Geophysical Research Abstracts
Vol. 16, EGU2014-10762, 2014
EGU General Assembly 2014

Effect of spatial organisation behaviour on upscaling the overland flow formation in an arable land

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Overland flow during rainfall events on arable land is important to investigate as it affects the land erosion process and water quality in the river. The formation of overland flow may happen through different ways (i.e. Hortonian overland flow, saturation excess overland flow) which is influenced by the surface and subsurface soil characteristics (i.e. land cover, soil infiltration rate). As the soil characteristics vary throughout the entire catchment, it will form distinct spatial patterns with organised or random behaviour. During the upscaling of hydrological processes from plot to catchment scale, this behaviour will become substantial since organised patterns will result in higher spatial connectivity and thus higher conductivity. However, very few of the existing studies explicitly address this effect of spatial organisations of the patterns in upscaling the hydrological processes to the catchment scale. This study will assess the upscaling of overland flow formation with concerns of spatial organisation behaviour of the patterns by application of direct field observations under natural conditions using video camera and soil moisture sensors and investigation of the underlying processes using a physical-based hydrology model.

The study area is a Hydrological Open Air Laboratory (HOAL) located at Petzenkirchen, Lower Austria. It is a 64 ha catchment with land use consisting of arable land (87%), forest (6%), pasture (5%) and paved surfaces (2%). A video camera is installed 7m above the ground on a weather station mast in the middle of the arable land to monitor the overland flow patterns during rainfall events in a 2m x 6m plot scale. Soil moisture sensors with continuous measurement at different depth (5, 10, 20 and 50cm) are installed at points where the field is monitored by the camera. The patterns of overland flow formation and subsurface flow state at the plot scale will be generated using a coupled surface-subsurface flow physical-based hydrology model. The observation data will be assimilated into the model to verify the corresponding processes between surface and subsurface flow during the rainfall events. The patterns of conductivity then will be analyzed at catchment scale using the spatial stochastic analysis based on the classification of soil characteristics of the entire catchment. These patterns of conductivity then will be applied in the model at catchment scale to see how the organisational behaviour can affect the spatial connectivity of the hydrological processes and the results of the catchment response. A detailed modelling of the underlying processes in the physical-based model will allow us to see the direct effect of the spatial connectivity to the occurring surface and subsurface flow. This will improve the analysis of the effect of spatial organisations of the patterns in upscaling the hydrological processes from plot to catchment scale.