Geophysical Research Abstracts
Vol. 17, EGU2015-11931, 2015
EGU General Assembly 2015

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Coupled prediction of flash flood response and debris flow occurrence in an alpine basin

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This contribution examines the main hydrologic and morphologic metrics responsible for widespread triggering of debris-flows associated with flash flood occurrences in headwater alpine catchments.To achieve this objective, we investigate the precipitation forcing, hydrologic responses and landslides and debris-flow occurrences that prevailed during the August 4-5, 2012 extreme flash flood on the 140 km2 Vizze basin in the Eastern Alps of Italy.
An intensive post-event survey was carried out a few days after the flood. This included the surveys of cross-sectional geometry and flood marks for the estimation of the peak discharges at multiple river sections and of the initiation and deposition areas of several debris flows. Rainfall estimates are based on careful analysis of weather radar observations and raingauge data. These data and observations permitted the implementation and calibration of a spatially distributed hydrological model, which was used to derive simulated flood hydrographs in 58 tributaries of the Vizze basin. Of these, 33 generated debris-flows, with area ranging from 0.02 km2 to 10 km2, with an average of 1.5 km2.
With 130 mm peak event rainfall and a duration of 4 hours (with a max intensity of 90 mm h^{-1} for 10 min), model-simulated unit peak discharges range from 4 m3 s^{-1} km−2for elementary catchments up to 10 km2 to 2 m3 s-1 km-2 for catchments in the range of 50 – 100 km2. These are very high values when considering the local runoff regime. We used a threshold criterion based on past works (Tognaccaet al., 2000; Berti and Simoni, 2005; Gregoretti and Dalla Fontana, 2008) to identify tributaries associated to debris flow events. The threshold is defined for each channel grid as a function of the simulated unit width peak flow, of the local channel bed slope and of the mean grain size. Based on assumptions concerning the mean grain size and given the distribution of the threshold values over the river network, we derive a catchment scale threshold index for the tributaries. The results show that the index has considerable skill in identifying the catchments where the studied rainstorm caused debris-flows.

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