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Spatial variation of soil properties and throughfall in European mixed beech forest

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Before it reaches the surface, precipitation is intercepted and redistributed by the vegetation canopy. Water reaching the soil is partitioned intro throughfall (PTF) and stemflow (PSF). Temporal persistent throughfall and stemflow patterns localize water input. Soil moisture patterns might be influenced by net precipitation hotspots, soil properties, and root water uptake. At the same time, spatial heterogeneity in soil moisture may decrease transpiration. Yet the feedback mechanism between spatial variabilities in net precipitation, soil properties, and root water uptake is not understood well.

Variability in soil properties influences soil-water-content distribution and hence plant-available water and might be a driver to organize root water uptake. At the same time net precipitation hotspots provide greater water availability for root systems. However, variation in throughfall and soil properties are rarely studied together.

As a first step, we compared in this study spatial variability of throughfall and soil properties. An intensive field observation platform consisting of net precipitation and soil water content measurements was established in the AquaDiva Hainich CZE (Thuringia, Germany). Undisturbed soil samples were taken during the sensor installation in fall 2014 and 2015 to assess soil properties. Event-based throughfall data was recorded manually in the year 2014, 2015 and 2016 for months May, June and July.

Throughfall spatial variation decreases with event size from CQV=1.00 for one of the smallest to CQV $\leq$ 0.08 for the large events. The spatial variation coefficients of bulk density, field capacity and porosity are less (CQV takes values from 0.05 to 0.09) than those of throughfall except for very large events. This suggest that spatial variation of water input and soil properties play similar roles for plant available water, and these drivers should be analysed separately to understand the corresponding effects on the root water uptake mechanism. .

Field capacity and bulk density are only weakly related. Soil texture might influence this relation which should be investigated next. Also, surprisingly the spatial variation in bulk density is elevated both in top and bottom soil (CQV of 0.08 and 0.05 respectively) whereas the field capacity and porosity exhibit much higher variation in deeper soil compared to the top soil.

The long term goal of this study is to explore how root water uptake is influenced by sub-canopy water input and soil properties. For this, the root water uptake will be determined based on soil moisture measurements, and multivariate data analysis will be applied to estimate the dominant driver for the spatial distribution of plant available water and root water uptake in the future.