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Interactive comment on "Probabilistic Tsunami Hazard Analysis For Tuzla Test Site Using Monte Carlo Simulations" *by* H. Basak Bayraktar and Ceren Ozer Sozdinler

Anonymous Referee #2

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The authors have conducted a Probabilistic Tsunami Hazard Analysis (PTHA) of the strategic Tuzla area using Monte Carlo simulations. The work arrives at a $90\%/95\%$ probability of exceedance for $0.3m$ wave height for the next $50/100$ years. As an important ingredient for future hazard planning, this and the other results in the paper, showcase the relevance of such PTHA studies. As the authors rightly highlight in the conclusions, the PIF is very close to Tuzla and hence the tsunami arrival times are short. This further accentuates the importance of the hazard maps generated in this work for planners.

General comments

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Discussion paper

1. The paper needs major revisions to increase its readability and clarify the adopted methodology (*esp.* the MC simulations). The title of the paper contains the word *"Monte Carlo simulations"*. Hence, it is pertinent that the authors include a succint description of what they mean by the term and how they actually go about utilizing the MC methodology in the context of the paper. For example, any picture showing their sampling of the different parameters (magnitude and depth) would be helpful to the readers to visualize the different scenarios. Thus, in this regard, the current description in Section 2 is inadequate.

2. While generating the 100 scenarios for the MC simulations, the PIF fault is defined as a characterisitic fault. This crops up in many places in the manuscript. Is this choice because of computational constraints with the simulations or difficulties in applying the MC methodology to multi-segment ruptures or does the seismicity in the PIF does not warrant it? It will be helpful if the authors elaborate on this aspect/choice.

Specific comments on the technical content

1. Throughout the paper the tsunami wave height, inundation depth *etc.* are mentioned as hydrodynamic *"parameters"*. Since the term *parameter* is usually used for physical constants in a model, or for independent variables, it is suggested that another word (*e.g. quantities*) may be used instead.
2. Lines 38-39 – Inclusion of references for studies *"regarding the fault mechanisms, ... and triggered tsunamis"* will benefit the readers.
3. Lines 39-40 – Please consider merging or rephrasing the sentence *"The region is attractive ... mega-city."* as it seems to be a repetition of facts in lines 34-37.
4. Line 48 – Please expand the abbreviation PIF the first time it occurs.
5. Lines 44-45 – Figure 1 gives a nice overview of the seismicity in the region. In the inset figure inside Figure 1, the labels describing the general tectonic map of Turkey are not clear even after zooming in. Consider either enlarging the inset figure or increasing the fonts of the labels or increasing resolution of the image.

6. Lines 59-61 – It is not clear why the sentence *"Therefore, making ... quite difficult"* has been added. Does this difficulty somehow influence the methodology or modelling in the paper?
7. Lines 75-78 – Consider splitting the sentence *"After the 1999 Izmit ... megacity Istanbul"* for increasing readability and clarifying the flow of thought.
8. Lines 78-90 – The critical importance of the PIF fault in generating the next earthquake has been brought out nicely in this paragraph. Inclusion of concrete numbers/facts from Ergintav et al. will add strength to the argument.
9. Line 82 – Please list suitable references related to *"studies on historical tsunami records"* at the end of the sentence. Would it be possible to replace *"majority"* by a concrete number?
10. Line 86-88 – A restructuring of the sentence *"The recent one ... tsunami."*, would make this fact more readable.
11. Line 91 – Please list suitable references related to *"tsunami hazard estimation studies"* at the end of the sentence.
12. Lines 93-95 – A rewording of the sentence *"When focused on ... normal component"*, would make the argument clearer.
13. Lines 98 – Please list suitable references related to *"probabilistic seismic and tsunami hazard analyses"* at the end of the sentence.
14. Lines 105-107 – Consider restructuring the sentence *"However, probabilistic ... probabilistic studies."*, for better clarity. The reades will benefit more, if the authors can cite a few other reasons as to why a probabilistic hazard assessment is important.
15. Lines 107-109 – The difference of the current work from previous approaches needs to be made clearer here. I found it difficult to lock on to the unique contribution of the paper by reading this.
16. Line 128 – Please give the expansion of the abbreviation *"SPTHA"*.
17. Lines 127-131 – The sentence *"Such studies ... maps"* is quite long. Consider splitting it up for clearing the flow of the argument.
18. Line 137 – Please give the expansion of the abbreviation *"PSHA"*. The word

