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Natural Hazards and Earth System Sciences
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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Comment 1_I've read your manuscript with interest, both because it concerns a research topic that is relevant to my studies, and because a landslide-rainfall inventory from my native region has been employed to validate the model you proposed. I must say that I agree with the remarks of the two reviewers about the format of your submission. In fact, I believe more details should be provided to understand and discuss your model, that cannot be contained by a short communication and seem better suited for a full research paper. Alternatively, I may suggest to prepare a substantial supplementary information file, to be attached to the paper, in which all the relevant details about the landslide-rainfall inventory and about the model can be presented exhaustively.

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Discussion paper

Replay 1_We would like to express our gratitude for the manifestation of interest and the comments provided. We agree with you and following your suggestion and also the requests of the referees, the manuscript will be reorganized keeping the format of short communication, but integrating with supplementary material the manuscript. In particular, we decided to provide the full database of the landslide events considered.

Comment 2_About the model itself, I believe that the success of I/D thresholds resides in their simplicity and in their empirical nature, so that large amounts of data are readily available for calibrating them, and monitoring data can be used straightforwardly in near real-time early warning systems. On the other hand, I/D thresholds do not say anything, directly, about the actual mechanism of slope failure that leads to the occurrence of landslides of any type. I believe, and I agree with you in this, that including information on soil moisture obtained from records of antecedent rainfall is one possible strategy to move from fully empirical to at least partly physically-based models, while maintaining the simplicity and immediacy of empirical-only models. On the other hand, I am sure the authors are aware that there is no straightforward connection in most cases between changes of soil moisture and slope instability. Soil moisture is not only markedly variable in space on the slope surface, but might also present significant gradients with depth.

Replay 2_The main objective of this paper is to define the possible role of soil moisture and saturation degree in the shallow landslides triggering, whose sliding surface is defined in the first few meters of depth, always bearing in mind, however, that the soil moisture is not the only factor that determines the evolution of the landslides but, in many cases it can be decisive as well as the lithological conditions, slope and aspect, vegetation coverage and the presence of a water table. The model proposed on a regional scale considers homogeneous soil moisture conditions in the space and in the first meters of depth in the areas affected by each landslide considered in the our database. Therefore, the considered antecedent soil moisture must not be confused with the specific distribution of soil water content in the slope, but it is representative of

the mean antecedent conditions that are neglected otherwise.

Comment_3 Of course, I understand that the model must be simplified when applied at regional scale, but at the same time I wish that the authors include some discussion about this point: i.e., when you speak of soil moisture, how do you relate it to the hydro-mechanical condition in the subsurface, where the strain localization that initiates landsliding actually occurs?

Replay 3_ The methodological approach used provides an assessment of the relationship between soil moisture and landslides on a regional scale, without considering the specific site conditions. A forthcoming extension of this research will aim to carry out a local downscaling to define the relations between I / D and the degree of soil saturation in the smallest territorial contexts characterized by the same climatic and lithotechnical conditions, in which the landslides inserted in our database have developed.

Comment_4 One additional remark I wish to make concerns the actual relevance of changes of soil moisture to landsliding. In fact, for landslides in which the shear zone is located even just a few meters deep, and which occur in clay-rich materials (which, again, is a common condition in Basilicata), the variation of soil moisture below the first 1-2 metres from the surface might be small or negligible throughout the hydrological year, and the shear zone might be always fully saturated. In such case, changes of soil moisture above the (potential) shear zone only have a limited effect on the stress state of the shear zone material, by changing the weight of the (potential) landslide body. However, this is only a marginal reason for landsliding, the most important one being the loss of suction or the increase of pore water pressures, that cause a decrease in the effective stress and consequently a decrease in the available resistance to shearing. I think this is a point worth of discussion for the significance and applicability of the model, also in relation to the landslide data set employed for its validation.

Replay 4_The mentioned processes is likely to occur and there may be cases were the inclusion of antecedent soil moisture condition do not provide any help in the descrip-

tion of the process. Our considerations are made at the regional scale and this may mask specific processes such as the one mentioned above. In a conceptual scheme, it would be hard to include this mechanism of predict them without a

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