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Influence of topography and soil type on rainfall thresholds for the possible initiation of shallow landslides in central Italy

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In Italy, rainfall induced shallow landslides cause casualties every year, and represent a serious hazard to the population. As a result, the prediction of shallow slope failures triggered by intense or prolonged rainfall is of primary importance for decision makers and civil protection authorities. At the national and the regional scales, the prediction of the possible occurrence of rainfall induced shallow landslides is achieved by comparing rainfall measurements and estimates with empirical rainfall thresholds, established through the analysis of past rainfall events that have resulted in slope instabilities. Using multiple sources of information (including newspapers and fire brigade reports), we have updated an historical catalogue listing > 500 rainfall events that have resulted in documented landslides in the Abruzzo, Marche and Umbria regions, central Italy, between 2002 and 2011. We have exploited this catalogue to determine new cumulated event rainfall - rainfall duration (ED) thresholds for the possible occurrence of slope failures in central Italy. It is known that the local topographical (morphological), lithological, soil and climatic settings condition the occurrence and spatial distribution of shallow landslides in an area. For this work, we have exploited the catalogue of rainfall events with landslides to investigate the role of morphology and soil types in the cumulated amount (E) and the duration (D) of the rainfall that has resulted in shallow landslides in our study area, in the 10-year considered period. For the purpose, we have subdivided the study area in 3 topographic sub-divisions and 7 regional soil domains, and we have analysed the (D,E) rainfall conditions in the two different terrain classifications. Adopting a Frequentist statistical method already used to define lithological and climatic thresholds in the study area, and their associated uncertainties, we have defined new ED rainfall thresholds for possible landslide occurrence for the individual topographic sub-divisions and regional soil domains. The new thresholds were compared with the existing geographical, lithological, and climatological thresholds in the same study area. We expect the results of this study to contribute to the understanding of the influence of topography and soil characteristics on the occurrence and spatial pattern of rainfall induced shallow landslides in central Italy. We further expect that the new topographic and soil thresholds can improve the ability to forecast shallow landslides in central Italy, and in neighbouring and distant areas characterized by similar morphological and soil settings.