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Do spatial patterns of water and matter fluxes below the main rooting zone depend on canopy processes?

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Besides precipitation also atmospheric deposition is modified by canopy processes. By passing the canopy, precipitation water washes out those deposited compounds and creates substantial heterogeneity of input of dissolved matter at the forest floor. At the same time, both dry atmospheric deposition of aerosols and net precipitation are affected by canopy heterogeneity, like variation in canopy density. In consequence, spatial patterns of both dry and wet deposition are expected to vary strongly in space and to depend on canopy structure, which may lead to hotspots of input and deep drainage. However, few studies so far have investigated the spatial patterns of deposition of e.g. nitrogen compounds. In this research we investigated the spatial and temporal patterns of nitrogen deposition and export from the main rooting zone in a beech dominated forest in the Hainich National Park.

We find that below canopy spatial patterns of both canopy drainage and nitrogen deposition show some temporal stability. Spatial variation in canopy drainage also affected soil water percolation in 30 cm depth, with higher canopy drainage leading to higher soil water fluxes. Nitrogen deposition at the forest floor however, seemed rather driven by canopy exchange than by drainage patterns or dry deposition. On the other hand, at 30 cm soil depth nitrogen export in seepage water was driven by the soil water flow, indicating that spatial patterns of transport capacity, and not nitrogen availability in the soil, determined the export of nitrogen from the main rooting zone. Interestingly, spatial variation of soil water fluxes was not dampened, but rather increased by passage of the rooting zone. In other words, the origin of spatial patterns of water flow and nitrogen export below the main rooting zone lay already within the canopy, but was further enhanced in the soil. The next steps will be to understand why the heterogeneity of water fluxes propagates and increases during rooting zone transit and whether there is an interaction with soil development.