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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 #2

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Review of hess-2012-479 Title: Estimation of debris flow critical rainfall thresholds by a physically-based model By Papa et al.

Evaluation

The objective of this work is to describe the derivation of threshold rainfall for landslide triggering based on an existing model, due to Iverson (2000), which describes shallow landslides occurrence under conditions of transient infiltration into initially unsaturated soils. The methodology is applied and tested over the 6.4 km2-wide Sambuco basin in southern Italy, where debris flows were triggered by two different historical events. The paper is well suited for HESS and it may attract the attention of hydro-geomorphologists interested in shallow landslides and debris flows. However, there are problems with

both the scientific content of the work and with its presentation. The main science problem is related to the pervasive confusion made between debris flows and shallow landslides. Moreover, it is difficult to see the innovation point in this work, given that the methods are not original and the main conclusions neither. So the authors must (thoroughly) modify the manuscript to focus on what is innovative. Given the time needed to perform such changes, I recommend major revisions. The revised version should be carefully checked by someone for whom English is the native tongue and who is also confident with the topic.

General comments

1. I found the title misleading: it deals with "debris flow critical rainfall thresholds" and it turns in the paper that the main physical process considered is shallow landsliding. The authors should made clear that, even when focusing on debris flows mobilized by landslides, not all failing hillslopes mobilize to form debris flows. I think the title should reflect more accurately the content of the paper.

2. The confounding overlapping between shallow landsliding and debris flows is not limited to the title and is widespread in the work. Perhaps the section which suffers most from this confusion is the one dedicated to the validation of the methodology. The map of 'traces of the landslides' (whatever this means) (Fig 3), which is used as a reference for the modeled landslide map (not reported, the authors examined only a percentage of the topographic elements in the catchment), does not show typical shallow landslides that are a result of slope water table. Fig. 3 reports the runout paths of the debris flows triggered by two storm events. The debris flow runout and deposition are clearly different processes than the one described by the Iverson's model used in this work. Of course, this leads to significant differences between the 'observed' and 'modeled' failing hillslope area and undermines the whole verification of the model.

3. The paper fails to give proper credit to related work. Among the several papers which are highly relevant to this work and which are not cited are: Frattini et al., 2009,

which develops probabilistic thresholds for triggering shallow landslides by rainfall using the Iverson's model (the work reports an application to a 180 km2 area in northern Italy); Baum et al. (2010) which develops a model of the infiltration process using a twoâĂŘlayer system that consists of an unsaturated zone above a saturated zone and implemented this model in a geographic information system (GIS) framework; Lanni et al. (2012) which combines a model for the initial unsaturated soil conditions through the whole soil profile and a groundwater model.

4. Model implementation. To save computation time, the hillslope instability model is applied to a number n of the topographic elements of the basin equal to 1%,. The authors reports that for n exceeding 1% of the total basin cells, the simulation results converge to the one obtained simulating all the basin cells. However, the authors fail to provide any indication on how to select the 1% of the basin, given that all the various classes of both the soil/geotechnical parameters and of the morphological (local slope, upslope area, convergence/divergence) parameters should be equally represented. 5. Epistemic uncertainty. The authors report that the uncertainties in the evaluation of the soil variables are taken into account assigning to each variable an average value along with a confidence interval. However, the results are reported without any reference to the said uncertainties.

Details

P1L22 Abstract: I don't understand what the 'virtual' basin mentioned here does mean. Which is the difference between the Sambuco basin and the virtual one? Moreover, it appears here a 'studied basin' which was not mentioned earlier. P7 and P9: Both equations at P7 and P9 are numbered as (9).

P9L21 Pyrosclastic

P10L8-10:

P10L9-11: A rather crude method is introduced to account for root cohesion: the value

of the soil cohesion is multiplied by 1,25. The authors should recognize the limitations and the implications of this crude method.

P11L8-11: 'In the studied example, as the 2005 event (failure percentage = 0.3%) did not reach Minori the critical failure percentage should be fixed between 0.3% and 3%.' This is an example of the effects triggered by confounding debris flows and landslides. The observation that the debris flows didn't impacted the downstream town should not have implications on the extension of the failing area (which should be observed per se). This may well depend on the characteristics of the triggering storm, or on processes (such as liquefaction) which are not included in the model.

P12L25-27: the text here should be reworded since it is very hard to understand

Figures

A figure should be added reporting the main morphological characteristics of the basin, the observed landslides (not debris flows) and the town of Minori (mentioned twice in the paper and unrecognized in the maps).

Figure 1: Please check the variable reported on the y axis. It is wrong.

Figure 2: Which is the meaning of the other basins identified in red?

Figure 3: A graphical scale should be added.

References:

Baum, R.L., Godt, J.W., Savage, W.Z., 2010: Estimating the timing and location of shallow rainfall-induced landslides using a model for transient, unsaturated infiltration. Journal of Geophysical Research F: Earth Surface, 115 (3), art. no. F03013.

Frattini, P., Crosta, G., Sosio, R., 2009: Approaches for defining thresholds and return periods for rainfall-triggered shallow landslides. Hydrological Processes, 23 (10), pp. 1444-1460.

Lanni, C., Borga, M., Rigon, R., Tarolli, P., 2012: Modelling shallow landslide susceptibility by means of a subsurface flow path connectivity index and estimates of soil depth spatial distribution. Hydrology and Earth System Sciences, 16 (11), pp. 3959-3971.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 12797, 2012.