Response to referee comment 1

Evaluation: This is a good work and I think can be published. But the text is unclear in some places and misses important citations. It is important that authors clarify the items mentioned below, and add the suggested citations in order to make their work more international. My comments are given below. I look forward to reviewing the revised version. Best regards.

Thank you for your valuable comments. Our responses are summarized below.

(1) Abstract: Abstract is too long and is non-conclusive. Please try to add more quantitative results in your abstract. Also I suggest making your abstract shorter.

Thank you for your kind suggestion. We will add quantitative results in the abstract and make it shorter.

(2) Figure is very similar to author team another article (https://doi.org/10.5194/nhess-22-1267-2022). Please try to make this figure different from your already-published article.

Since this paper uses same tsunami simulation results written in our previous paper (https://doi.org/10.5194/nhess-22-1267-2022), some figures are cited from the paper. Some figures do not have citation information, we will add the information.

(3) L26: what is meant by "…are not very compatible with probabilistic…?" please clarify.

As you pointed out, this sentence is unclear. We will revise the sentence.

(4)

L33/34: For PTHA, to give more diversity to your citations, please add the following two good articles: “Gopinathan et al. 2021” and “Heidarzadeh & Kijko 2011”.

Gopinathan, D., Hidarzadeh, M., Guillas, S. (2021). Probabilistic Quantification of tsunami current hazard using statistical emulation. Philosophical Transactions of the Royal Society A, 477, 20210180. https://doi.org/10.1098/rspa.2021.0180.

Hidarzadeh, M., Kijko, A. (2011). A probabilistic tsunami hazard assessment for the Makran subduction zone at the northwestern Indian Ocean. Natural Hazards, 56 (3), 577-593. https://doi.org/10.1007/s11069-010-9574-x.

L68: For the 2011 event please add a reference for clarity. I recommend the article by Prof Tsuji (Tsuji et al., 2011), as below:

Tsuji Y, Satake K, Ishibe T, Kusumoto S, Harada T, Nishiyama A, Kim HY, Ueno T, Murotani S, Oki S, Sugimoto M, Tomari J, Heidarzadeh M, Watada S, Imai K, Choi BH, Yoon SB, Bae JS, Kim KO, Kim HW (2011) Field surveys of tsunami heights from the 2011 Off the Pacific Coast of Tohoku, Japan, earthquake. Bulletin of the Earthquake Research Institute University of Tokyo 86:29–279 (in Japanese with English abstract)

L72: I think it is useful to add a line regarding the importance of this study. I recommend something like this: “The recent 2022 Tonga tsunami, which made global impacts (Heidarzadeh et al. 2022), showed that tsunami is an important costal disaster and studies like this work are needed”.

The reference is:

Heidarzadeh, M., Gusman, A., Ishibe, T., Sabeti, R., ŠepiÄ , J. (2022). Estimating the eruption-induced water displacement source of the 15 January 2022 Tonga volcanic tsunami from tsunami spectra and numerical modelling. Ocean Engineering, 261, 112165. https://doi.org/10.1016/j.oceaneng.2022.112165.

Thank you for your suggestion. We will add these references in the revised manuscript.

(5)

Figure 1: the color bar cannot be read. Please ensure they can be read easily and add a legend for them. Are they “Wave amplitude (m)?”, add them.

Spatial distributions shown in the Fig. 1 are just images, and color bars shouldn't have been included. We will delete them from the figure.

(6) L112: The 3D model is not clear? Please add a few references for that and explain more about it.

Because the explanation of the 3D model is written in detail in section 3 and the previous paper (Tozato et al. (2022)), we will add explanation to make this clear.

(7) L113: What is this boundary condition? Explain more about it by adding the boundary equation and a few references.

As you pointed out, the explanation of the boundary condition is inadequate. We will add a specific description of the boundary condition.

(8) L120: What are these data? Sea level? Velocity? Force?

In this study, the data indicate tsunami force and inundation depth. We will add explanation in the revised manuscript to make it clearer for readers.

