

The soil water regime of stony soils in a mountain catchment

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Investigation of processes related to runoff generation is an important topic in catchment hydrology. Observations are usually carried out in small catchments or on hillslopes. Many of such catchments are located in mountain or forested areas. From many studies it is evident that soil conditions and soil characteristics are one of the crucial factors in runoff generation. Mountainous or forest soils have usually high rock fragments content. Nevertheless, the influence of soil stoniness on water flow was not sufficiently studied up to now at catchment and hillslope scales due to flow formation complexity or problems with stony soil properties measurement (installing measuring devices, interpretation of measured data).

Results of this work can be divided in two groups: (1) hydrophysical properties of stony soils measurements, and (2) water flow dynamic modelling in stony soils.

Properties of stony soils were measured in the Jalovecky creek catchment, the Western Tatra Mts., Slovakia. Altitude of particular study sites varies from 780 to 1500 m a.s.l. We measured and analyzed the stoniness of reference soil profiles, as well as retention properties of stony soils (fine soil fraction and rock fragments separately) and hydraulic conductivities of surface and subsurface soil layers.

The methodology for determination of the effective hydrophysical properties of a stony soil (later used in modelling) was proposed using results from measurements, calculation, and numerical Darcy experiments.

Modelling results show that the presence of rock fragments with low water retention in a stony soil with moderate or high stoniness can cause the soil water storage decrease by 16–31% in compared to the soil without rock fragments. In addition, decreased stony soil retention capacity resulted in faster outflow increase at the bottom of the soil profile during non-ponding infiltration. Furthermore, the presence of rock fragments can increase maximum outflow value.

It is not possible to simply extrapolate the results from a soil profile to larger catchment scale because spatial variability of soil properties and unknown bedrock properties. Moreover, water outflow from the soil profile is a complex problem in which several factors co-operate. However, this points out that the presence of rock fragments in moderate or highly stony soils can play a significant role in catchment runoff generation under certain circumstances.