

Investigating runoff generation on compacted subsoil using a field rainfall simulator

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Identifying and understanding the dominant runoff processes is vital for both hydrologic and soil erosion research and modelling. Although lateral subsurface stormflow and consecutive topsoil saturation are well known to be rather frequent, majority of the models still favour Hortonian runoff. Such results, especially on sloping arable land with compacted subsoil, often leads to incorrect conclusions. Within this contribution we present the results of field rainfall simulations at the experimental field in Bykovický stream catchment and numerical simulations that quantitatively evaluate the effect of the subsurface runoff. At CTU in Prague a field rainfall simulator covering 16 m² experimental plots has been used for erosion and hydrologic research since 2012. As the compacted subsoil layer was identified during the early experiments, the setup was extended to monitor also the shallow subsurface flow. Eight sprinkling experiments of various rainfall intensities and durations ranging from 23 to 162 mm/hour and 60 to 155 minutes respectively were conducted under various topsoil and vegetation conditions. The subsurface flow, surface runoff and soil moisture in three depths were monitored. While surface runoff did not form at lower intensities, subsurface flow was observed in every simulation and started quickly, in average 20–30 minutes after the start of the rainfall. The subsurface runoff made up a third or more of the total runoff, depending on rainfall intensity and duration. Selected scenarios were numerically modelled. Both experimental and model results support the conceptual model of runoff formation on this particular site and suggest the need of considering the lateral flow also on similar locations. This research has been supported by the research grants GP13-20388P, SGS14/180/OHK1/3T/11 and QJ1520265.