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Spatial Patterns of Throughfall on a Douglas-Fir Forest and its relation with canopy metrics derived from high resolution Lidar measurements.

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Forest canopy structure intercepts around 15 to 35% of the gross precipitation (Pg) in temperate climates, the remaining proportion of Pg that reaches the forest floor is commonly known as throughfall (TF). The spatial distribution of TF below the forest canopy is relevant for many physical, chemical and biological process on the forest floor. In order to understand the spatial patterns of throughfall many sample methodologies have been tested, but most of them require big efforts and they cover relatively small areas. Nowadays, Lidar technology allows us to estimate canopy structure metrics at high resolution for a large spatial extend. This seems to be a promising tool for improving the sampling methodologies of TF.

In the present study we use a rover and a stationary sampling methods to study the spatial patterns of throughfall beneath the canopy of a mid-age Douglas-Fir forest (Speulderbos) in the centre of The Netherlands, to latter to compare the results with a set of canopy metrics derived from high resolution Airborne Lidar measurements.

We used 32 funnel-type collectors randomly distributed in a 32x64m plot to measure the spatial variability bellow the canopy from February to November 2015 divided in periods of around 15 days. During the first 8 periods we used the roving method and during the last 5 periods the stationary method. We also measured stemflow (SF) in 5 trees of different diametric classes, but it was negligible ($\sim$1% of Pg). To allow the comparison among periods we fitted standardized variograms. The length scale over which throughfall amounts were correlated in the stationary methodology was 7 m for aggregated TF values. In order to compare spatial distribution patterns among periods, we used standardized TF values. In this way we could combine TF values collected with the roving methodology, and this reduced the spatial correlation length to 3m , probably as an effect of the standardization of TF. We also derived a series of canopy metrics from Lidar measurements and we generated canopy metric products of 1 m resolution. The correlation of the TF values with the spatial corresponding values of the canopy metrics appeared to be low $|R|<0.4$, probably because we didn′t consider in the analysis other variables as wind direction or rainfall intensity However, the spatial correlation lengths of 5.7 m for canopy height, 5.9 m for the standard deviation of height, and 4.1 m for canopy density was in reasonable agreement with the correlation length for TF.

We conclude that the spatial patterns of the canopy structure metrics derived from Lidar measurements can help to understand the spatial patterns of the TF distribution, and that direct correlation with the canopy metrics needs to be investigated by including some other micrometeorological variables that affect throughfall distribution.