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Long-term investigation of the rainfall interception process: measurements in a spruce forest from 1997 to 2018

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Rainfall interception plays an important role in the forest water budget. In very dense forests, up to 50 % of the total precipitation can be stored in the canopy and evaporated back to atmosphere. The type, intensity and duration of precipitation, the evaporative conditions and the vegetation structure are factors that influence the interception process. Thus, rainfall interception models require a complex set of parameters. Since meteorological conditions and precipitation patterns are very variable, reliable parameters must be derived from measurements over a long observation period.

Within the Tharandter Wald we are conducting continuous measurements to investigate the interception process in a stand dominated by coniferous trees (mainly *Picea abies*; CarboEurope site since 1996; ASTW) since spring 1997. The site is a managed forest stand and parts have been subject to windthrow, drought and bark beetle infestation. The changes in forest structure are well documented and used to analyse possible effects on the stand water budget of the ASTW.

We apply a set of standardised measurement gutters made from stainless steel. Besides, there are precipitation measurements at the nearby clearing (Wildacker) since 1959, that are used as a reference precipitation for the calculation of the amount of intercepted rainfall in the forest canopy. The 22-year dataset is recorded with a 10-minute resolution and allows a detailed analysis of the water budget for the spruce stand.

After a quality check of the time-series, we derived rainfall-event-based data and daily values that are required for the application of regression models. We tested different regression methods (event based and daily; with parameters such as storage capacity and saturation capacity). Here, we discuss the temporal change of the parameters as an indicator for the changing stand structure.

One major result concerns the uniqueness of interception events. The amount of rainfall that is stored in the canopy can be highly variable between two single events of similar reference precipitation. Besides rainfall characteristics and stand structure, other meteorological factors play an important role for the understanding of canopy water storage. In order to investigate the influence of rainfall duration and intensity, the rainfall events are sorted into rainfall intensity classes.

Because of two major timber harvests in 2002 and 2011, the LAI (leaf area index) and the density of the stand decreased since the beginning of the measurements. We expect also to find decreases in storage capacity and the proportion of intercepted rainfall, especially directly after thinning or windthrow.