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Interactive comment on "Probabilistic landslide ensemble prediction systems: Lessons to be learned from hydrology" *by* Ekrem Canli et al.

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Dear referee #3, dear editor.

Thank you for your comments and suggestions on our manuscript. We have addressed your general and specific comments below.

Kind regards,

The authors

Anonymous Referee #3

General comment

Printer-friendly version

Discussion paper

The article “Probabilistic landslide ensemble prediction systems: Lessons to be learned from hydrology” presents an analysis of ensemble prediction systems in order to apply them in the probabilistic prediction of landslide occurrence. The paper is very long, especially in the introduction. However, it is well written, in a good English language. It follows somehow the IMRaD structure, even with some drawbacks, that should be improved. The subject is within the topic of special issue of NHESS journal. In my opinion, the manuscript needs major revisions before being accepted for publication. Mainly, the theoretical background described in the introduction is extremely long! I suggest a strong revision of this part aimed at shortening it. The same is for the conclusions section, which can be shortened. There are some parts of the introduction that should be moved in the discussion. On the other hand, the description of the method used for validating the background is quite fast, as for the results and discussion. Moreover, it seems that the Authors applied a method different from that extensively presented and discussed in the introduction. All these issues should be addressed in the revised version of the paper.

REPLY: Thank you for your remarks. We agree that our introduction and conclusion sections are lengthy. During our manuscript revision we intend to focus on shortening these sections. We will also critically review whether some parts can be moved to the discussion section. Moreover, we will aim to make it clearer how the methodology applied in our case study relates to the concepts and methods reviewed in the first part of the manuscript.

Specific comments

At page 1, lines 28-30, Authors state: “In this paper, we use prediction systems synonymously with early warning systems for terminological consistency within the landslide community although we acknowledge that early warning should also cover dissemination and response strategies”. I strongly disagree with this terminological association. As acknowledged, an early warning system includes a prediction system and many other components. Thus, if the “landslide community” has used the two terms as synonyms since now, this paper could be a milestone in proposing a separation between them. I suggest to distinct the two items.

REPLY: Yes, we agree with this suggestion. In the revised version of the manuscript, the two terms will be distinguished.

Page 3, lines 23-24: Also, Intrieri et al. (2013) have presented a complete scheme for landslide early warning systems.

REPLY: Thank you for the suggestion; this reference will be included and we will highlight that Intrieri et al. (2013) provide a framework for the implementation of landslide early warning systems.

Page 4, lines 13-14: Please give some examples of prototypal landslide early warning systems.

REPLY: We will include a selection of prototypal landslide early warning systems with examples from New Zealand (Schmidt et al., 2008), Italy (Aleotti, 2004; Sirangelo and Braca, 2004), Japan (Sakai, 2008), Indonesia (Liao et al., 2010) and Germany (Bell et al., 2010; Thiebes et al., 2013).

Aleotti, P.: A warning system for rainfall-induced shallow failures, Eng. Geol., 73(3–4), 247–265, 2004.

Bell, R., Mayer, J., Pohl, J., Greiving, S. and Glade, T., Eds.: Integrative Frühwarnsysteme für Gravitative Massenbewegungen (ILEWS) - Monitoring, Modellierung, Implementierung, Klartext, Essen, Germany., 2010.

Liao, Z., Hong, Y., Wang, J., Fukuoka, H., Sassa, K., Karnawati, D. and Fathani, F.: Prototyping an experimental early warning system for rainfall-induced landslides in Indonesia using satellite remote sensing and geospatial datasets, Landslides, 7(3), 317–324, doi:10.1007/s10346-010-0219-7, 2010.

Sakai, H.: A warning system using chemical sensors and telecommunication technologies to protect railroad operation from landslide disaster, in Landslides and Engineered Slopes: From the Past to the Future, edited by Z. Chen, J.-M. Zhang, K. Ho, F.-Q. Wu, and Z.-K. Li, pp. 1277–1281, Taylor & Francis, Xi'an, China., 2008.

Schmidt, J., Turek, G., Clark, M. P., Uddstrom, M. and Dymond, J. R.: Probabilistic forecasting of shallow, rainfall-triggered landslides using real-time numerical weather predictions, Nat. Hazards Earth Syst. Sci., (8), 349–357, 2008.

Sirangelo, B. and Braca, G.: Identification of hazard conditions for mudflow occurrence by hydrological model:: Application of FLaIR model to Sarno warning system, Eng. Geol., 73(3–4), 267–276, 2004.

