Natural Hazards and Earth System Sciences Discussions

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC1
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Comment on nhess-2021-279

Anonymous Referee #1

Referee 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-RC1, 2021

General comments

This paper presents the first attempt of local seismic effects assessment in Bhutan. Considering the small amount of input data available (i.e., no instrumental records of past earthquakes, reduced geotechnical characterization of soil deposits, etc..) this study represents a first and relevant step towards a possible future deeper seismic hazard assessment. However, several critical problems need to be addressed and explained to let the manuscript be accepted for publication.

Specific comments

- Introduction: This manuscript focuses on the study of seismic hazard more in particular on seismic site effects, however few lines and only one reference citation on site effects is reported in the introduction. A wider review of past studies focused on this topic needs to be integrated in the manuscript.
- Lines 113 – 117: This sentence does not seem to be consistent with Figure 2 since the geological formations falling in the study area (black square in Figure 2) are not the same reported in the sentence.
- Authors performed a reconstruction of the groundwater table in the study area considering 29 borehole data without indicating the season during which the data has been recorded. Reasonably, the groundwater table position varies during the year. An evaluation of the possibility of grouping borehole by seasons could help to refine the map, particularly in the area between Dhamdhara, Pipaldara abd Kabreytar and in that close to Rinchending.
- Lines 258 -259: "[..] low, medium, and high […]" with respect to what? Please specify in text
- Authors reported in Figure 11 the Fourier Spectra of the considering earthquake as Fourier Amplitude vs Period. It is common use to represent Fourier Spectra as Fourier

amplitude vs frequency, so this representation confuses the reader. It is opinion of this reviewer that just the X label is incorrect, but please check this figure and modify it consequently.

- Figure 12: This figure presents the variation of PGA induced by each earthquake at different depths in the soil. It could be more useful to present data by normalizing them to the maximum PGA of the earthquake input. Moreover, in case of Zone II the bedrock depth is fixed at 400m so Figure 12b should present data up to this depth.
- Authors performed a series of 1D linear-equivalent numerical modelling of eight soil columns representative of the study area and reported the results in Figures 13 and 14. They showed the response spectra at bedrock and on the surface. While results obtained by applying earthquake from M1 to M4 seem to be consistent, those obtained by considering M5 and M6 look anomalous. Furthermore, in the latter case the response spectra at the bedrock level are characterized by anomalous peaks at low period that are completely nullified at the ground level. I suggest the authors to check the signal processing of these earthquakes (M5 and M6) and verify the consistency with the input applied in the numerical simulations.
- All the presented results need to be more deeply discussed. Moreover, considering the shaking level of the seismic input and the typology of numerical simulation, the topic of non-linear behavior of the soil material should be addressed. This could also help for a better interpretation of the results (i.e. Figures 17 and 18)

Technical correction

- Line 24 -26: This sentence is not clear
- Line 86: Please specify which site effect you are investigating
- Line 186: This sentence is not correct.
- Line 189: This in-text citation is not present in the reference list
- Lines 359 - 360: This sentence is not clear.
- Line 396 – 398: This sentence is not clear.
- Are Baxa (Figure 2) and Buxa (Line 113) the same lithological group?
- Table 1: What "-do-" stands for?
- Figures 1b: The legend is missed
- Figure 2: Please add the location of boreholes reported in Figure 5. Moreover, north direction and scale are missed.
- Line 173 – 175: Acronyms should be explicitly reported in the manuscript.
- Line 195-197. This sentence about liquefaction and corresponding potential is out of the paper topic. Please delete it.
- Figure 3: The legend is not clearly legible
- Figure 7: The resolution of this figure is too low
- Figure 10 – 11: To improve the manuscript readability, these figures could be merged in a unique figure composed of two columns, one devoted to time histories and another to the corresponding FFT spectra.
- Figure 12: Colors chosen for Earthquakes M4, M5 and M6 are M6 are too similar. Please use more distinguishable colors
- Figure 13: Please add "bedrock" and "ground surface" as labels in the graph
- Figures 15 -16: Please specify how you calculated the red line FFT. Is it an average of the FFT values at each time step? Please specify in the text.
- Figure 17b/d – 18b/d: How have you calculated the "Response spectrum intensity" and "Mean frequency"? Please specify in the text
- All the figure's caption should be improved
- In-text citations need to be modified according to the journal guidelines.