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## Comment on nhess-2022-43

Anonymous Referee #2

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Referee comment on "Hazard Assessment of Earthquake-Induced Landslides Based on a Mechanical Slope Unit Extraction Method, A Case in Ghana" by Peter Antwi Buah et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2022-43-RC2>, 2022

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In this paper, the authors claim that available methods used to generate slope units have some significant drawbacks. To address those issues, they propose a technique called mechanical slope unit extraction. Specifically, they focus on an area in Ghana where they claim that earthquake-triggered landslides could provide a good case study to prove the validity of their approach.

Overall, slope units are widely used in landslide susceptibility and hazard assessment as an alternative landscape partition to grid-cells. In this regard, the manuscript has a reasonably good motivation. However, there are some fairly large points that I believe need further consideration. Below, I outline two main points to address before giving some detailed line-by-line comments.

Main comments:

- 1- Unfortunately, the manuscript was not written well and this affected my revision as a whole because I had a hard time following the flow and messages the authors are trying to convey. There are some terms (e.g., conventional, hydrological and mechanical methods) that are not really well explained but continuously being used throughout the manuscript. I am sure the authors are clear about what they are referring to but unfortunately the same is not valid for the readership. Also, the structure of the manuscript is a bit "out of ordinary". There is no flow like introduction, study area, data, method, results, discussion and conclusions. This also makes the text difficult to follow.
- 2- I am quite surprised to see that there is no landslide inventory or a specific earthquake the authors examined but still the manuscript is evolving around earthquake-induced landslides. I still do not understand how this could be possible. I might have missed something because of the reasons I mentioned above. However, taking this possibility aside, I do not understand the rationale of the manuscript. If there are no landslides triggered by earthquakes, the whole promise of the manuscript is just hanging in the air. I was planning to provide comments in detail for the entire manuscript but after realizing these issues mentioned above, I cut it short because, with all due respect to the authors' labor on the manuscript, I have to say those small revisions would not be adequate to make it publishable. Still, below I've included some of my line-by-line suggestions.  
Lines 17-18: "Landslides occur on slopes and have been the rationale behind making earthquake-induced landslides and seismic engineering a scientific and national demand". It is not clear what you mean here.  
Line 18: "its evaluation provides general estimates of future earthquake-induced landslides" Do you mean evolution of earthquake-induced landslides? What do you mean? Or are you referring to the evolution of techniques that we use to assess landslide hazards

or something? This line is not clear. Please revise and express it in a clearer way.

Line 21: You can still examine historical landslide catalogs and address some research questions even today, right? What do you mean? Do you think it is not an old fashion approach?

Lines 22-23: "current scientific and engineering stability analysis models" What are you referring to? Could you please be more specific?

Line 24: "The statistical method" Are you referring to a statistically-based method developed to assess landslide susceptibility? What sort of method are you referring to? Please be more specific. Also, from lines 24 to 28, you do not say "such as" each and every time. You can just say, for instance:

multivariate statistics (i.e., Logistic Regression, LR; Atkinson & Massari, 1998)

Btw, I also noticed that you do not refer to, for instance, the logistic regression later on in the text. If this is the case, you do not need to indicate the abbreviation either.

Line 29: "The robustness of the statistical method is, however, suspect". Of course, there is no perfect model. But you can not say that "The robustness of the statistical method is, however, suspect". Based on what? You can be critical for sure and mention some uncertainties, but not like this. Please revise the line.

Line 29: "statistical method generates landslide maps" What do you mean? Do you mean "landslide susceptibility maps"? You are resisting saying what we are really talking about. Susceptibility? Hazard? Or something else?

Lines 29-31: "Because the statistical method generates landslide maps by using a combination of maps generated by different control points that are assumed to be conditionally independent of each other, thus questioning its accuracy". What does this mean now? I have a hard time following the logic behind your argument. You are saying they are mostly using predictive variables which suffer from multicollinearity and this is why outputs of the statistically-based method have some accuracy issues? Then please say it clearly. Btw, I would say this is quite a minor issue among many others regarding the statistically-based method and actually, there are ways to deal with this issue in the literature. If you would like to be really critical, you should come up with better arguments/stronger. Also, are you sure that these papers support your argument (e.g., Youssef & Pourghasemi, 2021). Or these are the examples that you think that they are clearly representing the problem you mention.

Lines 31-32: "Recent engineering earthquake induced landslides and displacement analysis...(Rathje et al., 1998; Jibson & Keefer, 1993; Saygili, 2008)" these do not sound "recent" to me. Btw, please rewrite the line, there is no such thing called "engineering earthquake induced landslides". Also, "analysis" should be "analyses".

Line 34: "Newark Rigid Dynamic Block Model" should be "Newmark's sliding block method". Please do the same corrections through the text.

Lines 34-36: "The precision of the Newark Rigid Dynamic Block Model cannot be misconstrued, as it produces a stronger correlation between the estimated sliding block displacement and the mapping location of the earthquake-triggered landslide". Please do not say "cannot be misconstrued" out of blue and please support your argument by citing the literature. This is quite a subjective statement I would say. As there is no perfect machine learning technique to assess the spatial distribution of landslides, the same is also valid for their physically-based counterparts. If you would like to list the pros and cons of both approaches, you have to do it in an objective manner. Btw, this may not be even required because I still do not understand where you want to go from here. Do we really need to list all these here? Are these relevant for this paper? There is a large literature associated with both approaches and no need to destroy or glorify one of them compared to the other. However, if you would like to do this then do it properly. For instance, how accurately can you identify geotechnical parameters to run a regional-scale landslide susceptibility/hazard analyses?

Line 38: Why is that the final stage?

Line 39: "achievable through slope Mapping units". Please first tell us what the slope unit is and why you prefer working with it. Also, please prefer using either "Slope units" or "mapping units" not both.

Line 40: You started using susceptibility (e.g., in line 39) and hazard (e.g., in line 40) terms and which is ok but do not use them as if you can use them interchangeably. They are not the same thing, right?

Line 42: "slope unit model" there is no model, just slope units. Also, if you are referring to slope units, it is more appropriate to cite papers that proposed slope units, not the ones that only used them based on available sources.

Line 44: "(Xie et al., 2003)" please remove the parentheses

Line 48: "the best mapping unit for earthquake-induced landslide and displacement analysis" Do you mean it is the best mapping unit specifically for earthquake-induced landslides? Why is that? How about rainfall-triggered landslides?

Line 48: "The slope unit method" Slope unit is not the method but the output of some landscape partitioning methods which you haven't mentioned yet.

Lines 51-54: Please separately cite the corresponding paper of each method you mention.

Lines 62-63: "The conventional watershed method for slope unit extraction" Please be specific and cite corresponding papers.

Line 68: "The application of the framework is validated in Ghana." Which earthquake is that?

Line 70: "The impact of cohesion  $c$  is negligible, therefore neglected" In which context? You did not say anything about the landslides you examined. You can keep this statement for your method section and better explain it there.

Lines 71-72: I did not understand what you mean here.