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Modelling the influence of plants on the spatial heterogeneity of soil water

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Plants are sessile organisms and as such depend on sufficient local water supply. At the same time, plants themselves directly influence the spatial water distribution in the soil. Thus, plants partly regulate their own water supply. Current ecohydrological models apply simplified approaches to assess infiltration and the spatial distribution of water. They often neglect the influence of the vegetation the spatial heterogeneity in soil water. For example, the shape of the leafage and the rooting system strongly impact the amount of water that reaches the soil and how it is spatially distributed.

If rainfall hits the leafage only a fraction of the water falls trough directly. The remaining fraction is intercepted and firstly accumulates on the leaves. This water either runs down the stem (stem flow) or evaporates directly. As a result, more water is received in the local environment of the stem than under the remaining canopy. The rooting system additionally influences the amount of infiltrated water and its distribution in the soil: Roots lead to preferential flow paths and form small caverns that increase the water storage capacity.

In our work we developed a simulation model (using Netlogo) to track the path of rainfall from its first contact with the leafage to its storage in the soil. Our model structure supports simulations for different morphological plant types that allow us to evaluate the effect of branch structure, leaf density and the rooting system on water fluxes and thus local availability. The parameterization of morphological traits is based on 2-D profiles derived by simple image processing of pictures. This provides a highly flexible framework to evaluate different scenarios, which we aim to couple with a dynamic vegetation model in the future.