



Design of a reliable and operational landslide early warning system at regional scale

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Landslide early warning systems at regional scale are used to warn authorities, civil protection personnel and the population about the occurrence of rainfall-induced landslides over wide areas, typically through the prediction and measurement of meteorological variables. A warning model for these systems must include a regional correlation law and a decision algorithm. A regional correlation law can be defined as a functional relationship between rainfall and landslides; it is typically based on thresholds of rainfall indicators (e.g., cumulated rainfall, rainfall duration) related to different exceedance probabilities of landslide occurrence. A decision algorithm can be defined as a set of assumptions and procedures linking rainfall thresholds to warning levels. The design and the employment of an operational and reliable early warning system for rainfall-induced landslides at regional scale depend on the identification of a reliable correlation law as well as on the definition of a suitable decision algorithm. Herein, a five-step process chain addressing both issues and based on rainfall thresholds is proposed; the procedure is tested in a landslide-prone area of the Campania region in southern Italy. To this purpose, a database of 96 shallow landslides triggered by rainfall in the period 2003–2010 and rainfall data gathered from 58 rain gauges are used. First, a set of rainfall thresholds are defined applying a frequentist method to reconstructed rainfall conditions triggering landslides in the test area. In the second step, several thresholds at different exceedance probabilities are evaluated, and different percentile combinations are selected for the activation of three warning levels. Subsequently, within steps three and four, the issuing of warning levels is based on the comparison, over time and for each combination, between the measured rainfall and the pre-defined warning level thresholds. Finally, the optimal percentile combination to be employed in the regional early warning system is selected evaluating the model performance in terms of success and error indicators by means of the “event, duration matrix, performance” (EDuMaP) method.