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A virtual experiment on the effect of canopy and forest floor interception on subsurface flow behaviour

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From several field experiments we know that the soil moisture distribution is highly heterogeneous on a hillslope, and also lateral subsurface flow appears to develop irregular flow paths along its way downslope. However, knowledge is still lacking on which processes are causing this spatial distribution. One of the possible explanations could be interception. First of all, interception prevents a part of the rainfall to infiltrate in the unsaturated zone, which is immediately fed back to the atmosphere. This fast feedback is highly dependent on the vegetation density, and causes a spread in the distribution of the net rainfall. On the other hand, it appears that vegetation can also funnel rain water, causing hot spots of high infiltration. Finally, interception delays precipitation. Only after the interception storage has been filled, water can find its way down through several storages.

To investigate the influence of interception on subsurface flow processes, detailed experimental data is required. Because this data is often not available and new or additional field campaigns are very labour intensive, a virtual experiment can be a helpful tool. A virtual experiment is a numerical experiment driven by collective field intelligence. It provides a learning tool to investigate the effect of separated processes in a complex system.

We apply the concept of virtual modelling to investigate the effects of interception on subsurface flow processes. It will enable us to separate the effect of ‘no interception’, ‘canopy interception only’, and ‘both canopy and forest floor interception’. Furthermore, we shall explore if there occurs a change in flow paths patterns when we use lumped or distributed input data. We use the topography characteristics of the Panola hillslope (Georgia, USA). On this hillslope intensive trench and soil moisture measurements have been carried out. Since there are no detailed interception measurements at Panola, we use interception data from the Huewelerbach catchment in Luxembourg. Here, spatially distributed canopy interception is measured by a dense network of throughfall gauges. Forest floor interception is measured at point scale with a specially developed device.

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