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Preferential flow from plot scale to cacthment scale in a semi-arid catchment

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Flow of water through the vadose zone determines the partitioning of water among various components of the hydrologic cycle: infiltration, runoff, soil moisture storage, evapotranspiration and groundwater recharge. Preferential flow is the rapid flow of water and solutes along certain pathways bypassing a large part of the porous media. Preferential flow occurring in the vadose zone therefore affects infiltration, runoff, soil moisture distribution, groundwater response and subsurface stormflow. Based on a large amount of field data the ifluence of preferential flow from plot scale to catchment scale was studied for a semi-arid catchment in Spain.

Variability of soil moisture content during the transition from dry to wet season (September to November) within horizontal soil layers, leads to the conclusion that there is preferential infiltration into the soils. When the rainfall intensity is high, a water level rapidly builds up in the piezometer pipes in the area, sometimes even reaching soil surface. This water level also drops back to bedrock within a few hours (under dry catchment conditions) to days (under wet catchment conditions). As the soil matrix is not necessarily wet while this water layer is built up, it is thought to be a transient water table in large connected pores, which drain partly to the matrix, partly fill up bedrock irregularities and partly drain through subsurface flow to the channels. When the soil matrix becomes wetter the loss of water from macropores to the matrix and bedrock decreases and subsurface stormflow increases.

It may be concluded that the hillslope hydrological system consists of a fine matrix domain and a macropore domain, which have their own flow characteristics, but which also interact, depending on the soil matrix and macropore moisture contents. The macropore flow can result in subsurface flow, ranging from 12.8% contribution to total discharge for a large event of high intensity rainfall, high discharge to 80% of total discharge for a small event with low intensity rainfall, low discharge. During large events the fraction of subsurface stormflow in the discharge is suppressed by the large amount of surface runoff.