(9) L131: what is Lamda_k? what is d_j? every parameter needs to be defined as soon as they are used.

d_j represents the contribution rate for mode j and λ_k represents the k-th eigenvalue. Although the explanation of λ_k is written at Lines 126-127 the explanation of d_j is not written in the manuscript. We will add the definition of d_j.

(10)
L139: again some parameters are not defined. Please ensure you define al parameters as soon as they are used throughout the text.

Since it is unclear that α_{ik} is a component of matrix $\boldsymbol{A}$, we will add this explanation.

(11)
L200-204: it is not clear why authors considered only slip and rake for uncertainty? Please clarify this and try to convince the readers? Why not depth while depth is a very important factor regarding tsunami energy? Please clarify.

As you pointed out, there are some other important uncertainty parameters, such as depth. However, since this study mainly aims to propose a framework for the probabilistic optimal facilities placement, we employed the simple calculation condition that was considered in our previous work (Tozato et al. (2022)). We ask for your understanding.

(12)
L203: regarding rake, you could refer to the following good articles that studied rake variations through teleseimic inversions (Gusman et al., 2014; Heidarzadeh et al., 2017):

Gusman, A. R., Murotani, S., Satake, K., Heidarzadeh, M., Gunawan, E., Watada, S., & Schurr, B. (2015). Fault slip distribution of the 2014 Iquique, Chile, earthquake estimated from ocean-wide tsunami waveforms and GPS data. Geophysical Research Letters, 42, 1053-1060. https://doi.org/10.1002/2014GL062604.

Heidarzadeh, M., Murotani, S., Satake, K., Takagawa, T., Saito, T. (2017). Fault size and depth extent of the Ecuador earthquake (Mw 7.8) of 16 April 2016 from teleseismic and tsunami data. Geophysical Research Letters, 44 (5), 2211–2219. https://doi.org/10.1002/2017GL072545.

Thank you for the valuable information. We will add these references in the revised manuscript.

(13)
Figure 5: I assume that the elevation is “Topography elevation (m)”. Please modify the legend.

Thank you for pointing it out. We will revise the legend.

(14)
L208: For the 2011 Tohoku data, add reference to Mori et al. (2011):

Mori, N., Takahashi, T., and The 2011 Tohoku Earthquake Tsunami Joint Survey Group, (2012), Nationwide post event survey and analysis of the 2011 Tohoku earthquake tsunami. Coastal Engineering Journal, 54 (1), 1-27. https://doi.org/10.1142/S0578563412500015.

Thank you for your kind suggestion. We will add this reference in the manuscript.

(15)
Figure 8: what is the color bar? Please write it in the figure next to the colour bar. This way the figure can be easier and readers can notice it instantly, instead of reading your caption.

The color bar in Figure 8 indicates the values of modes (eigenvectors) extracted by POD. The values are normalized so that the maximum absolute value is 1. We will add to the explanation in the manuscript.

(16)
L254: It is not clear how the maximum impact force is calculated? Please write the equation tat you used to calculate the impact force here. Also please add a reference for that equation that you used for force calculations.

In this study, the impact force was assessed with a 2D grid size of approximately 10 m. The force is calculated as a resultant force acting on surfaces of buildings in the two horizontal directions. In addition, since the maximum impact force is represented by evaluating the maximum value at each evaluation point regardless of the time. We will add these explanations to the manuscript.

(17)
Figure 10: what is RBF? Mention the full name in the captions.

We will add the full name of RBF (Radial Basis Function) in Figure 10.

(18)
Figure 11: mention the legend of the color bar in the Figure. Is that maximum impact force? Add it to the figure.

The values of the color bars in Figure 11 indicate the impact force and inundation as shown at (a) (b) below the maps. We consider that the legend is not necessary because “(a) impact force” and “(b) inundation” represent the explanation of the color bars. We ask for your understanding.

(19)
Figure 13: what is colour bar? Mention it in the figure.

It indicates exceedance probability. We will add the label near the color bar of Figure 13.