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Frequency analysis of future landslide occurrences by using rainfall point processes and hydrological models

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Analysis of climate change impact on induced phenomena, like landslides, is a topic with increasing interest in scientific community. The recent 5th Assessment Report of the Intergovernmental Panel on Climate Change [1] points out that, for Europe and Mediterranean area, several studies indicate a general increase in the intensity and frequency of extreme precipitation, especially in winter during the last four decades, but however there are inconsistencies among studies. Moreover, future rainfall scenarios are usually provided by using Climate Models, characterized by spatial and temporal resolutions which are not completely suitable for analyses of induced phenomena at hydrological scale. For this reason, in this work the evaluation of climate changes for landslide analysis is carried out by using rain gauge data at several temporal resolutions. Attention is focused on process of occurrences and on intensity and duration of rainfall events, and the presence of possible trends is investigated. A stochastic rainfall generator is implemented to generate future rainfall scenarios, with parameters which respect particular mathematical forms of variation in time, derived from the previous step. The obtained scenarios are finally used as input for hydrological models of landslide forecasting; in detail, classical Intensity-Duration schemes (I-D, [2]; [3]; [4]) and FLaIR model (Forecasting of Landslides Induced by Rainfalls, [5]) are adopted. In these models, a landslide event occurs when rainfall critical thresholds are exceeded; consequently, frequency analysis of future mobilizations is carried out in terms of number of exceedances, and time interval between two consecutive predicted events. As study area, sites located in Calabria region (southern Italy) are considered, where heavy and persistent rainfall events induced thousands of shallow landslides and hundreds of deep-seated landslides during the period 2008-2010, with more than 2,000 crisis points and damages related to about 94 % of the municipalities.

References

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