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Natural Hazards and Earth System Sciences
Discussions

Interactive comment on "Estimation of the susceptibility of a road network to shallow landslides with the integration of the sediment connectivity" *by* Massimiliano Bordoni et al.

Anonymous Referee #1

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The work is an interesting contribution to the journal, and it provides new insights on the relationship between roads and landslides, from a land management point of view. I have, however, some major concerns that should be addressed before the paper is ready for publication. My concerns are mostly related to the model construction and evaluation. According to the manuscript, the variables of the model were selected using the AIC criterion, but the authors do not explain which one: the backward approach, the forward one or the backward-forward? In the Forward method, one starts with an empty model, and iterate over all features. For each feature, the model is trained, and one select the feature which yields the best model according to a specific metric. Similarly, further features that yield the best improvement when combined with the

already selected ones are added. In the backward method we start with all features, and iteratively remove that one whose removal least hurt the performance, or leads to the biggest improvement. Therefore, the models selected by forward selection or backwards elimination might not be the same, even using the same model selection criterion. Also, the authors do not specify what criterion is considered to define the 'best' model achieved when adding/removing a feature. They only speak about the final performance of the model but do not provide any comparison between results obtained by adding or removing variables.

A further question arises: what's the reason behind choosing 80% as the threshold for variable acceptance? There is no justification for this choice, aside from an author preference. While I do understand that 80% is a high number, what is the difference in the quality of the results at the change of this threshold? The authors should consider this a bit more in detail [i.e. as for the previous point, does removing/adding one variable or the other improve the results significantly? What if we select variables chosen more than 50% or 90% of the times?]. Addressing these two points would also improve the discussion in Chapt .4.2.1.

Another point is that currently there are no rational formulations for the indices that are kept or removed, other than the fact that they are a mathematical construct. What I mean is: is there a physical meaning behind the rejection or acceptance of such parameters? The description of the IC for the area helps to interpret its importance in the model, and the reason behind the increased quality of models that do include it in one way or another. However, the authors should also describe the other indices about the road network in their study (not just as a general statement on why they are important, as done in Chapt. 3.1.1), to justify their choice or confirm the model assumption. This would also help 'balance' the paper more: as of now, the focus on connectivity seems unbalanced, and similar to the previous work by (Persichillo, Bordoni, Cavalli, Crema, & Meisina, 2018).

Some minor comments arose as I read the manuscript.

English needs polishing. Some parts are too 'colloquial' (e.g. '' It is also worth noting that") or have some English mistakes, mostly in the first part of the manuscript e.g. "the evaluation of the importance of considering or neglecting sediment connectivity" is redundant, you can simply state 'the importance of considering sediment connectivity'. Line 31 p 3: "in the routes distribution that could be affected by shallow landslides" > is the distribution affected by shallow landslides or are the roads affected by it? Line 29 p 4. "The road sectors were built in correspondence of the valley floors or hillside, cutting a portion of a hillslope in correspondence of its medium part realising a halfway road" > this sentence is not clear, what Is a halfway road? Medium part of what, of the hillslope? Line 6 p 5: '30% of these shallow landslides WERE triggered in vineyards,' Line 10 p 5. What is a b2 type? Line 19 p 9 'to discriminate affected or not road sectors' this is redundant. It is clear that by discriminating affected road sections, it would remove those not affected.

Abstract needs rewording. Some concept are introduced without the reader knowing what they are, e.g. 'The random partition of the dataset used for building the model in two parts (training and test subsets), within a 100-fold bootstrap procedure.'

Literature in the introduction could be improved, e.g. about road networks and landslides (Bíl, Andrásik, Kubecek, Krivánková, & Vodák, 2017; Donnini et al., 2017; Hearn, Hunt, Aubert, & Howell, 2008; Martinović, Gavin, Reale, & Mangan, 2018; Penna, Borga, Aronica, Brigandì, & Tarolli, 2014; Postance, Hillier, Dijkstra, & Dixon, 2017; P. Tarolli, Calligaro, Cazorzi, & Dalla Fontana, 2013; Paolo Tarolli & Sofia, 2016) and about road-landslides and climate changes (Klose, Auerbach, Herrmann, Kumerics, & Gratzki, 2017; Michaelides, 2014; Strauch, Raymond, Rochefort, Hamlet, & Lauver, 2015)

Line 30 p 5: slope aspect (ASP), slope curvature (CURV) > these would be better defined as simply aspect and curvature. Also, what is the 'slope height'? Line 10 p 6. Why using the multiflow algorithm? Wouldn't it be more consistent to use the D-Infinity since the sediment connectivity is also computed through D-inf, which is more accurate and

less dispersive, especially on hillslopes? Line 15 p 6: why not considering a geodesic distance or a 3d distance, rather than a simply Euclidean distance? I'd assume that on a hilly slope, a 3d distance might be very different from a Euclidean one. Also, was this distance evaluated considering possible flow direction? I would assume that the possible direction/movement of a landslide would follow topography, and more specifically a shortest topographic travelling distance, rather than a simple 2d distance to the road network. Thus a 3d topographic distance might be more appropriate as a vulnerability index. Also in this paragraph, 'lowest distance' should be 'shortest distance.' Line 15 p 9: is there a reference for this holdout bootstrap method? Line 2 p 10: a buffer of 5 m from the middle of each road sector > what's the reasoning behind this buffer? Is this in line with the road size? Should it be varied considering main roads or minor roads?

The first paragraph of the discussion is not needed. It is a repetition of the introduction. Line 10 p 14. The authors state '' Instead, the proposed approach helps in filling the gaps and the limits still open in the definition of a reliable and, potentially, repeatable methodology.". However, I do not see how this was demonstrated. The method was replicated in their study case, so it is not that different from the previous literature they mentioned, where the methodologies were "developed and tested for particular geological/geomorphological settings." Line 13 to 19> this is not about the current work. If anything, this should be mentioned when the authors justify the choice of the data-driven method, but it is not a result to discuss. Line 7 to 15 p 15> this again is not about the current work. It should be eventually mentioned when the authors justify the choice of the IC, or to highlight similarities between their results and the mentioned works, which is not the case currently. Line 15 p 16 "They are in a buffer of less than 250 m, in particular between 50 and 200 m, respect to sectors hit in past, and they present morphological and connectivity features similar to threatened traits." > shouldn't the authors also include these locations (sectors hit in the past) in their assessment as reference data? If their model is meant to be feasible outside their study area and not the case-specific, it should be able to identify correctly all the elements, not only those triggered in one specific event. The first paragraph of line 17

> ‘Hence, more detailed scenarios of susceptibility changes about land use changes will take into account also for the morphological modifications linked to these changes, also using a higher resolution DEM (less than 1 m).’ is this a future research line or a result?

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