

Reviewers' comments:

Referee 1

1. Weaknesses and Areas for Improvement:

While the study is comprehensive, there are several areas that require improvement to enhance the manuscript's quality. Firstly, the introduction could benefit from a more detailed literature review to contextualise the current study within the broader field of seismic hazard analysis. Secondly, the methodology section, although detailed, could be more clearly structured to ensure readers can easily follow the complex modelling processes. Additionally, while the study highlights the importance of fault segmentation and multi-segment rupturing, it would benefit from a more explicit discussion of the limitations of the models used and the assumptions made during the simulations.

Thanks for your review.

1. Expand the literature review to include more recent studies on seismic hazard analysis and multi-segment rupturing to provide a comprehensive background for the research.

Thanks for your recommendation! We added the recent studies on multi-segment rupturing seismic hazard analysis in Section 3. See Line 339 in our modified version.

2. Clarify the methodology section by breaking down the modelling process into more distinct sub-sections, each with clear headings and explanations.

Thanks for your suggestion! We divided the methodology part into section 3.1 and section 3.2.

3. Discuss the limitations of the study in greater detail, particularly the assumptions made during the modelling and their potential impact on the results.

Thanks! We added section 4.1 of "Model limitations and mitigation measures".

4. Include a section on future research directions, highlighting how the current study could be expanded or refined with additional data or more advanced modelling

techniques.

Thanks for your suggestion! We added the future research directions in the last paragraph in Line 737-746.

2. Research Gaps:

The paper identifies the lack of comprehensive seismic hazard models that integrate fault geometry and segmentation with historical seismicity rates as a significant research gap. While the study makes a substantial contribution towards filling this gap, further research is needed to validate the models used and to explore the potential for other fault systems to exhibit similar multi-segment rupturing behaviour. Additionally, the impact of climate change on landslide probabilities and seismic hazards in the region could be an important area for future investigation.

Thanks for your suggestion! We will focus on the impact of climate change on landslide probabilities and seismic hazards in the region in the next studies.

3. Missing References:

Several relevant references are missing from the current manuscript. These include recent studies on seismic hazard analysis, fault segmentation, and multi-segment rupturing. Incorporating these references would provide a more comprehensive context for the research and strengthen the validity of the study's findings.

Furthermore, I would like to kindly suggest that the authors incorporate references to a few previous studies that seem to have been overlooked. For instance, the phenomenon of multiple ruptures has been applied to the problem of tsunami generation, as demonstrated in the following article:

Dutykh, D., Mitsotakis, D., Gardeil, X., & Dias, F. (2013). On the use of the finite fault solution for tsunami generation problems. *Theoretical and Computational Fluid Dynamics*, 27(1–2), 177–199. <https://doi.org/10.1007/s00162-011-0252-8>.

Additionally, probabilistic methods have been applied to tsunami hazard assessment,

as illustrated in the manuscript: Rashidi,

A., Shomali, Z. H., Dutykh, D., & Keshavarz Farajkhah, N. (2020). Tsunami hazard assessment in the Makran subduction zone. *Natural Hazards*, 100(2), 861–875. <https://doi.org/10.1007/s11069-019-03848-1>.

It would be beneficial for the authors to examine the approaches utilised in the tsunami wave community and compare them with the methodologies applied in their study of landslide hazards. Incorporating these references will not only strengthen the context of the research but also provide a broader perspective on multi-segment rupture phenomena and probabilistic hazard assessment.

Thanks! We added these studies as the reference work in Line 332 to Line 354. We also referred the works of multi-segment rupturing on tsunamic studies in Line 348 and Line 349.

4. Language and Grammar Corrections:

The manuscript contains several language and grammar errors that need correction.

Here are some identified issues:

1. Page 3, Line 45: "the Eurasia Platea" should be "the Eurasian Plate."

Modified in Line 45.

2. Page 3, Line 46: "Plateau world highest" should be "Plateau, the world's highest."

Thanks! We modified it in Line 45.

3. Page 5, Line 80: "diverse rupture behaviors contributes" should be "diverse rupture behaviors contribute."

Modified in Line 80.

4. Page 6, Line 108: "resulting in notable errors" should be "resulting in significant errors."

Thanks! We modified it. See Line 107.

5. Page 8, Line 160: "increased precision and reliability" should be "increasing precision and reliability."

Modified in Line 156.