Geophysical Research Abstracts
Vol. 21, EGU2019-7188, 2019
EGU General Assembly 2019

Rainfall threshold for debris flow occurrence in the Gadria catchment, eastern Italian Alps

Lorenzo Marchi (1), Velio Coviello (2), Francesco Comiti (2), Stefano Crema (1), Marco Cavalli (1), and Pierpaolo Macconi (3)

(1) Research Institute for Geo-hydrological Protection, CNR, Italy, (2) Free University of Bozen-Bolzano, Faculty of Science and Technology, Italy (velio.coviello@unibz.it), (3) Civil Protection Agency, Autonomous Province of Bozen/Bolzano, Italy

Critical rainfall thresholds for shallow landslides and debris flows are widely used in warning systems based on precipitation measurement and may contribute to understanding the hydrometeorological controls on these instability processes under different climate and geomorphic conditions. The catchments instrumented for debris-flow monitoring are especially suitable for getting insights on the control of rainstorm characteristics on debris-flow occurrence because high rain gauge density permits reducing the uncertainties related to the spatial representativeness of rainfall measurement sites. Moreover, the precise knowledge of the time of occurrence enables recognizing which part of the rainstorm actually triggered the debris flow.

In this work, we present the analysis of rainfall triggering debris flows from 2011 to 2018 in the instrumented catchment of Gadria Creek (Venosta Valley, South Tyrol, Eastern Italian Alps). The Gadria catchment has a drainage area of 6.3 km^2 and ranges in elevation from 1,394 to 2,945 m a.s.l. Steep channels, highly fractured metamorphic rocks and thick Quaternary deposits set the perfect conditions for chronic debris-flow activity within the basin. The study area is characterized by dry inner-Alpine climate, with mean annual precipitation of 480 mm in the valley floor. Precipitation increases with altitude, with 662 mm measured at a rain gauge located at 1,754 m a.s.l. (period 1993–2012). Preliminary rainfall analysis revealed that maximum 10-minutes rainfalls can be used to distinguish triggering from non-triggering rainfalls and hourly rainfall larger than about 10 mm is likely to provoke debris flows. We defined a burst as a segment of a storm that has less than 30 min gaps between rain gage bucket tips. We considered the arrival time at the monitoring station located on the fan apex for the definition of the rainfall duration. We computed the mean intensity, I (mm/h), and the total duration, D (h), of the triggering rainstorms. We defined the following minimum $I - D$ threshold for Gadria:

$$I = 8(D)^{-0.96}$$

An anomalous debris flow event that occurred on 26 July 2016, characterized by very low intensity and rainfall amount, was not considered in defining the $I - D$ threshold. We compared this equation with other local I-D thresholds computed in other debris-flow catchments in the Alps and with a regional threshold for the whole Bozen/Bolzano Province. The rainfall threshold defined at Illgraben (Switzerland) is relatively similar, while significantly higher $I - D$ threshold reported for the Moscardo is consistent with the higher rainfall amounts recorded in that area. In the Gadria most debris flows were triggered by rainfall events characterized by $I - D$ values comparable with those that produced water floods. This result confirms that rainfall analysis alone does not explain the type of sediment fluxes at the catchment scale. We argue that, even in a catchment characterized by unlimited sediment supply, as the Gadria is, short-period variations in the sediment sources in the headwater channels influence the triggering of debris flows. The occurrence of debris flows after short, low-intensity precipitation, as it occurred on 26 July 2016, will be a challenging task for further investigations.