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## A procedure for identifying rainfall thresholds for the occurrence of landslides

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Rainfall-induced landslides are widespread phenomena that cause casualties and economic losses every year. In Italy, intense or prolonged rainfall is the primary trigger of landslides. The identification of the rainfall conditions responsible for the initiation of landslides is a crucial issue and may contribute to reduce landslide risk at regional scale. In the literature, the most widely used criteria for the identification of rainfall conditions initiating slope failures are based on rainfall intensity-duration (I-D) or cumulative rainfall-duration (E-D) charts. In this study, a novel E-D procedure for the objective reconstruction of the rainfall conditions responsible for landslide occurrence is proposed. Rainfall measurements are derived from the satellite-based NASA Global Precipitation Measurement (GPM) database, which contains gridded precipitation estimates, with a half-hour temporal resolution and a 0.10-degree spatial resolution. Firstly, precipitation measurements are aggregated at hourly temporal resolution and the mean rainfall values over each territorial unit is calculated. Then, rainfall measurements are aggregated in order to obtain a sequence of rainfall events. Finally, for each rainfall event all the possible rainfall combinations are differentiated in two groups depending on whether they triggered or did not trigger landslides. The proposed procedure has been tested in a study area including six weather warning zones defined for hydrogeological risk management in Italy in the period between January 2010 and December 2018. Data on landslide occurrences are derived from the FraneItalia catalog (<https://franeitalia.wordpress.com>), a landslide inventory based on information retrieved from online Italian news. In the study area, the FraneItalia database reports 513 landslide events in the period 2010-2018. This procedure shall be a contribution toward objectively defining rainfall conditions responsible for landslides in different geographic areas, thus reducing the subjectivity inherent in the often-adopted heuristic treatment of rainfall and landslide data when defining rainfall thresholds for landslide occurrences.