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Rainfall Spatial variability, rainfall intensity–duration (ID) thresholds, and the initiation of debris flows in the eastern Italian Alps

Oliver Francis¹, Hui Tang¹, Carlo Gregoretti², Matteo Berti³, Martino Bernard², and Alessandro Simoni³

¹German Research Centre for Geosciences (GFZ), Potsdam, Germany

²University of Bologna, Bologna, Italy

³University of Padua, Padua, Italy

Runoff-generated debris flows are a significant hazard in steep mountain ranges across the world. During intense rainfall storms, runoff can rapidly form in small steep basins and mobilise large volumes of sediment triggering debris flows which can damage infrastructure and endanger lives. A common method for forecasting debris flows is deriving empirical rainfall intensity–duration (ID) thresholds from previously recorded debris flow events in a given area. However, the storms which trigger debris flows usually are short and intense with high spatial variation making an accurate recording of the conditions responsible for initiation difficult.

In this study, we investigate the impact of the spatial variability of rainfall on debris flow initiation in small, steep, and debris flow prone catchments in the eastern Italian Alps (Dolomites) using the SWEHR (Shallow Water Equation Hairsine-Rose) numerical model. The modelled catchments are monitored by multiple rain gages which we use to quantify the uncertainty of the rainfall ID thresholds due to the spatial variation of rainfall by comparing empirical and numerically modelled thresholds. We also compare simulated triggering discharges for debris flows with available field observations in the study area. This study will help to improve the quality of hazard forecasting of debris flows in mountainous regions