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Implications of high resolution spatial and temporal rainfall patterns for shallow landslide triggering at catchment scale

Jonas von Ruette, Peter Lehmann, and Dani Or
Terrestrial Ecosystems, USYS, ETH Zurich, Switzerland (jonas.vonruette@env.ethz.ch)

Triggering of shallow landslides is often associated with heavy rainfall events where infiltrating water decreases soil strength and increases mechanical load and pore pressure in the soil mantle. The nature of hydrological loading of slopes necessitates information on spatial and temporal distribution of rainfall intensities that are often deduced from hourly radar-data with spatial resolution of a few kilometers that smooth out much of the critical rainfall pattern heterogeneity essential to the triggering process. We explore the role of rainfall heterogeneity on volume and time of mass release using a 'catchment-scale landslide hydrological-triggering model' (CLHT). The study area for this analysis is a small catchment where a local summer storm in 2002 triggered 51 shallow landslides. Artificial heterogeneous rainfall maps were created based on the constraint that the total rainfall added to the catchment corresponds to the amount measured with radar data during actual triggering event. Simulated landslide maps reveal that rainfall pattern scenarios play a major role for the spatial and temporal failure dynamics and affects number, volume, and location of landslides. The interplay of soil hydraulic conductivity and infiltration capacity and runoff generation may reduce soil weakening and decrease landslide susceptibility. Results suggest that highly resolved rainfall spatio-temporal pattern may hold the key to understanding mechanisms of landslide hydro-mechanical triggering that are presently obscured by the use of areal mean rainfall and thus may help advance predictability of such common natural hazard.