Thiebes, B., Bell, R., Glade, T., Jäger, S., Mayer, J., Anderson, M. and Holcombe, L.: Integration of a limit-equilibrium model into a landslide early warning system, Landslides, 11(5), 859–875, doi:10.1007/s10346-013-0416-2, 2013.

Page 7, lines 1-3: I think that the time between triggering/propagation and collapse stages varies also according to the landslide types.

REPLY: Yes, this will be mentioned accordingly in the revised manuscript.

Section 7.2.1 is a description of a model, thus it should not be in the "Case study" section.

REPLY: In the revised manuscript we will split the chapter: 7 will introduce the modelling approach, and chapter 8 will describe the case study.

Page 11, lines 18-19: Recently, Tran et al. (2017) proposed an application of TRIGRS with a 3D model to analyze 3D slope stability.

REPLY: Thanks a lot for this remark – we will include the reference to Tran et al. (2017) in the revised manuscript.

At page 12, line 7, Authors state that they computed 25 model runs. At page 13, line 20, they refer to 24 model iterations. Please explain.

REPLY: The figure only shows 24 model runs out of the 25 completed iterations. For the revised manuscript, we will modify the figure to only show 6 or 9 selected model runs (as suggested in your comments). We will also explain that these only represent a selection of model runs to visualize the different modeling outcomes.

Please check all the brackets in the text: somewhere, in particular in relation to references, there are many of them.

REPLY: We will check the brackets and delete the ones not necessary.

Please check the acronyms in the text. Use always acronyms after defining them.

REPLY: We will check all acronyms to make sure that acronyms are being used after they were introduced.

Figures

Figure 1. I suggest to add a map of the whole Austria with the indication of Lower Austria (for non-European readers).

REPLY: Yes, we agree. We will change the figure to also show an overview map of Austria.

I can't understand the meaning of the elevation classes. I suggest using a continuous scale.

REPLY: Thank you. We will omit the classified elevations and use a continuous scale as suggested.

Figure 3. This figure is extremely hard to see and read. It's quite impossible to see the differences between the different maps. I suggest to split it in 2 or 3 figures or to leave in the text just 6 or 9 significant cases and to put the other maps in an ancillary file.

REPLY: Thank you for this suggestion. We will follow this suggestion in our revision.

Figure 4. There are incongruities in the legends of "probability of failure" and "building

exposure”. As an example, a pixel with probability of failure (or building exposure) equal to 0.25 is in the first or in the second class? The same for values equal to 0.50 and 0.75. Please correct them including or excluding the extremes in the classes as appropriate.

REPLY: Thank you for pointing this out. We will change the class breaks during the revision.

Why the forested areas are reported in the map? Figure 5.

REPLY: We will omit the forest area in the revised version of the figure. In addition, we would like to add a hillshade to the figure so that the reader gets an impression of the topography.

As for the previous figure, I suggest to correct the incongruities in the legends and to explain why the forested areas are reported in the map.

REPLY: As in our reply to your comments on figure 4, we will correct the legend of this figure and omit the forest in the revised version of the manuscript.

I can’t understand the symbols used for indicating landslide head scarps. If two dimensions are not needed, I suggest using a point layer.

REPLY: We chose this symbol to increase the visibility of the landslide points. However, following your suggestion, we will use a simple point symbol in the revised figure.

TECHNICAL CORRECTIONS

Page 3, line 14: please delete “p. 1”.

Page 3, line 16: please delete “p. 1”.

Page 9, line 1: please correct “this event”.

Page 10, line 16: please correct “km2”.

Page 10, line 18: please change “,” into “;” in the references.

Page 13, line 10: insert “of” in “representation surface topography”.

Page 16, line 30: Replace “a couple” with “some”.

Page 18, line 7: correct “landslides types”.

REPLY: All technical corrections will be carried out as suggested.

REFERENCES

Intrieri, E., Gigli, G., Casagli, N., and Nadim, F.: Brief communication “Landslide Early Warning System: toolbox and general concepts”. Nat. Hazards Earth Syst. Sci. 13, 85–90, doi:10.5194/nhess-13-85-2013, 2013.

Tran, T.V., Alvioli, M., Lee, G., and An, H.U.: Three-dimensional, time-dependent modeling of rainfall-induced landslides over a digital landscape: a case study. Landslides, doi:10.1007/s10346-017-0931-7, 2017.

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