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Does variability matter? - Virtual and field experiments to understand subsurface stormflow generation

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The influence of the spatial variability of soil hydrological properties (water retention curve, saturated hydraulic conductivity, preferential pathways) and the spatial and temporal variability of precipitation and soil water content on runoff generation have been observed in many watersheds. Focusing on individual aspects, studies were able to describe and sometimes predict details of the observed variabilities. Understanding the combined responses, however, has been difficult. We present a study that combines individual variables and variabilities in space and time to systematically analyze their effect on runoff generation. First, we use field experimental investigations including tracer studies to detect and elucidate the main controls on subsurface stormflow. Then, we combine the gained "field intelligence" with numerical simulations within the framework of virtual experiments to explore how the different spatial and temporal variabilities affect subsurface stormflow generation, response time, and solute transport. In particular, spatial variability of soil depth, initial soil moisture content, and precipitation variability due to canopy interception is analyzed. Combining our conceptual understanding and field observation of runoff generation processes with virtual experiments, we can more effectively determine the influence of variability on subsurface stormflow and isolate controlling factors.