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Soil moisture monitoring on land use legacy soils – a study on relict charcoal hearth sites in Brandenburg, Germany

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The stratigraphy and properties of soils can significantly be altered by human land use, even in areas that have continuously been used for forestry over the past centuries. An example for such a pedological legacy of past forest use are soils on relict charcoal hearths (RCHs). RCHs have been documented in high spatial densities and can cover a significant proportion of the surface in RCH landscapes, so that their soil properties can also affect ecological site conditions of woodlands today. RCH soils are most prominently characterized by a technogenic layer rich in charcoal fragments deposited above the natural forest soil. Similar to other land use legacy soils, RCH soils often show a high spatial heterogeneity in their structures and properties, which imposes challenges on soil moisture monitoring.

The objective of our study is to characterize the soil water regime and hydraulic properties of RCH soils in comparison to reference forest soils on sandy substrate in the Northeastern German Lowland. RCH and reference soils were studied in woodlands around the historic iron work in Peitz (Brandenburg, Germany), using infiltration experiments with a dye tracer, sensor-based monitoring of soil moisture contents and matric potential, and analyses of water repellency, bulk density, pore size distribution, and saturated hydraulic conductivity.

The results of infiltration experiments and related analyses show a high spatial and temporal variability of water repellency and preferential infiltration in the RCH soils, with strongly preferential infiltration after dry periods but more uniform wetting for wet antecedent conditions. Results of the monitoring with soil moisture and matric potential sensors affirm this observation, showing a very high variability of recorded data especially after the prolonged dry period in summer 2018. The results further show a high spatial variability of total porosity in RCH soils within the studied sites, and a high variability of pores size distribution between the sites. While moisture monitoring shows slightly higher water contents in RCH soils, laboratory results do not indicate higher water retention and plant available water contents on RCHs, despite the generally high porosity of the substrate. Overall, the results show that the legacies of historic charcoal production increase the spatial and temporal variability of soil moisture in the RCH landscape, which in turn can cause an increased variability of ecological site conditions in historic charcoal production areas.