



Erosion prediction for alpine slopes: a symbiosis of remote sensing and a physical based erosion model

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Abstract

As rainfall simulations represent an established tool for quantifying soil detachment on cultivated area in lowlands and low mountain ranges, they are rarely used on steep slopes high mountain ranges. Still this terrain represents productive sediment sources of high morphodynamic. A quantitative differentiation between gravitationally and fluvially relocated material reveals a major challenge in understanding erosion on steep slopes: does solifluction as a result of melting in spring or heavy convective rainstorms during summer cause the essential erosion processes? This paper aims to answer this question by separating gravitational mass movement (solifluction, landslides, mudflow and needle ice) and runoff-induced detachment.

First simulated rainstorm experiments are used to assess the sediment production on bare soil on a strongly inclined plot (1 m², 42°) in the northern limestone Alps. Throughout precipitation experiments runoff and related suspended sediments were quantified. In order to enlarge slope length virtually to around 20 m a runoff feeding device is additionally implemented. Soil physical parameters were derived from on-site sampling. The generated data is introduced to the physically based and catchment-scaled erosion model EROSION 3D to upscale plot size to small watershed conditions. Thus infiltration, runoff, detachment, transport and finally deposition can be predicted for single rainstorm events and storm sequences.

Secondly, in order to separate gravitational mass movements and water erosion, a LiDAR and structure-from-motion based monitoring approach is carried out to produce high-resolution digital elevation models. A time series analysis of detachment and deposition from different points in time is implemented. Absolute volume losses are then compared to sediment losses calculated by the erosion model as the latter only generates data that is connected to water induced hillside erosion. This methodology will be applied in other watersheds in varying climatic conditions of central Italy and the Franconian Jura in southern Germany.