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Multi-decadal water-table manipulation alters peatland hydraulic structure and moisture retention.

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Peatlands are a globally important store of freshwater and soil carbon. However, there is a concern that these water and carbon stores may be at risk due to climate change as vapour pressure deficits, evapotranspiration and summer moisture deficits are expected to increase, leading to greater water table (WT) drawdown in northern continental regions where peatlands are prevalent. We argue that in order to evaluate the hydrological response (i.e. changes in WT level, storage, surface moisture availability, and moss evaporation) of peatlands under future climate change scenarios, the hydrophysical properties of peat and disparities between microforms must be well understood. A peatland complex disturbed by berm construction in the 1950's was used to examine the long-term impact of WT manipulation on peatland hydraulic properties and moisture retention at three adjacent sites with increasing average depth to WT (WET, INTermediate reference, and DRY). All three sites exhibited a strong depth dependence for hydraulic conductivity, specific yield, and bulk density. Moreover, the effect of microform on near-surface peat properties tended to be greater than the site effect. Bulk density was found to explain a high amount of variance ($r^2 > 0.69$) in moisture retention across a range of pore water pressures (-15 to -500 cm H_2O), where bulk density tended to be higher in hollows. The estimated residual water content for surface *Sphagnum* samples, while on average lower in hummocks (0.082 m^3 m^{-3}) versus hollows (0.087 m^3 m^{-3}), increased from WET (0.058 m^3 m^{-3}) to INT (0.088 m^3 m^{-3}) to DRY (0.108 m^3 m-3) which has important implications for moisture stress under conditions of persistent WT drawdown. While we did not observe significant differences between sites, we did observe a greater proportional coverage and greater relative height of hummocks at the drier sites. Given the potential importance of microtopographic succession for altering peatland hydraulic structure, our findings point to the need for a better understanding of what controls the relative height and proportional coverage of hummocks in relation to long-term disturbance-response dynamics. While current peatland models can simulate bulk density that varies as a result of changes in rates of production and decomposition for different plant functional types and different microforms, the spatial component of microtopographic succession is missing. We argue that the effects of microtopographic succession on the spatial pattern of bulk density and associated hydrophysical properties are important for capturing changes in hydraulic structure that result from disturbance.