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Hydrology and Earth System Sciences Discussions

Interactive comment on "Estimation of debris flow critical rainfall thresholds by a physically-based model" *by* M. N. Papa et al.

Anonymous Referee #1

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This paper presents an interesting methodological framework in order to assess rainfall induced debris flow hazard with CRT methods. Nevertheless, there are serious problems concerning several points suggesting accepting the paper but with major revision (seeing comments below). The major problems concern: (1) the type of flow-like phenomena the authors are dealing with (see comments below), (2) the presentation of data, (3) the interpretation of some results and their link with other references.

1.Does the paper address relevant scientific questions within the scope of HESS? YES 2.Does the paper present novel concepts, ideas, tools, or data? NO 3.Are substantial conclusions reached? NO 4.Are the scientific methods and assumptions valid and clearly outlined? YES 5.Are the results sufficient to support the interpretations and

conclusions? NO 6.Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)? YES 7.Do the authors give proper credit to related work and clearly indicate their own new/original contribution? YES 8.Does the title clearly reflect the contents of the paper? NO 9.Does the abstract provide a concise and complete summary? YES 10.Is the overall presentation well structured and clear? YES 11.Is the language fluent and precise? NO 12.Are mathematical formulae, symbols, abbreviations, and units correctly defined and used? YES 13.Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated? YES (see comments) 14.Are the number and quality of references appropriate? NO (see comments) 15.Is the amount and quality of supplementary material appropriate? YES

SPECIFIC COMMENTS: Introduction: Authors should first indicate the main debris-flow triggering mechanisms (e.g. rainfall, earthquake, rapid snow/ice melting, etc.) in the Introduction and then make a focus (with key references) on landslides induced debris flows. Some key references about debris flows triggered from landslides are for example: Baum and Godt (2010), (Landslides) Crosta and Frattini, (2008), (Hydrological Processes) Hungr et al. (2001), (Environmental and Engineering Geoscience) Malet et al. (2005), (Geomorphology)

A key reference about rainfall induced debris flows and landslides (with specific emphasis on CRT curves): Guzzeti et al. (2008), (Landslides)

'The conoid of mountain torrents. . .'. Please replace conoid with fan, which is the correct term in a geomorphological point of view;

This study is limited in a single kind of a phenomenon which is not representative of the most part of debris-flow events. For instance, scouring and entrainment are responsible of 50 to 90% of the volume of material involved in the debris-flow. To my point of view, the authors are dealing with shallow landslides or mud-flow triggering, not debris-flow triggering. If they want to clarify the term, they should provide information about the

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rheology of the flow, the grain size distribution, the morphology of the deposits, etc. Moreover, they are not considering the sediment supply, which is of primary importance for debris-flows. They should specify at the start that this study is dealing with not limited sediment supply debris flows.

2.2 Paragraph .... (and therefore rainfall intensity decreasing with rainfall durations). The sentence is not clear; in fact rainfall intensity is decreasing when the rainfall duration is increasing (for the dame rainfall amount).

3. Study case

Please indicate the minimal and the maximal elevation, which are much more useful that the mean one.

Sometimes authors classify the phenomenon as a mud-flow, sometime as a debris flow, sometime as a shallow landslide. These is confusing, please clarify this by using the same term for each events, or if authors have clear field evidence (grain size distribution, morphology of deposits, etc.), they should first provide a classification of the flow like phenomena that are concerned by this study.

'The reconstruction of the areas that were mobilized (Papa et al., 2011a), showed that 2,8% of the total basin area was affected by the detachments' ... This is a crucial point. Authors should provide a quick synthesis of this paper (2-3 sentences) which exposes the methods (field investigation, multi-date DEM reconstruction with aerial photographs? Old geomorphologic maps? Other?) used for the definition of the volume of debris flow solid material. The 300'000 m3 is the solid part or the total volume of the debris flows (water+solid)?

"The event rainfall curve approaches the ID lines corresponding to simulated failure percentages of 0.3 %, for rainfall durations of about 8 h. This is in good agreement with the observed failure percentage (0.3 %)." ... This is not good, this is perfect. In other terms your debris flow is only rainfall-dependant? No sediment supply dependant?

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They should also provide a statistical analysis of daily rainfall characteristics NOT associated to debris flow event. Did they observe in the data catalog, heavy/strong daily rainfalls where no flow-like phenomenon was observed/recorded?

" After the position of antecedent rain equal to the observed value (212mm.month$-$1) the only antecedent rain, without any event rain, causes a failure percentage greater than the observed one (Papa et al., 2011b)." ... This sentence is not clear or confusing. Moreover authors should precise what they mean with "greater", no quantitative values?

4. Results and discussion

"When the historical database is not wide enough, or in the case of total absence of historical debris flow 5 events, the failure threshold can be fixed by simulating the downstream effect of different debris flow volumes. These simulations can be performed through the mathematical and numerical modeling of debris flows propagation (O'Brien et al., 1993; Medina et al., 2008). By carrying out a large number of simulations with different input volumes (and consequently discharges), it is possible to asses a threshold 10 for the total amount of debris volume that may comport an hazard for the downstream areas." ... This work has been performed by many authors with various type of models, for instance: Malet et al., 2005 (Geomorphology). Authors should add this reference which deals perfectly with the topic. This paper discuss also the type fo models associated to the type of flow-like phenomenon. Otherwise, the model proposed by O'Brien in 1993 (Quadratic model) did not include originally the scouring effects. A complete review of debris-flow models including scouring effects is available in Quan Luna et al. 2012 (Engineering Geology).

Figures:

Figure 4: Authors should add some elevation spots (or elevation lines) on the geomorphological map.

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