agricultural peatlands in Germany is estimated to be 37 ± 11 vol% (mean ± standard deviation). In Germany, the AWC decreases with increasing soil depth for highly degraded peatlands, which are characterised by BD values of 0.4 g cm^{-3} > BD > 0.2 g cm^{-3}. However, for extremely degraded peatlands (BD > 0.4 g cm^{-3}), the AWC increases with increasing soil depth. For those highly and extremely degraded peatlands, we estimated that 1 wt% organic carbon loss causes a drop of 1.25 vol% in AWC. Peatland rewetting may increase soil AWC, however, plants may still suffer from a water deficit under extreme dry weather conditions.