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Discussions

Interactive comment on "The role of antecedent soil moisture conditions on rainfall-triggered shallow landslides" *by* Maurizio Lazzari et al.

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This study addresses an important issue related to representing antecedent soil moisture conditions in thresholds for landslide warning systems. The manuscript has the potential to contribute to a growing body of literature to advance process understanding of landslide initiation and improve future development of hydro-meterological thresholds. The writing and figures are mostly clear, but some details are not obvious, and others are simply not provided. The manuscript was submitted as a brief communication, but I think it might need to be slightly longer to be fully informative. Although the study seems to be relevant and displays some promising results that could ultimately be of interest to readers of NHESS, the lack of rigor and important details is problematic. My primary concern when evaluating the technical merit of this work is the lack of details

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available about the data, modeling, and analysis used to develop the thresholds and arrive at the conclusions. Therefore, the manuscript should undergo major revisions to address the following general question and issues before the work can be evaluated further.

1. Information is needed about the size of the field area and the actual variables measured.

2. Details are missing about the model equations, input/output, physical parameters, parameterization or calibration, and spatial and temporal resolution.

3. The simulated soil moisture does not seem to be compared to any observed soil moisture data, so the accuracy of the model output is highly uncertain.

4. It is unclear how the various antecedent saturations were quantitatively evaluated to select the significant value of 0.70.

5. It appears that the thresholds for >0.70 and <0.70 were optimized by identifying a best-fit line through the landslide data, rather than identifying a threshold that distinguishes between landslide and non-landslide events. This is highly unusual and needs to be justified.

6. Furthermore, there does not appear to be any quantitative analysis of the threshold performance for predicting landslide events, such as ROC analysis or other statistical metrics.

In addition to these general concerns, the following specific comments are worth noting in the revisions.

The abstract needs to focus more on the actual study and results. The motivation is important, but an informative abstract should include a clear description of the methods and state the primary contributions.

P1,L11. Preventing landslides seems like a nearly impossible goal and beyond the scope of this study, but reducing the losses and impacts is more achievable through developing better landslide thresholds for early warning. That is the focus of this work.

P2,L1&4. The Mirus et al. 2018a,b references might be more appropriate to cite in line 1 as we actually developed new thresholds that improve predictive capabilities, though they do not explicitly consider rainfall I/D. Also consider adding Thomas et al., 2018, Geophysical Research Letters, doi:10.1029/2018GL079662, which uses a deterministic approach with infiltration simulations to identify rainfall-saturation thresholds.

P2,L8-9. Thomas et al., (2018) also does a nice job of quantifying the sensitivity of thresholds for different hydraulic and strength properties in relation to rainfall-saturation thresholds, though it doesn't deal with I/D directly. Godt et al., 2006 directly examines how antecedent moisture index affects the accuracy of an I/D threshold. It is not clear how/why your objectives should be distinguished from these prior advances.

P2,L9. Question seems repetitive. To put it more simply: "How does the initial saturation impact ID thresholds?" However, upon reading the analysis, it seems it would be more accurate to state that the study "evaluates correlation between antecedent saturation and rainfall intensity during landslide events."

P2,L24. Consider providing the inventory with dates here and a table or link to appendix. Plotting landslide locations on the map in Figure 1 would also be great, though perhaps too busy. Figure 1. A scale bar or lat-long coordinates are needed for readers who are not familiar with this region.

P2,L26. Specifically, which meteorological variables are measured? At what timescale?

P3,L3. How are the variables calculated in equation 1? Is the model 1D or distributed in 2D or 3D? What is the spatial and temporal resolution of the model application?

P3,L7. What are the physical parameters?

P4,L17. The statement "... a linear decreasing trend between the rainfall thresholds and initial soil moisture. . .” is somewhat confusing because it is unclear whether Figure 3 intended to illustrate possible thresholds, or merely the decreasing linear trend between rainfall ID and antecedent saturation for landslide events?

Are these colored lines in Figure 3 supposed to be thresholds or merely plots that relate ID to antecedent saturation during landslide events? The y-axis is labelled I/D, but with units of mm/h. It seems that different I/D lines are plotted for uniform duration and different intensities, but the data portion of the plot is unclear. Are the dots data? Are they plotted for a specific timescale/duration? If these are thresholds, they aren’t very useful as it seems that about half the landslide events are below the lines.

P4,L18. What is “maximum rainfall” in this context?

P4,L27-28. How did you test different saturation thresholds to arrive at the value of 0.70?

P5,L1. Probability of what? Revise for greater clarity. Table 1 is not clear what the probabilities apply to. What does H1,H2,H3 represent?

Figure 4. Should label that the color bar represents antecedent saturation. I note that for longer duration storms the two thresholds cross, which means that longer storms are more likely to generate landslides when the soil is dry. I cannot imagine a reasonable physical explanation for this, which is problematic.

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