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Presence-only approach to assess landslide triggering-thickness susceptibility. A test for the Mili catchment (North-Eastern Sicily, Italy)

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This study aims at comparing the performances of a presence only approach, namely Maximum Entropy, in assessing landslide triggering-thickness susceptibility within the Mili catchment, located in the north-eastern Sicily, Italy. This catchment has been recently exposed to three main meteorological extreme events, resulting in the activation of multiple fast landslides, which occurred on the 1st October 2009, 10th March 2010 and 1st March 2011. Differently from the 2009 event, which only marginally hit the catchment, the 2010 and 2011 storms fully involved the area of the Mili catchment. Detailed field data was collected to associate the thickness of mobilised materials at the triggering zone to each mass movement within the catchment. This information has been used to model the landslide susceptibility for two classes of processes clustered into shallow failures for maximum depths of 0.5m and deep ones in case of values equal or greater than 0.5m. As the authors believed that the peculiar geomorphometry of this narrow and steep catchment played a fundamental role in generating two distinct patterns of landslide thicknesses during the initiation phase, a HRDEM was used to extract topographic attributes to express near-triggering geomorphological conditions. On the other hand, medium resolution vegetation indexes derived from ASTER scenes were used as explanatory variables pertaining to a wider spatial neighbourhood, whilst a revised geological map, the land use from CORINE and a tectonic map were used to convey an even wider area connected to the slope instability. The choice of a presence-only approach allowed to effectively discriminate between the two types of landslide thicknesses at the triggering zone, producing outstanding prediction skills associated with relatively low variances across a set of 20 randomly generated replicates. The validation phase produced indeed average AUC values of 0.91 with a standard deviation of 0.03 for both the modelled landslide thicknesses. In addition, the role of each predictor within the whole modelling procedure was assessed by applying Jackknife tests. These analyses focussed on evaluating the variation of AUC values across replicates comparing single variable models with models based on the full set of predictors iteratively deprived of one covariate. As a result, relevant differences among main contributors between the two considered classes were also quantitatively derived and geomorphologically interpreted. This work can be considered as an example for creating specific landslide susceptibility maps to be used in master planning in order to establish proportional countermeasures to different activation mechanisms.

Keywords: statistical analysis, shallow landslide, landslide susceptibility, triggering factors, presence-only approach