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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Uncertainty analysis of the estimation of stony debris flow rainfall threshold: the application to the Backward Dynamical Approach" *by* Marta Martinengo et al.

Anonymous Referee #2

Received and published: 9 November 2020

Dear Authors, Dear Editor,

I have read and carefully evaluated the manuscript "Uncertainty analysis of the estimation of stony debris flow rainfall threshold: the application to the Backward Dynamical Approach" submitted for possible publication in NHESS. The manuscript applies a double Monte Carlo simulation to investigate the robustness of the recently proposed BDA model with respect to uncertainty of input factors required to derived rainfall thresholds for stony debris flows. The idea is interesting and original and deserves attention. The English is generally clear. I identified a few shortcomings, as highlighted in my comments below. The manuscript could be considered again for publication after major

revisions.

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GENERAL COMMENTS

1) The topic of rainfall threshold for landslides/debris flow initiation is intensely debated and many papers are published continuously. Most of the published papers have a low content of originality. I therefore suggest to better stress the elements of novelty in the proposed research. As instance:

- To my understanding, "stony debris flow" is a rather specific category. This could be briefly highlighted in the introduction and conclusion: most of the works abut rainfall thresholds mix different landslide typologies, others include DF and shallow landslides, others are addressed at DF in general (references could be easily found, e.g. with some review paper already in your reference list). You could highlight that studies explicitly addressed to stony DF are rare and thus more knowledge is needed on this field, hence suggesting the need of this test on the BDA model.

- You could expand the state of the art review and better link it to the originality (and usefulness) of your work. You cite a few relevant papers, but many other could be cited, especially in the central part of the introduction, to better set the stage for your work. And most of all, to avoid a sentence like "As stressed in the Introduction, the rainfall intensities i(t) associated with the event are assumed to be certain. Future analysis will assess and study also the uncertainties related to this piece of data", which seems an unnecessary justification. You could just say that uncertainty in rainfall threshold has been already investigated for temporal resolution (Marra 2019; Gariano et al., 2020, both already in your reference list), definition of the triggering rainfall (Peres et al. 2018), rain gauge selection (Abraham et al 2020) and so on. Whereas, a study is missing for the uncertainty in the parameters used by BDA for stony debris flows thresholds: nobody did it, this is (in my opinion) your main contribution to the progress of the state of the art. Abraham, M. T., Satyam, N., Rosi, A., Pradhan, B., & Segoni, S.

(2020). The Selection of Rain Gauges and Rainfall Parameters in Estimating Intensity-Duration Thresholds for Landslide Occurrence: Case Study from Wayanad (India). Water, 12(4), 1000. Peres, D. J., Cancelliere, A., Greco, R., & Bogaard, T. A. (2018). Influence of uncertain identification of triggering rainfall on the assessment of landslide early warning thresholds.

2) This paper is conceived and organized around some mathematical calculations. The risk is that the reader could perceive it as a "synthetic" experiment. I think it is important for NHESS readers to better put their minds on the specific case of study and it could be useful to add a brief description of the study case. This should include a brief description of the test area features and of the debris flows at hand. Also, some more information on the input data are needed (e.g. source of rainfall and debris flows datasets)

3) Discussions are almost missing, mainly they are mixed with the conclusions. I suggest providing separate sections. Discussions should contain an interpretation of the results, while in the conclusions you should summarize the lessons learnt. In particular, some points in my opinion are not clear enough: how does this study help us in predicting stony debris flows? Does it prove that BDA is robust, or does it prove that the utmost care should be put in calibrating/measuring the input parameters required? How does the uncertainty is reflected in the forecasting effectiveness of the resulting threshold? The latter point, in particular, is very important and some tests about that should be shown in the revised version of the manuscript.

SPECIFIC COMMENTS

L17. About review casualties, I suggest to add also the review "Dowling, C. A., & Santi, P. M. (2014). Debris flows and their toll on human life: a global analysis of debris-flow fatalities from 1950 to 2011. Natural hazards, 71(1), 203-227."

L23 I suggest "Usually, rainfall thresholds for debris flows initiation are power laws that link the rainfall duration to the rainfall cumulated or Intensity". This is because

when dealing with other landslide typologies, other parameters are often used (e.g. antecedent rainfall indexes).

L25 I would add also the work of Caine (1980), who started this methodology of analysis. Also, I would add some review. And I would substitute the work by Guzzetti by his work published the year after, reviewing ID thresholds (thus, more strictly related to your research).

L59 The Backward Dynamical Approach (BDA). . .

L106: Since the study area is located in the Alps, this equation seems very low. Has this threshold been validated before (e.g. in Rosatti et al., 2019)? Could you report the validation result? Before going on with the reading, the readers should know how reliable this threshold is. How I said, this value seems very low to me and maybe another information should be provided about how the rainfall threshold is operated. E.g. within a long rainfall event a shorter but more intense burst of rain could easily reach the hourly peak intensity of 6.2 or higher. In that case is the threshold exceeded or not?

L112:"some": which one? The ones in tb. 1?

L157-160. This is not clear to me. If I understood correctly, in section 3.1 you set N=100, obtaining 100 random "points" in the I/D plane. Now, you randomly pick one of the I/D points, and you do it 5000 times. I guess most of the points are sampled many times. Because 5000 » 100. Moreover I do not understand how you can generate a threshold for each one of the selected points (5000 thresholds), since you should use many points to define a threshold (in short: many ID couples are needed to define a single a-b couple). I think I misunderstood something in this part, therefore I suggest to rephrase or to explain better.

L175. For what concerns = regarding?

L209: please check: the flow of the text is broken by the table and the image. It is hard

to follow (similar issues elsewhere)

L238-239: please check the text: possible issues.

GRAPHICAL IMPROVEMENTS

Figure 2: I strongly suggest adding another panel to this figure, where the DTM of the study area could be shown together with other relevant data (e.g. debris flows locations).

Please check the text immediately before and after images and tables. Sometimes sentences are split.

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