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Tracing spatial variation of canopy water fluxes to the soil: An experimental approach to assessing heterogeneity with high resolution data

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Due to the mechanisms of interception, stemflow and canopy throughfall, precipitation reaches a forest soil surface in an altered temporal and spatial distribution. The retention of water by canopies is contrasted by the formation of dynamic hotspots, which channel rain water down to the soil, e.g. canopy dripping points and stemflow.

Throughfall patterns are often assumed to be the main driver for soil water content heterogeneity in forests, yet this relation has not been studied extensively and there is no prove to this theory. Because it is impossible to measure net precipitation input and soil water content in the same place at the same time, elaborate sampling is necessary for a data set allowing to address this subject.

Within the last two years, in the framework of the Collaborative Research Centre AquaDiva, our group has established a new experimental site to investigate on the relationship of forest precipitation and soil water.

We have developed an experimental design combining the measurement of throughfall, stemflow and soil water content on a 1 ha plot in a manner so all measurements are representative for the plot yet do not disturb each other. We adapted a statistical sampling method common for throughfall measurement to soil water content measurement comprising a high number of measurement points (throughfall: 350, soil water content: 210). To gain good insights in soil water dynamics and to capture preferential flow, soil water content was recorded in a high frequency (1* 6^{-1} min^{-1}) in two soil depths. Stemflow was measured area-based on regular subplots (11% of the total plot area, 65 trees). Stand and soil surveys were made to investigate canopy impacts and identify soil-born patterns in soil water content.

The plot is located in a mixed beech forest of the Hainich national park in Thuringia, Germany. Shallow loamy soils cover the lime- and marlstone bedrock. The forest plot is complemented by a smaller neighboring grassland plot acting as a control.

First results show, that the impact of throughfall on soil water content can be tracked by variance. Clear patterns of soil water content exhibit a seasonal hysteresis, partly supporting and partly disproving the hypotheses. Statistical analysis work out the properties of the spatial and temporal patterns of the different parameters to make them comparable.

The potential of the data set is promising for future profound research of the relationship of the co-processes of vegetation, precipitation and soil water.