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Subsurface structures and properties of a medium-scale peatland area by means of hydrogeophysical methods

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Intact peatlands are natural sinks of climate-relevant atmospheric CO_2 and they are able to store high amounts of organic carbon (C). In addition, intact peatlands are increasingly important given positive effects on biodiversity, hydrological processes and corresponding management issues. Nevertheless, large parts of peatlands in populated areas were modified by human activity during the last centuries. In Germany, more than 90% of the peatlands are drained, mainly for agricultural use. Due to the recent recognition of the positive effects of intact peatlands, there are presently several initiatives for re-wetting parts of these peatlands. However, a restoration to nearly natural conditions needs an evaluation of the current situation as well as an assessment of the restoration potential. Therefore, soil properties like peat layer thickness, bulk density and moisture content need to be known. Non-invasive hydrogeophysical methods offer the possibility for a time and cost-effective characterization of peatlands. In this study, we investigated a medium-scale peatland area (approximately 35 ha) of the 3000 ha large 'Großes Moor' peatland. We present apparent conductivity (ECa) values obtained from Electromagnetic Induction (EMI) measurements representative for three investigation depths (approximately 0.25, 0.5, and 1m). We selected zones with dissimilar ECa to identify areas where strong changes in the subsoil properties with depth are expected (i.e. shallow peat soil on top of sand). Within these areas, additional measurements were made using Ground Penetration Radar (GPR) and soil sampling was performed. In total, six 30 m long GPR profiles and corresponding common midpoint (CMP) measurements were recorded. Additionally, 15 soil cores were taken down to a depth of 0.9 m in order to obtain peat thickness, water content, pore water EC, bulk density (BD), as well as C and N content. Each core was divided into several 5 to 20 cm thick layers to obtain information on the vertical variation of these soil properties with depth. Our results indicate that the peat layer is generally characterized by lower BD, higher pore water EC, higher C content, and higher water contents compared to the underlying sand layer. Preliminary EMI results indicate a ECa - C content correlation that decreases with EMI investigation depth from 0.25 to 1 m. Regarding all soil core properties, the strongest contrast occurs at the peat-sand interface. This contrast also clearly appears in some of the GPR results. The EMI apparent conductivities are positively correlated with soil water content and peat thickness obtained from the soil cores. Preliminary GPR results confirm an increased thickness of the upper layer in areas with increased ECa values. The EMI results also reveal clear patterns linked over several fields with different land use history that represent natural structures in the subsurface.