Geophysical Research Abstracts
Vol. 17, EGU2015-8736, 2015
EGU General Assembly 2015

Predicting debris flow occurrence in Eastern Italian Alps based on hydrological and geomorphological modelling

Efthymios I. Nikolopoulos (1), Marco Borga (1), Elisa Destro (1), and Lorenzo Marchi (2)

(1) University of Padova, Land, Enviroment, Agriculture and Forestry, Legnaro-Padova, Italy (thymios.nikolopoulos@gmail.com), (2) Consiglio Nazionale delle Ricerche, IRPI, Padova, Italy

Most of the work so far on the prediction of debris flow occurrence is focused on the identification of critical rainfall conditions. However, findings in the literature have shown that critical rainfall thresholds cannot always accurately identify debris flow occurrence, leading to false detections (positive or negative). One of the main reasons for this limitation is attributed to the fact that critical rainfall thresholds do not account for the characteristics of underlying land surface (e.g. geomorphology, moisture conditions, sediment availability, etc), which are strongly related to debris flow triggering. In addition, in areas where debris flows occur predominantly as a result of channel bed failure (as in many Alpine basins), the triggering factor is runoff, which suggests that identification of critical runoff conditions for debris flow prediction is more pertinent than critical rainfall.
The primary objective of this study is to investigate the potential of a triggering index (TI), which combines variables related to runoff generation and channel morphology, for predicting debris flows occurrence. TI is based on a threshold criterion developed on past works (Tognacca et al., 2000; Berti and Simoni, 2005; Gregoretti and Dalla Fontana, 2008) and combines information on unit width peak flow, local channel slope and mean grain size. Estimation of peak discharge is based on the application of a distributed hydrologic model, while local channel slope is derived from a high-resolution (5m) DEM. Scaling functions of peak flows and channel width with drainage area are adopted since it is not possible to measure channel width or simulate peak flow at all channel nodes. TI values are mapped over the channel network thus allowing spatially distributed prediction but instead of identifying debris flow occurrence on single points, we identify their occurrence with reference to the tributary catchment involved. Evaluation of TI is carried out for five different basins located in the Upper Adige region, Eastern Italian Alps. Analysis involved eight debris-flow triggering storms for which high-quality radar-rainfall fields and a detailed debris flow record (with a total of 87 occurrences) is available. Results show that in all cases examined TI exhibits significant skill in predicting debris flow occurrence. However, sensitivity analysis of the results on the channel width scaling functions, the grain size and peak flow estimation uncertainty revealed considerable variability in the results. This suggests that successful application of TI as a predictor in a warning system requires local adjustment of the channel width law and grain size parameters while characterization of uncertainty in hydrologic model predictions should also be considered.

Berti, M., Simoni, A., 2005: Experimental evidences and numerical modelling of debris flow initiated by channel runoff. Landslides, 2 (3), 171-182.
Gregoretti, C. and G. Dalla Fontana, 2008: The triggering of debris flow due to channel-bed failure in some alpine headwater basins of the Dolomites: analyses of critical runoff. Hydrol. Process. 22, 2248–2263.
Tognacca C., Bezzola G.R., Minor H.E., 2000: Threshold criterion fo debrisflow initiation due to channel bed failure. In Proceedings of the Second International Conference on Debris Flow Hazards Mitigation Taipei,August, Wiezczorek, Naeser (eds): 89–97.