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Spatial structure and scaling of macropores in hydrological process at small catchment scale

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During rainfall events, the formation of overland flow can occur under the circumstances of saturation excess and/or infiltration excess. These conditions are affected by the soil moisture state which represents the soil water content in micropores and macropores. Macropores act as pathway for the preferential flows and have been widely studied locally. However, very little is known about their spatial structure and conductivity of macropores and other flow characteristic at the catchment scale. This study will analyze these characteristics to better understand its importance in hydrological processes.

The research will be conducted in Petzenkirchen Hydrological Open Air Laboratory (HOAL), a 64 ha catchment located 100 km west of Vienna. The land use is divided between arable land (87%), pasture (5%), forest (6%) and paved surfaces (2%). Video cameras will be installed on an agricultural field to monitor the overland flow pattern during rainfall events. A wireless soil moisture network is also installed within the monitored area. These field data will be combined to analyze the soil moisture state and the responding surface runoff occurrence. The variability of the macropores spatial structure of the observed area (field scale) then will be assessed based on the topography and soil data. Soil characteristics will be supported with laboratory experiments on soil matrix flow to obtain proper definitions of the spatial structure of macropores and its variability. A coupled physically based distributed model of surface and subsurface flow will be used to simulate the variability of macropores spatial structure and its effect on the flow behaviour. This model will be validated by simulating the observed rainfall events. Upscaling from field scale to catchment scale will be done to understand the effect of macropores variability on larger scales by applying spatial stochastic methods.

The first phase in this study is the installation and monitoring configuration of video cameras and soil moisture monitoring equipment to obtain the initial data of overland flow occurrence and soil moisture state relationships.