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Comment on nhess-2022-199

Anonymous Referee #2

Referee comment on "Rainfall thresholds estimation for shallow landslides in Peru from gridded daily data" by Carlos Millán-Arancibia and Waldo Lavado-Casimiro, Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2022-199-RC2, 2022

The manuscript presents an interesting application of methods for the definition of empirical rainfall thresholds for landslide occurrence at a national scale. The aim of the paper is clear and the results are also well-presented. Despite some points not very clear, I found the manuscript clear and sufficiently well-organized. From a methodological point of view, I found some problems in the work, which should be addressed before the paper can be reconsidered for publication.

I list in the following some general comments and a few specific technical corrections and other suggestions.

General comments

The main problem of the work lies in the validation procedure. In particular, the use of only one year of data as validation set is inconvenient. This choice was proved to be not effective cause is too much linked to the variability of the selected year. Indeed, you found that the performances decreased in the validation, “which may be due to the fact that, in the year 2020, there were no extreme rainfall events as in other years, and the number of landslides was lower than in other years”. A more reliable procedure would consider a random selection of triggering and non-triggering rainfall conditions in a calibration (e.g. 80% of the total) and a validation set (remaining 20%). You can found examples in: https://doi.org/10.1007/s11069-019-03830-x or https://doi.org/10.5194/hess-25-3267-2021

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The use of daily rainfall data is also not the best choice for defining rainfall thresholds, particularly for shallow landslides, given the high uncertainties related to this temporal resolution as highlighted by https://doi.org/10.1007/s1106 9-018-3508-4 https://doi.org/10.1007/s11069-019-03830-x. This should be pointed out and discussed better. I would add that there are currently other satellite-based rainfall products with better temporal resolutions (e.g GPM), which could be employed in such analyses.

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The whole section 2.4 misses several information and needs a check and a huge review. It is not clear how the association between a rainfall event and a landslide is done (Line 120), in order to classify an event as a triggering rainfall event.
Moreover, at line 118 it is reported that "For coastal Pacific regions, 0.5 mm was considered the minimum rainfall threshold". What about the other regions?
At lines 131-136, it is not clear the actual method used to define the thresholds, based both on 1 or 2 variables. How the parameters and the equations were obtained? Before "maximizing predictive performance" a threshold should be calculated using a method. Which method was used? This issue needs to be better explained.
Moreover, at line 133 is written "variables independent of rainfall properties (Imax,E,D, Imean)"; actually, Imean and D are not independent on each other, being Imean=E/D. Please explain also this point.
Finally, I believe that proposing thresholds based only on one parameter (e.g. E, D, Imean, or Imax) is now anachronistic, given the huge literature on rainfall thresholds based on two variables.
Regarding the thresholds based on two variables, actually there is no need to calculate both E-D and Imean-D thresholds, given that they are analytically equivalent, being Imean=E/D. I can't figure out how different results are obtained for the two types of thresholds (I-D and E-D); they should have the same performaces).

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Line 170: actually, a threshold is represented by a point in the ROC space (the point is the TRP,FPR couple), so I believe that the area under curve is only a quadrangle. Please explain better this point. Being the thresholds represented only by one point in the ROC space, I would suggest using the distance of this point from the perfect classificatory point (upper left corner of the space, TPR=1, FPR=0) instead of the area under curve. You can find more details in https://doi.org/10.1016/j.geomorph.2014.10.019

Lines 179-182: actually, more simple and useful definitions are: TPR = TP/(TP + FN); FPR = FP/(FP + TN). I would suggest using these definitions instead of mentioning sensitivity and specificity.

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Passing to Section 3, regarding the regionalization, it is not clear how many empirical points are employed for calculating the thresholds in each of the 11 regions. Please add this information and discuss possible limitations in case of thresholds based on too few points.

Figure 6. Please note that the thresholds should have duration ranges based on the minimum and maximum durations of the triggering events. Theoretically, you can't draw a threshold in a duration value when you don't have a triggering event. This allow also avoiding having very low values of thresholds at long durations (see thresholds for Andes 4, 5, 6). Moreover, I would suggest correcting all the equations replacing Y and X with Imean and D, and replacing the "^" with a proper superscript.

Figure 7. Is there some physical explanation for the variation of the values of the 1-variable thresholds? In some cases, I see differences that seem not related to morphology or other environmental factors.

Technical corrections and suggestions

Abstract: I would use the present tense in the abstract

I would use rainfall instead of precipitation everywhere in the text.

Line 24: "Terrain saturation is the original cause of landslide occurrence". Actually, this depends on the type of landslides.

Line 33: perhaps the correct reference is Segoni et al 2018 (already mentioned), not Segoni et al 2014

Line 36-39: The sentence "For example, global thresholds have been developed based on antecedent precipitation indices (Caine, 1980; Guzzetti et al., 2008; Kirschbaum and Stanley, 2018), and national thresholds have been established under an empirical–statistical approach (Leonarduzzi et al., 2017; Peruccacci et al., 2017a; Uwihirwe et al., 2020)." is not correct. Actually, both the mentioned thresholds based on antecedent precipitation and the cited national thresholds are established using and empirical-statistical approach. Please review and correct.

Line 38: Note that there are two references to the work "Peruccacci et al. (2017)" a and b, which are actually the same.

Line 47: I would suggest using "slope" instead of "hillside"

Line 51: in relation to environmental subdivisions within a national territory, please consider also the work of Peruccacci et al. (2017) – already mentioned – which present several morphological, geological, meteorological, climatic subdivision of the Italian territory with the aim of defining rainfall thresholds.

Caption of figure 2. Delete "Methodology six steps"

Line 101: I suppose you wanted to write "is shown in Figure 2".

Line 185-186: please check syntax and grammar.

Line 196: actually, TSS varies between -1 and 1, as you correctly mentioned some lines above.

Table 3: I would suggest using always the same number of decimal places.