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A prototype regional early warning system for shallow landslides and debris flows

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Rainfall-induced shallow landslides and debris flows represent a significant geomorphological hazard in mountainous regions. The development of early warning systems (EWS) is key in order to anticipate the hazard prior to the event and to improve the response of emergency actions. However, operational EWS are very scarce around the world, especially at regional or national scale.

EWS for rainfall-induced shallow landslides and debris flows are based on the combination of debris flow susceptibility and rainfall measurements and/or forecasts. The phenomena studied here are usually very local and frequently triggered by convective storms. At such scales, numerical weather prediction models and low-resolution rain-gauge networks cannot always establish the real rainfall that triggered the event. As an alternative, radar rainfall measurements can be used.

The aim of this work is to design and test a prototype algorithm that predicts areas that may experience debris flow or shallow landslide activity and that can be used in the framework of an operational EWS over large domains (regional scale). The system has been designed to qualitatively assess the triggering of debris flows and shallow landslides and combines static susceptibility information and high-resolution real-time radar rainfall observations. The system also incorporates rainfall forecasts to issue a warning level nowcast.

The study also compares the results obtained using various methods to characterize susceptibility. Two different representative elementary areas (first and second order catchments, and grid cells) were used. Several alternatives of regional and global I-D thresholds were also applied to characterise triggering rainfalls.

A preliminary version of our model was successfully implemented in Catalonia and Switzerland. Validation of the model was done for past events using standard inventory records and monitoring observations in a few catchments, where rainfall data is available. First results are promising and show that the model is capable of identifying most of the studied events.