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Spatial and temporal variability of throughfall and soil moisture in a deciduous forest in the low mountain ranges (Hesse, Germany)

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Spatial and temporal patterns of throughfall can affect the heterogeneity of ecological, biogeochemical and hydrological processes at a forest floor and further the underlying soil. Previous research suggests different factors controlling the spatial and temporal patterns of throughfall, but most studies focus on coniferous forest, where the vegetation coverage is more or less constant over time. In deciduous forests the leaf area index varies due to the leaf fall in autumn which implicates a specific spatial and temporal variability of throughfall and furthermore of the soil moisture. Therefore, in the present study, the measurements of throughfall and soil moisture in a deciduous forest in the low mountain ranges focused especially on the period of leaf fall. The aims of this study were: 1) to detect the spatial and temporal variability of both the throughfall and the soil moisture, 2) to examine the temporal stability of the spatial patterns of the throughfall and soil moisture and 3) relate the soil moisture patterns to the throughfall patterns and further to the canopy characteristics.
The study was carried out in a small catchment on middle Hesse (Germany) which is covered by beech forest. Annual mean air temperature is 9.4°C (48.9°F) and annual mean precipitation is 650 mm. Base materials for soil genesis is greywacke and clay shale from Devonian deposits. The soil type at the study plot is a shallow cambisol. The study plot covers an area of about 150 m^2 where 77 throughfall samplers where installed. The throughfall and the soil moisture (FDR-method, 20 cm depth) was measured immediately after every rainfall event at the 77 measurement points. During the period of October to December 2015 altogether 7 events were investigated. The geostatistical method kriging was used to interpolate between the measurements points to visualize the spatial patterns of each investigated parameter. Time-stability-plots were applied to examine temporal scatters of each investigated parameter. The spearmen and pearson correlation coefficients were applied to detect the relationship between the different investigated parameters.
First results show that the spatial variability of throughfall decreases if the total amount of the throughfall increases. The soil moisture shows a similar behavior. It‘s spatial variability decreases if higher soil moisture values were measured. Concerning the temporal stability of throughfall it can be shown that it is very high during the leaf-free period, although the rainfall events have different total througfall amounts. The soil moisture patterns consists of a low temporal stability and additionally only during one event a significant correlations between throughfall and soil moisture patterns exists. This implies that other factors than the throughfall patterns control the spatial patterns of soil moisture.