"should" is quite strong. Consider replacing it by a milder alternative or adding a sentence or two to justify its usage.
19. Line 139 – Please clarify the phrase *"passive margins"*.
20. Line 144 – Please list suitable references related to *"Paleoseismologic studies"* here.
21. Line 146-147 – It is not at all clear what the authors intend to convey by the sentence *"According to Aki ... seismic cycles"*.
22. Line 170 – The authors are requested to clarify if they perform *"seismic zonation"* for this work, or use existing results.
23. Lines 174-175 – The sentence *"Tsunami risk ... local ones"*, seems to be a repetition of the previous one. Please consider merging the two sentences.
24. Line 180 – The term *"randomly"* is quite vague. The authors are requested to situate the term in their context by giving more details about say, the sampling *etc.*.
25. Line 182 – It is not clear what is conveyed by *"represents the number of iterations randomly done in MC simulations"*. The authors can either explain it/cite references as to why 100 seems to be representative of the number of samples.
26. Line 192 – The authors are requested to verify the range of magnitudes *"Mw 6.5-7.1"* vis-a-vis the constants given in line 194. It would be better to supply the particular values of a and b (apart from the standard errors and deviations) that have been used to arrive at the range.
27. Lines 206-211 – The authors are requested to clarify what is the range of depths used for generating the scenarios. Is it $5 - 14\,km$ or $10 - 14\,km$? It would be beneficial to the readers if the ranges of parameters used for the MC simulations were included in Table 1, alongside the other fault parameters.
28. Line 218 – Please list suitable references related to *"Brownian passage time (BPT), log-normal or another probability distribution"* here.
29. Lines 218-220 – The sentence *"In this model ... elapsed time."*, needs to be rephrased or split for better readability.
30. Lines 221-224 – It is not clear what the authors mean to convey by this paragraph.

Is this relevant to the application of the method used in this work?
31. Lines 228-232 – This paragraph is a repetition of lines 70-74 and should be deleted.
32. Line 236 – The authors can share the reasons for adopting the simplification: *"earthquake releases all energy loaded on the fault and then starts the new failure cycle."*. Is it because of lack of earthquake cycling models with residual energy or perhaps, due to incompatibility with the BPT model?
33. Lines 247-249 – The authors are suggested to cite a reference for the definition of Tr so that interested readers may look into it.
34. Lines 269-270 – The linear version of the SW equations is usually faster than the non-linear version, needs lesser memory and is accurate in deep water where non-linear effects may be neglected. Thus, the reasons given by the authors here are not convincing. A NSW model is, of course, a better model than the linear case because it models the physics better. The authors can supply a sentence or two as to why the use of NSW is attractive in this work.
35. Line 274 – THe authors have used Okada equations for calculating deformation due to the fault. A figure of the PIF segmentation (maybe in Figure 2, left figure) portraying one of the scenarios from the 100 cases would be helpful to visualize the fault.
36. Lines 279-280 – Accurate coastal bathymetry is crucial for accuracy in high-resolution simulations near the coast. The authors can clarify the source for the bathymetry-topography data at $3m$ resolution. Is it simply the downscaled version of $30m$ ASTER and $900m$ GEBCO data? Or is it another, local dataset? Also, when merging the different bathymetry datasets, a common problem is the fixing of the coastline. How do the authors decide the coastlines between GEBCO and ASTER, as well as the digitized coastline from ArcGIS(?)? A few sentences describing their adopted methodology would be appropriate.
37. Line 292 & Figure 4 – The ratio $1:3$ has been employed here for scaling of consecutive mesh resolutions for simulation. Is there a similar guideline for appropriate spacing between the different nested grids? In Figure 4, the nesting rectangles for $3m$, $9m$, and $27m$ are bunched together on their right (eastern) sides. This would create

