Nat. Hazards Earth Syst. Sci. Discuss.,
https://doi.org/10.5194/nhess-2019-125-RC2, 2019

Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Dynamic path dependent landslide susceptibility modelling" *by* Jalal Samia et al.

Anonymous Referee #2

Received and published: 6 September 2019

Summary

In this manuscript the authors present a landslide susceptibility analysis for a study area in Italy based on a multi-temporal landslide inventory employing logistic regression. They introduce two new spatial variables to account for past landslides and conclude that based on Area Under the Curve and Akaike Information Criterion metrics models considering the variables reflecting the landslide history perform better than a more conventional model based on digital elevation model (DEM) derived variables.

General remarks

The paper is written in good English and it is well structured. The concept of path dependency is introducing a new idea to landslide susceptibility mapping, and it is

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interesting to see that this phenomenon manifests in the data.

It should be noted though that this is the fourth publication of the authors with the same dataset for a small study area. I know that such multi-temporal datasets are scarce, but in order to prove the idea I think it is also important to test the concept with other datasets rather than introducing yet another tweak in the methodology.

It is also hard for me to follow the interpretation and conclusion that the models considering path dependency are “substantially” better than the conventional one. With the information provided I consider it hard to take a decision at all, but I would tend to rate the conventional model as the best, see also my comments below.

I think it is necessary to also show the detailed susceptibility maps of the conventional model to be able to compare the spatial performance. In the end, it is important that a model is making sense in the spatial context to see if it is plausible and useful on an operational level. In all path dependent susceptibility maps it is obvious that the path dependent variables clearly dominate the spatial distribution of landslide susceptibility (bullseye artifacts). Are those “hot spot” susceptibility maps useful in practice? Are the models well-balanced? The conventional model probably has a poor variability as it only contains DEM derived variables. What happens if more fundamental information is introduced, like lithology? I understand that it was intended to use a model with minimal data requirements, but it also hast to be demonstrated first that this works comparing it to a more complex dataset.

The methodology is also not completely clear to me based on the explanations provided. Were models produced for different time slices or only one model for each parameter set? See also comments below.

To sum it up, although I believe the idea of the authors to introduce landslide history in susceptibility modelling is interesting and the paper is well written, I do not agree with the main conclusions based on the information provided. Thus, in my opinion more information and a more critical discussion are required for publication. Please

find some more detailed comments and suggestions below.

Specific comments

Methodology:

E.g. L 94-98: To better understand the whole concept it would be good to understand how the authors define “follow-up landslides” and if/how they are for example discriminated from reactivated landslides.

L 112-113, Fig. 1: Is this figure not taken from Samia et al. 2017a or b?

L 183, Fig. 5: The figure is not referred to in the text. Is it correct that the arrows on the left point from the start to the results? Are they not supposed to start at the Smoothed STC sketch?

L 205-215: I am not sure if I understand the composition of the training and testing data and the whole procedure. Were the models trained on a single time slice from L 201 each and then tested with the subsequent testing time slice from L 202? Then 10 samples were taken for each time slice? How were the results in tables 1 and 3 generated from the different time slice models? Maybe the methods section could be put more clearly.

Results and discussion:

L 218-219: Is it possible to show a map of what the variables reflecting the path dependency look like spatially?

L 225, Fig. 6: What does the color code represent?

L 228-230: Isn’t a spatial scale of 60 m quite small? Because 60 m can be below the size of a single landslide. Are these new landslides or reactivated ones?

Table 1, Table 3: Are the results available for different time slices? It is unclear to me which results are presented here. Is this a summary of all time slice models? Or the

best models?

Section 5.2, Table 3: I do not agree with the interpretation that the conventional plus path dependent and path dependent models are substantially better than the conventional one. The conventional one has slightly more hits and less misses (false negative). In my opinion, false negatives are more critical than false positives, which actually contribute to a better zonation when the goal is not the accurate detection of landslides but the identification of susceptible areas. It would be interesting to see also the susceptibility maps (like figures 8 and 9) for the conventional models to be able to better compare their spatial performance. Success rate curves plotting the distribution of landslides over the susceptibility classes would add more information.

L 235-237 and L 339-341, using only path dependent variables: I do not understand, why should we want to predict landslides just based on past landslides? Firstly, at this point multi-temporal landslide inventories are rarely available and secondly, this is in my opinion in disagreement with the fundamental paradigm of data-driven landslide susceptibility analysis, which is deducing landslide occurrence from independent variables. Also, the susceptibility maps based on the path dependent variables only have extreme bullseye effect artifacts and I doubt that the maps are in this form useful for practical implementations.

Figures 7, 8 and 9:

- the maps would be easier to interpret with a hillshade in the background and the outlines of the corresponding training and/or test landslides, which are required to assess the spatial performance of the models.

- it is a good idea to show the distribution of the susceptibility classes, but pie charts are not very effective for comparing multiple part-to-whole relationships. They are inconvenient to read and it is hard to perceive the quantitative relationships. Bar or column charts would be more suitable.

- why are there blank/white areas in the maps containing path dependent variables?

L 345: I think this should be the map on the left in Figure 7.

L 347-349, usage of landslide susceptibility maps for amount of time of landslide inventory: I think this is hard to generalize and depends on the task, but for sustainable planning of resilient urban areas I would rather counsel time-insensitive susceptibility models based on intrinsic parameters. Figure 10: I do not understand what hypothetical means. Is this graph based on real data or is this just a sketch?

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