Earth Surf. Dynam. Discuss.,
https://doi.org/10.5194/esurf-2020-36-RC2, 2020


Earth Surface Dynamics Discussions
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# *Interactive comment on* "Earthquake-induced debris flows at Popocatépetl Volcano, Mexico" *by* Velio Coviello et al.

**Anonymous Referee #2**

Received and published: 6 September 2020

General comments: Coviello et al. 2020, entitled "Earthquake-induced debris flows at Popocatépetl Volcano, Mexico" details the co-seismic landslides triggered by the M71 2017 Mexico earthquake and the subsequent debris flows induced by the succeeding rainfall. The manuscript presents a well-planned out geomorphological study comprising of remote sensing analysis, field investigations, grain size analysis of samples collected from the mass movements, and interpretations explaining the context, failure mechanisms, and characteristics of the co-seismic landslides and debris flow. However, I do have some significant suggestions which would be helpful for the authors to improve the presentation of their data and readability of the manuscript. I would suggest minor to moderate revisions following the comments below (also the same is attached as a PDF to ease the revision process). Specific comments: 1.



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Discussion paper

Focus: The manuscript is entitled “Earthquake-induced debris flows” but analyses both co-seismic landslides and subsequent debris flows induced by the rainfall. I would suggest the authors rethink the title as Mass movements at Popocatépetl Volcano, Mexico induced by the 2017 M7.1 Puebla-Morelos earthquake”. 2. Abstract: The focus and the contents of the manuscript are not clear from the abstract. The authors should emphasize that the cause of debris flows post-earthquake is also the rainfall that occurred between 17th to 19th September 2017. Further, antecedent rainfall would also be a key factor to destabilise the volcanic ash and pumice slopes with partial or complete saturation. The predisposing and initiation conditions detailed in the discussion part would better be reflected in the abstract as well. 3. Introduction: The authors introduced the earthquake-induced mass movements in general and provided a brief review of co-seismic mass movements in volcanic regions but only within Mexico or near the study area. As earthquake-induced volcanic mass movements occur in many other places i.e. during the 2018 Hokkaido Eastern Iburi Earthquake and the 2004 Niigata Chuetsu earthquake etc., I suggest the authors provide a paragraph briefly reviewing the earthquake-induced volcanic mass movements occurred elsewhere in the world similar to the 2017 M7.1 Puebla-Morelos earthquake. Please refer to (Sassa 2005; Yamagishi and Yamazaki 2018; Wang et al. 2019) 4. Factors (predisposing): The authors discussed the predisposing factors of the co-seismic landslides in a better way. I would also suggest the authors prepare and complete inventory of the landslides and perform a factor analysis in a GIS environment (would be too much for this manuscript but just a suggestion). By doing this the predisposing factors can be understood statistically including tectonism, earthquake acceleration, geology, stratigraphy, faults, distance to ridges and soil cover (if possible), etc. However, this is just a suggestion and not necessary to include them within this manuscript. 5. Failure mechanism: I commend the authors for the deep thoughts regarding the failure mechanism of pumice fall and volcanic ash deposits during an earthquake. By seeing the antecedent rainfall occurred before the earthquake, it is obvious that partial or complete saturation of pumice deposits are possible. Liquefaction of pumice deposits

is a well-known phenomenon. To elaborate more on the same, I recommend the authors discuss the failure mechanism compared to the case on the 2018 Hokkaido Eastern Iburi earthquake. Wang et al. (2019) and Kameda et al. (2019) provide detailed explanations of the fluidized landslides over pumice deposits. Further, as also suggested by Referee #1, please explain how the co-seismic landslide deposits were transformed into debris flows. Minor specific comments: 1. Line 48: Please mention here how the debris flows were transformed from landslides? With the help of antecedent and subsequent rainfall? 2. Line 65: Figure 1. Please add the coordinates to Figure 1(a) and (b). The units and fonts in Figure 1(c) should be magnified. Overall, please improve this figure. 3. Line 135: Figure 3. Please see is it possible to differentiate the co-seismic landslides and debris flow in this figure? 4. Line 218: Table 2: Would it be better to show the grain-size in a figure? 5. Line 361: Figure 12: Please see, if you can include the effect of rainfall and partial saturation in this conceptual diagram? Technical corrections: 1. Grammatical errors and some spelling mistakes are spotted here and there. Please check them thoroughly. 2. Figure 12: Please correct the spelling for debris flows in (3). Suggested references Kameda, J., Kamiya, H., Masumoto, H., Morisaki, T., Hiratsuka, T. & Inaoi, C. 2019. Fluidized landslides triggered by the liquefaction of subsurface volcanic deposits during the 2018 Iburi–Tobu earthquake, Hokkaido. Scientific reports, 9, 13119, doi: 10.1038/s41598-019-48820-y. Sassa, K. 2005. Landslide disasters triggered by the 2004 Mid-Niigata Prefecture earthquake in Japan. Landslides, 2, 135-142. Wang, F., Fan, X., Yunus, A.P., Siva Subramanian, S., Alonso-Rodriguez, A., Dai, L., Xu, Q. & Huang, R. 2019. Coseismic landslides triggered by the 2018 Hokkaido, Japan (M w 6.6), earthquake: spatial distribution, controlling factors, and possible failure mechanism. Landslides, 1-16. Yamagishi, H. & Yamazaki, F. 2018. Landslides by the 2018 Hokkaido Iburi-Tobu Earthquake on September 6. Landslides, 15, 2521-2524, doi: 10.1007/s10346-018-1092-z.

Please also note the supplement to this comment:

https://esurf.copernicus.org/preprints/esurf-2020-36/esurf-2020-36-RC2-supplement.pdf

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