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Systematic patterns of forest soil water retention depending on the tree distance in a European mixed beech forest.

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Soil water content and soil water fluxes in the dynamic and for plant water uptake relevant moisture range are strongly driven by soil structure. Soil structure is subject to high variation at small spatial scales. Recent results showed a systematic organization of the spatial heterogeneity of soil water content and field capacity in a forest depending on tree proximity: Areas within 1 m circumference to a tree were generally dryer than areas more distant to trees, and this pattern was reflected by laboratory-measured field capacity. Thus, a possible explanation of this phenomenon could be a shift in the soil water retention curve, and consequently in the pore size distribution, from tree-close to tree-distant soils. To compare soil water retention close and distant to trees, we conducted measurements of soil water content and soil water potential in concert at paired locations close (ca. 0.5 m distance) and distant (ca. 2 m distance) to the same tree. The study site is located in the Hainich National Park in central Germany and is characterized by a mixed beech stand and shallow, silty to clayey soils. For this study, we chose exemplary beech trees with a diameter at breast height > 0.3 m. We conducted in-situ measurements of soil water content and potential (0.1 m distance from each other), and determined high-resolution soil water retention curves in the laboratory on undisturbed soil samples with the evaporation method. All measurements show a lower soil water retention capacity, and higher drainage, in tree-close areas compared to further away. Soil water retention curves are shifted towards lower soil water contents at the same soil water potential in the proximity of trees for the examined wet range. This indicates a higher fraction of coarse pores and coarse middle pores near trees. The shift in pore size distribution leads to higher drainage and a reduced fraction of easily plant available water, and therefore a changed water flux partitioning, in tree-close areas. This could especially be relevant to the fate of the peak input fluxes of stemflow, and lead to coupling of aboveground and belowground water flux hotspots.