



A review of rainfall thresholds for the initiation of landslides

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Rainfall is a recognized trigger of landslides in different physiographic and climatic regions world wide. Various investigators have attempted to determine the amount of precipitation needed to trigger slope failures, and to establish rainfall thresholds for the initiation of landslides. Determining the amount of rainfall needed to trigger a landslide is a problem of both scientific and societal interest, and the literature on the topic is vast. In this work, we present preliminary results of an attempt to systematically collect, compare, and analyse published rainfall thresholds for the initiation of landslides. We consider only empirical rainfall thresholds, i.e., thresholds determined through the analysis of event or historical rainfall conditions that have resulted (or have not resulted) in slope failures. Information on the empirical rainfall thresholds was obtained by searching the literature, including international journals, proceedings of regional, national and international conferences, and national, regional, and local technical and event reports. We obtained a catalogue of 70 empirical rainfall thresholds for the initiation of landslides, including global (i.e., worldwide), regional and local thresholds. We analysed the obtained thresholds based on the type (i.e., shallow or deep-seated) and the abundance of the landslides (i.e., lower limit, abundant landslides, or catastrophic thresholds), and the climatic regime for which the thresholds were proposed. For the analysis, we subdivided the published thresholds in three main categories: (i) thresholds that use precipitation measurements obtained for a specific rainfall event, (ii) thresholds that consider the local rainfall history and temporal pattern, e.g., through measurements of the antecedent rainfall or soil moisture conditions, and (iii) other types of rainfall and hydrological thresholds. We further subdivided the thresholds that use a combination of precipitation measurements obtained for a specific rainfall event in four sub-categories: (i) intensity - duration (ID) thresholds, (ii) thresholds

based on event (i.e., storm, critical) rainfall, (iii) rainfall event - duration thresholds (ED), and (iv) rainfall event - intensity (EI) thresholds. We discuss the results obtained, with emphasis on the advantages and limitations of the different types of thresholds, and the possible application of the published thresholds in operational landslide warning systems, at different geographical scales, from the local to the national scale. The work was supported by RISK-AWARE (Risk - Advanced Weather forecast system to Advise on Risk Events and management), a research project partly financed by the European Commission through the Interreg IIIB - CADSES programme.