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Predicting storm triggered debris flow events: application to the 2009 Ionian-Peloritan disaster (Sicily, Italy)

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Debris flows are shallow landslides triggered by extreme meteorological events and propagating into the drainage lines of a slope as a fluid. A debris flow susceptibility map depicts the spatial probability for future phenomena to be triggered in a given area. Stochastic approaches are widely used in landslide studies for the assessment of the susceptibility. In fact, they allow to obtain a predictive function which relates a response variable (presence/absence of landslides) and a set of physical-environmental variables which are expected to control the slope failure phenomena. Future landslide occurrences are typically predicted by studying a past landslide inventory, under the basic assumption that "new landslides will occur under the same conditions which drove the past ones". The present research is aimed at testing the basic assumption, in case of extreme event triggered landslide scenarios. The study case is the debris flow event occurred in the Messina area in 2009. In particular, by applying logistic regression, a model was calibrated by exploiting an inventory dated at 2007 and validated with respect the 2009 inventory (forward chrono-validation). Moreover, a model was calibrated with the 2009 and validated in predicting the 2007 landslides (backward chrono-validation). Under the basic assumption, the two modelling procedures should achieve the same results. Cross-validation procedures have been applied to investigate precision, reliability and robustness of the models, both in terms of predictive performance and inner structure of the model. The results of the research attest for high performance and good agreement between the two chrono-validated models. However, some differences arose, indicating possible limits in the basic assumption.

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