Geophysical Research Abstracts
Vol. 17, EGU2015-2880, 2015
EGU General Assembly 2015

Landslides and the interplay of infiltration, soil permeability and bedrock exfiltration on steep slopes

Philipp Schneider (1), Cornelia Brönnimann (2), Manfred Stähli (2), and Jan Seibert (1)

(1) Department of Geography, Hydrology and Climate Group, University of Zurich, Zurich, Switzerland (philipp.schneider@geo.uzh.ch), (2) Swiss Federal Institute for Forest, Snow and Lanscape Research WSL, Birmensdorf, Switzerland

Shallow landslides pose substantial risks to people and infrastructure in mountain areas. Their occurrence is influenced by soil and bedrock characteristics and triggered by precipitation-induced pore water dynamics. The bedrock may drain or contribute to groundwater in the overlying soil depending on permeability, degree of fracturing, saturation and hydraulic head. Here, we present a case study from Central Switzerland designed to illuminate a situation where such interactions are decisive and investigate runoff formation processes at hillslopes prone to slide. The bedrock in the study area represents a succession of fissured conglomerate-sandstone and weathered marlstone layers, overlaid by a gleysol. Evidence of a temporally confined aquifer in bedrock fractures was gathered from a severe storm event in August 2005. First, a geological model of the investigated slope derived from electrical resistivity tomography surveys, borehole data, and bedrock outcrops formed the basis for test site instrumentation. Second, the soil moisture and the groundwater response to 32 storm events were monitored in different soil and bedrock layers. Although the subsoil horizons are not particularly permeable, a fast and substantial rise of hydraulic heads in the bedrock was observed, suggesting that rapid percolation through bedrock fractures caused the immediate increase of pore water pressures. The data document how pore water pressure builds up in fractured bedrock below a low-permeable soil during storms, which may trigger shallow landslides. Third, sprinkling experiments were conducted on subplots with variable rainfall intensities and different dye tracers to identify preferential infiltration, percolation and storm runoff formation at the hillslope. Brilliant blue dye stained the entire organic topsoil, vertical soil fractures, and macropores. Lateral drainage in the subsoil or at the soil-bedrock interface was not observed; drainage was limited to the organic topsoil. In the context of shallow landslides, the subsoil with its low permeability acted locally as a soil percolation and bedrock exfiltration barrier, producing significant lateral drainage in the organic topsoil and pronounced pore water pressure changes in the bedrock.