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Unravelling sediment connectivity during an extreme event in an Alpine catchment

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This work presents the results of the basin-scale analysis of sediment connectivity between hillslopes and the main channel during an extreme event in a mountain catchment. The Stolla basin (South Tyrol, Italy) was affected by a high-magnitude event in August 2017, during which the channel experienced widening and bed level changes and more than 600 debris flows, and landslides occurred in the basin.

Hillslope and channel processes were mapped and characterized by using geomorphological analysis of orthophotos and pre- and post-event Digital Terrain Models (DTMs). Mass wasting process connectivity was derived by combining field survey evidence and GIS analysis. The coupling between the debris flows and landslides and the main channel was also evaluated by applying the Index of sediment connectivity (IC) by Cavalli et al. (2013). Binary logistic regression and the receiver operating characteristic curve was used to define thresholds that allow to discriminate connected from disconnected debris flows and landslides, based on IC values with respect to the main channel of the Stolla stream.

First results indicate that the Stolla's post-event channel width was up to five times the pre-event width. Channel widening occurred mainly through bank erosions, removals of riparian vegetation and over bank depositions. Widening appeared to be accompanied by channel bed aggradation up to 1 m or incision up to -2 m. Depending on the morphological characteristics of the channel and of the valley, sediments were eroded from the banks, from the bed or were delivered by connected debris flows, landslides, and toe erosion processes. Statistical analyses indicate a high efficiency of the logistic regression model and the associated threshold to separate connected from disconnected debris flows and landslides using the IC as a predictor variable.