Authors' response to the reviewer's comments

Title: Tsunami Hazard Assessment in the South China Sea Based on Geodetic Locking of the Manila Subduction Zone

We are very grateful to the reviewer for the comments and suggestions to improve the manuscript. Following the reviewer's suggestion, the manuscript has been revised accordingly.

This is an important study which estimate the spatial distribution of tsunami hazard in the South China Sea based on Geodetic locking of the Manila subduction zone. The study should be published because the influence of geodetic locking on the distribution of slip is rarely considered on tsunami hazard assessment in the South China Sea region among the current researches. It can help to understand the influence of uncertainties of the seismic source on tsunami hazard assessment. The article is well organized and well written. The present manuscript only needs minor revision for Natural Hazards and Earth System Science publication with the following comments.

Response: Thank you very much for your review work and valuable suggestions. These will also be of great help to our future work.

Comments:

1. In general, the English of the text is good, but could be further improved. If you can, please ask a native speaker to polish the text to improve its readability.

Response: The text has been further polished.

2. At present, the abstract part does not give a good overview of the innovative points of the article. Please further summarize it.

Response: The innovation points of the article include providing a dataset of tsunami hazard in the South China Sea and considering the locking distribution in the analysis which make the slip distribution and assessment results more realistic. The abstract has been revised to include the innovative points regarding the impact of locking distribution on tsunami hazard assessment, as follows:

Moreover, the assessment results involving the effect of locking distribution should be more realistic, and show a larger tsunami height than only considering the stochastic slip in most areas, which prompt the coastal management agencies to enhance the tsunami prevention awareness.

3. Please check terminology consistency throughout the text. Such as "the maximum possible magnitude" and "the possible maximum magnitude", as we all know, they represent different meanings.

Response: The terminology consistency has been checked and the "maximum possible magnitude" has been uniformly adopted.

4. Line 258: "in the current researchs" should be "in the current researches"; Please

check out.

Response: “In the current researchs, the influence of geodetic locking on the distribution of slip is rarely considered” has been changed to “Existing studies rarely consider the influence of geodetic locking on the distribution of slip”.

5. In the introduction part, it will be good that the quantitative tsunami hazard assessment results from other researchers should be addressed and cited.

Response: Some researches about the probabilistic tsunami hazard assessment and their results at Hong Kong has been addressed and cited in the introduction part. For example, Li et al. (2016) studied the impact of uniform and heterogeneous slip distribution on the tsunami hazard assessment and the tsunami wave height with 1000-year return period of Hong Kong is about 2.0 m. Li et al. (2017) studied the role of upper magnitude limits in probabilistic tsunami hazard assessment and the tsunami hazard of Hong Kong at return period of 1000 years are about 0.5~3.5 m. Sepúlveda et al. (2019) conducted probabilistic tsunami hazard assessment focusing on the sensitivity to earthquake recurrence relationships, the maximum tsunami amplitude of 0.18 m is exceeded in Hong Kong with a mean return period of 100 years. Liu et al. (2021) considered the local and regional tsunami sources and the tsunami wave height of Hong Kong is 0.32 m for 475-year return period and 0.50 m for 975-year return period. Yuan et al. (2021) considered the tsunami source from both the South China Sea and the Northwest Pacific Ocean and the maximum wave amplitude of Hong Kong is about 2.5 m for 2000-year return period and 1.5m for 500-year return period.

6. The impact of source uncertainty on tsunami hazard assessment in Figure 3a, why does the authors use the 100-year return cycle as an example instead of 1000 years? In addition, we can find that the impacts did not have a consistent trend at different locations with the same heterogeneous slip scenarios. Please add possible reasons for the results.

Response: The map of tsunami hazard of 100-year return period and 1000-year return period were both obtained, but the manuscript only showed the results of 1000-year return period. In the comparison of Figure 3, the results of 1000-year return period are added. And an analysis is conducted on the differences in results between the tsunami wave heights of 100-year return period and 1000-year return period. At the same time, an analysis of the differences in the patterns of change at different locations is added, as follows:

When the return period is 100 years, the scenarios with the largest tsunami wave heights are those that only the Gaussian locking distribution is considered without the stochastic slip, with an increase of 21% at Hong Kong compared to uniform slip scenarios. When the return period is 1000 years, the scenarios with the largest tsunami wave heights are those that only the Gamma locking distribution is considered, with an increase of 60% at Hong Kong compared to uniform slip scenarios. In Gamma locking distribution, slip is assumed mainly concentrated in shallow areas of the subduction zone, which will increase the tsunami hazard when the range of earthquake rupture includes shallow areas of the subduction zone. For small magnitude earthquakes, only a small number of potential earthquakes are affected due to the small range of earthquake rupture. For earthquakes with large magnitude, most potential earthquakes are affected due to the large rupture range. When the recurrence period is short, the tsunami hazard level is mainly affected by small magnitude earthquakes, and the Gamma locking distribution produces a lower level of tsunami hazard due to the lower upper limit of magnitude in the south segment. When the recurrence period is long, the tsunami hazard level is affected by earthquakes with large magnitude, and the Gamma locking distribution that considers fault slip occurring in the shallower area of the subduction zone, may results in large tsunami waves. Meanwhile, the impacts of heterogeneous slip do not have a consistent trend at different locations. This is related to the propagation characteristics of tsunami waves. Different heterogeneous slip distributions cause the initial water field of the tsunami to concentrate in different region, thereby affecting the propagation of the tsunami wave. At specific locations, the amplitude of tsunami waves generated by highly concentrated slip may not necessarily be large. But by comparing the tsunami hazard in the overall sea area, similar patterns can still be obtained.

7. It might be good to provide brief discussions on the limitation of the present method of based on geodetic locking especially for tsunami hazard assessment.
Response: The limitation of the tsunami hazard assessment based on geodetic locking is provided in the Discussion and Conclusions. There is still great uncertainty in the geodetic locking and fault segmentation results in this study due to the limited understanding of locking and segmentation at present, resulting in limitations of the present method.