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Defining physically-based rainfall thresholds for early warning systems

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In general, rainfall thresholds for landslides occurrence are not spatially explicit. However, to issue effective warnings, the emergency managers need to know which areas are included in the warning. Probabilistic rainfall thresholds compiled on correlations between recorded data show that precipitation amounts and durations required to trigger shallow landslides vary with climatic, geotechnical and topographic conditions; consequently, thresholds exhibit a high degree of spatial variability, even across relatively small geographic areas (Baum & Godt, 2010; Guzzetti et al. 2008). For rapid analysis of intensity/duration rainfall thresholds at the local scale, GIS-based modeling techniques have been developed and successfully applied starting from Iverson's theory (Baum et al. 2008, Godt et al. 2008, Salciarini et al. 2008). A GIS-based code permits the evaluation of the spatial distribution of the minimum rainfall intensity which triggers shallow landslides and debris flows over a given study area, based on the rainfall duration and the local geometric, hydrologic and mechanical characteristics of the slopes. In this work, we combine such an approach with short-time predictions of rainfall data, derived from a real-time meteorological monitoring by Decentrate Functional Centre (CFD) of the Umbria Region Department of Civil Protection (central Italy), with the aim of implementing an early warning system. An example of application to a study area of the Umbria Region in central Italy is presented, describing the capability of the model of providing site-specific thresholds for different rainfall scenarios and issuing different levels of hazard warning. The application illustrates some challenges on the technically feasibility of shallow-landslide early warning systems, capable of including specific information on the affected areas, probability of landslide occurrence and expected timing.