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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Meteorology triggering factors analysis for rainfall induced hydrogeological events in alpine region" *by* Andrea Abbate et al.

Anonymous Referee #2

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The manuscript deals with an interesting attempt to strengthen the estimation of extreme hydrological conditions, which led to landslide and flash flood phenomena in the Sondrio Province (northern Italy) in the period 1951-2019, by linking them to estimations of magnitude and return period (temporal probability) as well as meteorological conditions occurred at the continental scale. In the opinion of this reviewer, such a methodological effort is certainly to be appreciated because tending to reduce uncertainties of a single approach, such as empirical rainfall thresholds for shallow landslide triggering and hydrological probabilistic models. Specifically, starting from an inventory of principal landslide and flash flood phenomena collected for the study area, authors analyzed triggering hydrological factors by three methods. The first is based on

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Discussion paper

the comparison of intensity/duration of rainfall events, which led to landslide and flash flood phenomena, to empirical rainfall thresholds for shallow landslides known by the literature for the region studied and worldwide. The second is the estimation of return periods for triggering rainfall conditions by a known regional probabilistic model (De Michele et al., 2005). The third is the analysis of meteorological conditions which lead to extreme rainfall events, based on data taken from the National Centres of Environmental Prediction (NCEP) (Kalnay et al., 1996; MeteoCiel, 2020; NOAA, 2020). Notwithstanding the challenging and innovative premises, the manuscript presents several conceptual points of weakness which are described below in form of both general and specific comments.

GENERAL COMMENTS 1) Rainfall thresholds considered, known by the literature, are related to shallow landslides, instead Authors compare to them also deep-seated phenomena (1987 deep-seated Val Pola landslide) and flash floods. Therefore, the comparison appears too heterogeneous and would need a motivation. 2) The procedure used for assessing the magnitude ranking (Fig. 6), by taking into account of both return period and areal extent of meteorological phenomena, appears questionable for being based on the mean of normalized value. By a conceptual point of view, considering the mean value is allowed for the same variable, not for different variables. Very likely, the normalized product of return period and areal extent of meteorological phenomena would incorporate more consistently the magnitude at local scale (return period) and the areal extension. 3) Parts of the paragraph 3.2.1 regards general methodological aspects and preceding knowledge, therefore they appear more suitable for the methods section rather than the results one. 4) Nothing is given about the regional probabilistic model (De Michele et al., 2005), which has been considered to the estimation of return periods. In the opinion of this reviewer, it's an important point to explain aspects related to the regional probabilistic model adopted. 5) Authors should motivate with a greater emphasis the possible applications of their findings in the field of landslide and flood hazard assessment as well as early warning systems. 6) English language should be revised.

SPECIFIC COMMENTS

The adjective “hydrogeological”, used extensively throughout the text, appears not suitable to indicate landslide and flood phenomena. It is recommended to substitute this term.

Block 20. The sentence is not clear and it should be rewritten.

Block 30. The use of the term “back analysis” is questionable because it is commonly used in the geotechnics field for inverting a slope stability analysis and estimating shear strength of geological materials involved in landsliding. In this case the analyses carried out are just re-examinations of past landslide and flash flood events.

Block 40. Substitute “deep landslide” with “deep-seated landslide”.

Block 80. Substitute “will be” with “is”.

Block 90. “Old debris” is not a geological term. Maybe, just debris could be better, otherwise the age should be indicated more clearly (e.g. Pleistocene).

Table 1: A column indicating the mean intensity should be considered. The definition of Extremely Localized (EXTL) and Diffuse (DIF) could be substituted with Localized (L) and Areal (A).

Blocks 250-255 and Fig. 4. To consider the vertical distance between the curve and the critical event point appears conceptually incorrect due the possibility that the curve itself (I/D rainfall thresholds) indicates points with different return period. Authors should verify and discuss this point.

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