



## **Mapping debris flow hazard on medium scale: Valtellina di Tirano, Italy**

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Debris flow hazard modelling on medium (regional) scale has been subject of various studies in recent years. Estimation of the hazard consists of incorporating information about spatial and temporal probability of occurrence, together with the delimitation of potential runout areas of debris flows. In this study an approach based on modelling the occurrence probability coupled with runout delimitation is proposed. For that purpose a map of debris flow hazard initiation probabilities was prepared, based on susceptibility zones available for the study area, and two sets of aerial photographs for the debris flow temporal probability estimation. Afterwards the runout zones were delimited. As the complexity of the phenomenon, the variability of the local controlling factors, and lacking data limit the use of process-based models for the runout zones delimitation a simple GIS-based model developed at the University of Lausanne (Switzerland) was applied in the area of the Consortium of Mountain Municipalities Valtellina di Tirano (Central Alps, Italy). This approach, associating automatic detection of the source areas and a simple assessment of the debris flow spreading, provided results for the hazard analysis at the medium scale. The model used a digital elevation model, with a 10 m resolution, together with landuse, geology and debris flow hazard initiation map to automatically identify potential source areas. Afterwards runout areas were calculated using multiple flow and energy based algorithms. Maximum probable runout zones of debris flows were calibrated using documented past event as well as aerial photographs. Finally two debris flow hazard maps were prepared. First one is simply delimiting five hazard zones, while the second incorporates the information about debris flow spreading direction probabilities showing areas more likely affected by future debris flows.