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Analysis of hydro-meteorological triggering thresholds of landslides at catchment scale - The case study of Emilia-Romagna (Italy)

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Rainfall represents the most frequent landslide triggering factor often causing damages and casualties. Different types of empirical rainfall thresholds for identifying the possible initiation of landslides have been proposed on the basis of landslides database of Emilia-Romagna. However, these methods are based on meteorological information only and do not directly consider the hydrological factor.
The purpose of this work is to investigate catchment hydrological conditions and rainfall characteristics to define a relationship between both hydrological and meteorological factors and the occurrence of landslides at catchment scale. The hydrological conditions of a catchment can be assessed and used as an explanatory factor in regional landslide hazards assessment. The analysis of catchment water storage is assumed to be an effective proxy for soil moisture conditions and groundwater levels, as important predisposing of landslide triggering. The analysis has been applied to Emilia-Romagna (northern Italy), exploiting the historical landslide inventory, discharge data and weather data.
The study describes catchment hydrological state using river discharge data and catchment water balance modelling. Catchment hydrological descriptors like flow duration curve, run-off coefficients, base flow index are investigated, and the water balance (precipitation, discharge and evaporation) of the catchment is calculated on a daily time scale. The proposed hydro-meteorological triggering thresholds are compared with the more classical precipitation-intensity-duration relationships commonly adopted in technical literature. Recommendations on how hydro-meteorological triggering thresholds could be used in professional practice for regional landslide hazard assessment and early warnings are given.