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Benefits and limitations of using the weather radar for the definition of rainfall thresholds for debris flows. Case study from Catalonia (Spain).

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Torrential processes such as debris flows or hyperconcentrated flows are fast movements formed by a mix of water and different amounts of unsorted solid material. They occur in steep torrents and suppose a high risk for the human settlements. Rainfall is the most common triggering factor for debris flows. The rainfall threshold defines the rainfall conditions that, when reached or exceeded, are likely to provoke one or more events. Many different types of empirical rainfall thresholds for landslide triggering have been defined.

Direct measurements of rainfall data are normally not available from a point next to or in the surroundings of the initiation area of the landslide. For this reason, most of the thresholds published for debris flows have been established by data measured at the nearest rain gauges (often located several km far from the landslide). Only in very few cases, the rainfall data to analyse the triggering conditions of the debris flows have been obtained by weather (Doppler) radar. Radar devices present certain limitations in mountainous regions due to undesired reboots, but their main advantage is that radar data can be obtained for any point of the territory.

The objective of this work was to test the use of the weather radar data for the definition of rainfall thresholds for debris-flow triggering. Thus, rainfall data obtained from 3 to 5 rain gauges and from radar were compared for a dataset of events occurred in Catalonia (Spain). The goal was to determine in which cases the description of the rainfall episode (in particular the maximum intensity) had been more accurate. The analysed dataset consists of: 1) three events occurred in the Rebaixader debris-flow monitoring station (Axial Pyrenees) including two hyperconcentrated flows and one debris flow; 2) one debris-flow event occurred in the Port Ainé ski resort (Axial Pyrenees); 3) one debris-flow event in Montserrat (Mediterranean Coastal range).

The comparison of the hyetographs from the different devices showed that the reliability of the radar is higher for short, high intensity storms more than for long lasting, medium intensity ones. Additionally, the best fit corresponds to the situations where the storm nucleus is located near the source area of the debris flow. The results of the comparison between different rain gauges show similar trends. The ones located in the same valley as the debris flow usually show good results, but if there are orographic elements in-between the debris-flow torrent and the rain gauge or the distance is large, the results can imply a great error in the definition of rainfall intensity. Therefore, we can state that the reliability of the use of the weather radar to define rainfall thresholds is strongly depending on the type of the storm and the distance between the source area and the nucleus of the storm.