a sharp gradient of mesh resolution from $3m$ to $27m$ in that region. The authors can comment on the possible repurcussions due to this on the results.
38. Lines 323-325 – The authors make a good point about the importance of the minimum wave height in terms of stranding of ships. A citation/past example would make this point even better.
39. Lines 348,471 – The inundation depth calculated in worst case earthquake scenario is given as *"*$4.48\,m$*"*. I am unable to find this number in Figures 5 or 6. The authors can clarify this. Also, should it be *"*$2.16\,m$*"* or $-2.16\,m$, as is written in line 471?
40. Line 352 – I was very interested in the hazard of small amplitude waves dragging people. A citation would be relevant for readers (like me) who would want to dig more into this aspect.
41. Line 363 - Do the authors mean *"mean (average) inundation depth values"* or *mean (average) probability values*? It would be more clarifying to include a step-by-step/point-by-point procedure of calculating the excedance probablities from the 100 MC simulations.
42. Lines 434-444 - This discussion of uncertainties does not shed enough light on the results. As such, it is better positioned in the methodology section (maybe? before line 233/discussion of BPT model). Otherwise, the authors can expand this section a bit more with concrete connections to the numbers in the numerical results.

Technical corrections

The introduction (*i.e.* till line 116) is relatively free of typos. However, the authors are recommended to check the grammar and sentence constructions in the rest of the paper. I list below (a few) corrections for the typos that I have come upon. The authors need not follow these corrections exactly, and can make their modifications, as long as readability is maintained.
1. Line 64 – Replace *"ranging"* with "ranges".
2. Lines 37,75,79 – Replace *"*$M > 7$*"* with *"*$M_w > 7$*"*.
3. Line 76 – Insert comma after *"event"* . Replace *"extend"* with *"extends"*.

4. Line 82 – Insert *"The"* before *"1509"*.
5. Line 85 – Insert *"The"* before *"1894"*.
6. Line 89 – While using multiple ands, a comma seems appropriate, especially after *"Hereke"*.
7. Line 98 – Replace *"are"* by *"were"*.
8. Lines 125-126 – Replace *"source, such as earthquakes, landslide, volcanic activity etc. in various scales,"* by *"sources, such as earthquakes, landslides, volcanic activities etc. at various scales;"*.
9. Line 127 – Insert *"is"* after *"method"*.
10. Line 128 – Insert *"are"* before *"generated"*.
11. Line 138 – Replace *"primarily"* by *"primary"*.
12. Line 141 – Insert *"are"* before *"exposed"*.
13. Line 150 – Replace *"constant"* by *"constants"*.
14. Line 151 – Replace *"package"* by *"packages"*.
15. Line 157 – Replace *"segments"* by *"segment is"*.
16. Line 158 – Replace *"PIF, as given"* by *"PIF are given"*.
17. Line 159 – Delete *"the"* before *"Armijo"*.
18. Line 160 – Delete *"is"* before *"also fits"*. Replace *"constant"* by *"constants"*.
19. Line 174 – Delete *"of"* before *"a more"*.
20. Line 181 – Replace *"for to having"* by either *"for having"* or *"by having"*, as appropriate.
21. Line 194 – Replace *"errors"* by *"error"*.
22. Line 205 – Replace *"scenarios"* by *"scenario"*.
23. Line 213 – Replace *"is describing"* by *"describes"*.
24. Line 216-217 – Insert *"is* after *"occurence"*. Replace *"that was passed"* with *"that has passed"*.
25. Line 219 – Consider rephrasing *"... the additional required information in addition to ..."*.
26. Line 258 – Delete repeated phrase *"in the next"*.

27. Line 303 – Insert *"years* after *"and 100"*.
28. Line 324 – Replace *"is important as much as of"* by *"is as important as of"*.
29. Line 434 – Replace *"includes"* by *include*. Replace *"rare occurence nature"* by *"nature of rare occurence"*.
30. Line 437 – Replace *"effects"* by *"affects"*.
31. Line 468 – Consider deleting the word *"decreases"*, as it appears misleading here.
32. Line 479 – Replace *"them has a"* with *"them have a"*.

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