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# Influence of rainfall temporal resolution on the definition of empirical rainfall thresholds for landslide occurrence

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The definition of empirical rainfall thresholds for the prediction of landslide occurrence is conditioned by several issues. The most debated ones are: the definition of objective and automatic procedures for threshold calculation; the evaluation and quantification of diverse uncertainties resulting from data and methods; the definition of validation procedures; the implementation of thresholds into landslide early warning systems. However, threshold reliability strongly depends on the quality and quantity of input data, e.g. rainfall time series and information on landslide occurrence. In particular, the temporal resolution of rainfall data influences the equation, the shape and the validity range of the thresholds. Recent studies have proved that the use of rainfall data with coarse temporal resolution causes a systematic underestimation of thresholds, due to the overestimation of the duration of the rainfall events responsible for the failures. Moreover, thresholds calculated using daily rainfall data are always lower and steeper than those defined with hourly data. These issues have relevant implications when the thresholds are implemented in warning systems for the operative prediction of landslide occurrence.
In this work, we analyse how the rainfall temporal resolution influences the definition of rainfall thresholds, their validation and the uncertainty associated with them. For the purpose, we use hourly rainfall measurements collected by a network of 172 rain gauges and geographical and temporal information on 561 rainfall-induced landslides occurred in Liguria region (northern Italy) between October 2004 and November 2014. We use a comprehensive tool, already published, that automatically reconstructs the rainfall conditions responsible for the failures and calculates frequentist cumulated event rainfall-rainfall duration (ED) thresholds. To evaluate the influence of different temporal resolutions we cluster the rainfall data in different, increasing bins of 1, 3, 6, 12, and 24 hours (representing decreasing temporal resolutions). We apply the automatic tool to reconstruct rainfall conditions responsible for failures and to define ED thresholds. We find that the rainfall temporal resolution influences considerably the threshold definition. In particular, decreasing the rainfall temporal resolution, we obtain thresholds with a smaller intercept, a higher slope, a shorter range of validity, and higher uncertainties. On the other hand, it seems that the rainfall temporal resolution does not influence the validation procedure and the threshold performance indicators.