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Reply on RC2

Karma Tempa et al.

Author comment on "Sensitivity analysis of input ground motion on surface motion parameters in high seismic regions: a case of Bhutan Himalaya" by Karma Tempa et al., Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2021-279-AC2>, 2022

Reviewer #2

Authors have presented a research on Sensitivity analysis of input ground motion on surface motion parameters in high seismic regions: A case of Bhutan Himalaya. This paper is most like a lecturing note has serious drawbacks in both poor presentations and applied technics. This paper deals with a very known approach without any new contribution. A critical drawback of this work is that the reliability of the collected geotechnical data was not comprehensively reviewed. The paper is well structured and written, however, considering the quality of the paper and uniqueness of the research, I have concluded that the manuscript is not suitable for publication in Natural Hazards and Earth Science Systems.

Response: We appreciate the reviewer's efforts for putting forth such insightful comments and critiques. Despite the darkness observed by the reviewer in totality, we assessed all the comments and concerns raised by the reviewer and conclude that we can fairly meet the expectations of the reviewer. Thus, we would like to submit the revised version of the manuscript. The reviewer notes that the paper is like a lecture note, but we would like to draw the attention of the reviewer that limited work is done in Bhutan Himalaya, which makes understanding of seismic site effects pretty underrepresented when compared with the global landscape. To have a comprehensive discussion, we have tried to include as much details as possible as and when required. We agree that the reviewer on the use of very well-known approach but our data and study region are completely new and surely the eastern fringe of Himalaya, which is kind of hotspot for several moderate to strong earthquakes, can have benefit of this study. And regarding the comment from the reviewer on "without any new contribution", we firmly object the idea and let you know that similar works are absent for the region. In terms of the query as raised on "reliability" we have used the government agency provided database and probably we are not accountable for reliability exhaustively. However, surely we will add comprehensive discussions on the collection process and mechanisms, citing pros and cons of the adopted procedure.

- Abstract and introduction are very general and there is no significant in the scientific border. There is ample room to improve the introduction as "Introduction" is actually

weak.

Response: We have noted the concern. We will present exciting abstract and introduction sections in the revised manuscript. Basically, developing a clear problem, approach, and critical discussions of the results together with the insights that could be instrumental for the region in the future. We will juxtapose published work with our own study to demarcate novelty and unique contribution too.

- Presenting facts is not sufficient for a journal paper, there needs to be more direction to the writing and evidence of critical analysis.

Response: We appreciate the reviewer for this wonderful comment. Indeed, we agree with the point. However, we do not believe that just facts are randomly reported in the paper. We will undoubtedly insert critical discussions despite facts and results in the revised manuscript.

- Authors highlighted anomalous damage patterns in various parts of Bhutan due to the earthquake but failed to present any data or photos etc. to highlight the damage.

Response: Thanks for your concern. Anomalous damage patterns cannot be shown directly with image rather can be reported citing the soil condition only. By anomalous damage, we mean to state that far field damage was sometimes more prominent than the near-field one. To this end, we cited anomaly. We will update the discussion in the revised manuscript.

- Some of the statements presented in the manuscripts are contrary to each other.

e.g. Abstract:....this study is the first attempt to quantify the influence of the 14 local site conditions in the eastern fringe of the Himalaya...

Introduction: In Bhutan, very few studies on local seismic response analysis have been 34 conducted so far. Some of the recent studies

Response: We appreciate the reviewer's concern. We will assure consistency throughout the manuscript in the revised version.

There are many others.....

- I do not see any earthquake greater than Mw 7.0 in Figure 1, but authors mentioned that records of past earthquakes in Bhutan are available since 1713 (Mw 7.0). Authors highlighted at several places that Bhutan is one of the most seismically active regions in the world.

Response: According to literature review, the statement "earthquake greater the Mw 7.0 since 1973" has been indicative. However, authors could use only USGS database starting from early 1900. The authors will check and revise correctly.

- Page 2, Line 49: Local site conditions during historical earthquakes in Bhutan were identified as the main cause of structural damage. Any documents or reference or photos?

