Response to Reviewer 2

September 13, 2022

We thank the reviewer for acknowledging our work, taking the time to read it, and giving suggestions to improve the work. We hope the reviewer will find our revised paper better suited for publication. We have highlighted changes to the paper in response to the reviewer's comments in blue in the revised article and in response to the reviewer's letter.

Reviewer Comments on the Paper

Dear authors,

I would like to express my appreciation on your work. I have read it with great interest and found the overall manuscript of particular scientific relevance for the geomorphology community.

Below I will summarize the manuscript content and later provide my feedback and suggestions, which I would like to stress here from the very beginning are very minor.

The manuscript deals with a very important topic, as it proposes a protocol to estimate the likely trigger of landslides from their shape and size characteristics. This is done by using a CNN architecture, which adds a numerical and methodological flavor to an article that adresses an important research question. In fact, as also stated by the authors, any attempt to predict landslides relies on previous information, this being usually expressed in polygonal inventories. However, often these inventories only provide the location of landlside occurrence and extent lacking to report the date. These inventories are usually geomorphological inventories (sensu Guzzetti et al. 2012) and they still represent the vast majority of the available inventories. This means that not knowing the date we cannot know the trigger responsible for the landslide occurrence, which is a fundamental requirement to then better understand the slope response over the whole affected landscapes.

Therefore, the protocol proposed by Rana and co-authors brings a very relevant tool for geomorphologists and for any other pratitioner, especially because of the way the authors opted to share their work through a python script. This is particularly important for repeatability and reproducibility.

Aside from this general overview of why I think this manuscript deserve to be published, specific elements support the same conclusion. In fact, the text

is extremely elegant and it flows nicely while reading it. I actually read it all in one go, which is something that not always occurs. In addition to the style and readability of it, I would like to stress the originality of the manuscript because to my knowledge at least, no other work has addressed the same issue, specifically with an open source solution to the problem. Also, the quality of scientific illustrations is very high. I am usually quite picky and yet I have no real comment to add, other that complimenting the authors.

We thank the reviewer for highlighting key innovations of our work. We hope landslide research community will find our work useful and further improve it.

In terms of feedback I can provide to improve the text, I have comments almost exclusively related to the literature review and what could be potentially added. One is that the authors refer to Taylor et al. (2018) in their text and rightfully so. But, at least for me a very similar if not better article has been recently published along the same lines that Taylor and co-authors introduced for the first time. The work I am mentioning is authored by Amato et al. (2021), where they also use a neural network architecture to explore landslide shape characteristics and infer on the landslide type at hand. This is even closer to your work because of the method they chose to use and I feel should be mentioned in your text. Another potential missing reference could be Lombardo et al. (2019), a paper where the trigger pattern has been derived from the inventory itself, although using a latent effect featured in a statistical model. Of course what you propose here is different but the question is basically the same: "How do I retrieve the trigger from the landslide themselves?". It is worth mentioning that I am the first author of that paper, therefore if you feel like I am imposing a reference, feel free to avoid my comment. I swear it is a genuine one, without a second interest to it.

Other than this minuscule details, your work is impecable to me and I would definitely be happy once I see it published in NHESS.

Again, congratulations. Kind regards,

Luigi Lombardo

References

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Lombardo, L., Bakka, H., Tanyas, H., van Westen, C., Mai, P.M. and Huser, R., 2019. Geostatistical modeling to capture seismicâshaking patterns from earthquakeâinduced landslides. Journal of Geophysical Research: Earth Surface, 124(7), pp.1958-1980.

We appreciate the reviewer's comment about the work and feedback to improve it. We have included all the additional essential references in our main paper. Also, We have added a new paragraph in the Introduction section explaining more about the importance of trigger information for landslides. We reproduce the added paragraph below.

"Landslide planforms are used to estimate the mobilized landslide volume, for example, estimating the potential sediment budget of a large landslide triggering events (Malamud et al., 2004; Fan et al., 2012). This type of scaling relationship between the area of landslide planforms to mobilized landslide volume allows comparing the impact of different landslide triggers, such as human versus earthquakes, in terms of the landslides triggered influence on landscape (Tanyaş et al., 2022). However, this area-volume scaling depends on the triggering mechanism of landslides. For example, an earthquake-triggered landslide has a different area-volume relationship than a rainfall-induced landslide. Hence, extracting the landslide triggers information could enhance the estimation capacity of landslide volumes (Moreno et al., 2022) and also help predict the size of co-seismic landslides for a given earthquake (Lombardo et al., 2021). Also, when the exact trigger is known, observed landslides help assess earthquakes' ground motion patterns when no seismic observation is available (Lombardo et al., 2019)."

References

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