Lithological control on rainfall thresholds for the possible initiation of landslides in central Italy

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In Italy, landslides are frequent and widespread geomorphological phenomena triggered primarily by intense or prolonged rainfall. Using a variety of information sources, we have compiled a national catalogue of 1200 rainfall events that have resulted in documented landslides in Italy, between 1841 and 2010. The catalogue represents the single largest collection of information on rainfall-induced landslides in Italy. We exploit the catalogue to determine empirical intensity-duration (ID) rainfall thresholds for the possible occurrence of slope failures in Italy (national ID thresholds). For the purpose, we use two independent and complementary statistical methods: (i) a Bayesian inference method, and (ii) a Frequentist method. The national ID thresholds are currently used in an operational landslide warning system to forecast rainfall-induced landslides in Italy. The Italian national Department for Civil Protection uses the system routinely in an attempt to mitigate landslide risk in Italy.

From the available national catalogue, we select three regional subsets of rainfall events with landslides in central Italy, including: (i) 175 events in the Marche region, (ii) 140 events in the Umbria region, and (iii) 84 events in the Abruzzo region. First, for each region, we use the selected subsets of rainfall events with landslides to determine separate regional ID thresholds. Next, using 1:500,000 scale regional lithological maps, we determine the main lithological types in the areas where the rainfall induced landslides were reported. Lastly, we use the rainfall and lithological information to investigate the role of lithology on rainfall thresholds for the possible initiation of landslides in central Italy. We further attempt to generalize the obtained results at the national scale, in Italy.