Response: The authors intended to mention damages being caused due to its geographical and geological settings. The sentence will be revised to align the aim of the current study. The damages of structures refer to the recent earthquake of April 2020 and September 2009 earthquake. We have some

documental evidence only, which we re-interpreted to draw this conclusion.

- Page 5, Lines 129-140: Is this paragraph related to Seismicity and geological setting of the study area? There are some information which seem to be irrelevant for the article.

Response: The authors will improve this section based on the relevancy of the current study.

- Page 6: The groundwater table in the study area is shallow and varies between 0.5 m to 16.0 m. Are you still considered groundwater table at 16 meter as shallow depth? Please double check literature.

Response: The authors will check the depth variability interpretation through literature and revise the statement.

- Page 10, Line 195-196. The term liquefaction came out of nowhere.

Response: We appreciate this concern. The statement about liquefaction will be deleted in the revised manuscript.

- What about temporal variation of water table? Groundwater table is highly sensitive to rainfall. Did you consider it? It seems authors consider the groundwater table at the time of geotechnical investigation which can be random throughout the year. This could be attributed to wide range of groundwater table within small area.

Response: The investigation date is available. A revised map will have a legend according to the seasons; however, information regarding the investigation month is missing. We will add as much details as available in the revised manuscript.

Table 1 shows more than 100 soil samples, but authors presented only 7 particle size distribution curves. Where is PSD curve for Rinchending?

Response: The authors presented average PSD of each site for holistic representation of particle size. The Figure 6 (Zone II) is the Rinchending area that comprises four sites. We will provide annotation in the revised manuscript.

- Table 1: The dry density of soil sample is higher than the bulk density for Rinchending. Even I do not believe the cohesion of the sample having SPT-N value higher than 100 is only 0.18 kg/cm². Where is plastic limit and liquid limit values?

Response: We appreciate the reviewer for pointing this out. We will present the precise geotechnical investigation data in the revised manuscript and make necessary correction to the current version.

- Soil at Dhamdhara is described as coarse-grained sand with gravel/cobbles and rock piece but authors reported PI value. PI values at Rinchending and Dhamdhara is not reliable based on soil descriptions.

Response: We will confirm with the geotechnical investigation report and make necessary changes accordingly.

- Double digit for shear wave velocity is not required.

Response: The authors will remove this double-digit presentation of shear wave velocity.

- Quality of Figure 7 can be improved significantly.

Response: We will recreate Fig. 7 in the revised manuscript.

- Authors should present the profile of peak ground acceleration (PGA) for the locations presented in Figure 5.

Response: In Figure 5, two bore logs belongs to Zone I (larger area than Zone II) and one bore log in Zone II. The profile of PGA is presented one each from the two zones.

- The manuscript currently lacks a cogent argument / thread. This stems from the introduction, which lacks an aim.

Response: We will restructure and at large rewrite the entire manuscript for coherence, clarity, and conciseness.

- Could the findings in the study be applied to any countries or only adopt to Bhutan? Please describe the contribution of this study from the viewpoint of local characteristics and universal ones.

Response: The conceptual framework remains valid globally for similar soil conditions. The significance of such studies can be incorporated for similar seismic regions with comparable soil types.

- Why not consider one or two ground motion from earthquake in Himalaya?

Response: Since the current study is one of the preliminary studies in Bhutan to study the seismic site effects, further in-depth studies can be conducted in future considering earthquake in Himalayan region as advised. Recent studies have also shown applicability of synthetic ground motion where instrumental records are not available as in the case of Bhutan.

- Irrelevant self citation. Similarity index is quite high. Some of the text were copied exactly from the following paper and other reports.

Tempa et al. (2021). "Shear wave velocity profiling and ground response analysis in Phuentsholing, Bhutan" , Innovative Infrastructure Solutions.

Response: The authors will restructure the sentences.

- Page 17, Lines 282-287: This is like a lecture note, a very well-known statement.

Response: We will update the sentence.

- Figure 12, why not PGA profile is presented up to bedrock? I would suggest to present PGA profile in terms of amplification ratio or factor by normalized PGA of input motion. It will help to visualize the results.

Response: The PGAs illustrated in Figure 12 will be normalized and presented up to the bedrock.

Thank you.

