



Uncertainties on the definition of critical rainfall patterns for debris-flows triggering. Results from the Rebaixader monitoring site (Central Pyrenees)

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Empirical rainfall thresholds are a widespread technique in debris-flow hazard assessment and can be established by statistical analysis of historic data. Typically, data from one or several rain gauges located nearby the affected catchment is used to define the triggering conditions. However, this procedure has been demonstrated not to be accurate enough due to the spatial variability of convective rainstorms.

In 2009, a monitoring system was installed in the Rebaixader catchment, Central Pyrenees (Spain). Since then, 28 torrential flows (debris flows and debris floods) have occurred and rainfall data of 25 of them are available with a 5-minutes frequency of recording (“event rainfalls”). Other 142 rainfalls that did not trigger events (“no event rainfalls”) were also collected and analysed.

The goal of this work was threefold: a) characterize rainfall episodes in the Rebaixader catchment and compare rainfall data that triggered torrential events and others that did not; b) define and test Intensity-Duration (ID) thresholds using rainfall data measured inside the catchment; c) estimate the uncertainty derived from the use of rain gauges located outside the catchment based on the spatial correlation depicted by radar rainfall maps.

The results of the statistical analysis showed that the parameters that more distinguish between the two populations of rainfalls are the rainfall intensities, the mean rainfall and the total precipitation. On the other side, the storm duration and the antecedent rainfall are not significantly different between “event rainfalls” and “no event rainfalls”. Four different ID rainfall thresholds were derived based on the dataset of the first 5 years and tested using the 2014 dataset. The results of the test indicated that the threshold corresponding to the 90% percentile showed the best performance.

Weather radar data was used to analyse the spatial variability of the triggering rainfalls. The analysis indicates that rain gauges outside the catchment may be considered useful or not to describe the rainfall depending on the type of rainfall. For widespread rainfalls, further rain gauges can give a reliable measurement, because the spatial correlation decreases slowly with the distance between the rain gauge and the debris-flow initiation area. Contrarily, local storm cells show higher space-time variability and, therefore, representative rainfall measurements are obtained only by the closest rain gauges.

In conclusion, the definition of rainfall thresholds is a delicate task. When the rainfall records are coming from gauges that are outside the catchment under consideration, the data should be carefully analysed and crosschecked with radar data (especially for small convective cells).