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Comment on nhess-2020-427

Jean Roger (Referee)

Referee comment on "Assessing local impacts of the 1700□CE Cascadia earthquake and tsunami using tree-ring growth histories: a case study in South Beach, Oregon, USA" by Robert P. Dziak et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2020-427-RC3, 2021

Dear Editor,

Please find hereafter my comments concerning the paper manuscript NHESS-2020-427 entitled "Assessing local impacts of the A.D. 1700 Cascadia earthquake and tsunami using tree ring growth
histories: A case study in South Beach, Oregon, U.S.A."

- **Generalities**

This paper dealing with the study of tree ring growth from old trees to assess tsunami and earthquake hazard in a region where the seismicity has an actual low rate although known to have triggered megathrust earthquakes and associated tsunamis over the past centuries is of major concern. In fact, being able to use old trees to know if there has been a strong event in the past could help to assess the hazard in regions where the written history is not sufficient and to propose recurrence periods of such big events.

The authors have set their study over the Cascadia subduction zone, where a Douglas fir stand located at South Beach, Oregon, US West coast provides sufficiently old trees to travel in the past until at least the big January 26, 1700 Cascadia earthquake more than 320 years ago.

First, they use tsunami modelling on a DEM built from LIDAR data from which they have removed the 2 modern jetties at the entrance of the river to fit better the past topography of the area in order to model the tsunami propagation over the South Beach coastal area.

This way, they can show that the Douglas fir stand has probably been inundated by the 1700 tsunami with water depth between 0-10 m, in addition to being affected directly by the earthquake shaking.

Then, they use the tree cores they have collected on this stand trees to determine if both the earthquake and tsunami have let their footprints in the ring growth of those trees. To remove one big uncertainty on the data concerning multiple non negligible growth variations, they compare their results with previous studies done on other stands of about the same age from areas that could not been flooded by the tsunami. Thus, they can show that the variation in 1700 has probably no link with a climatic disturbance like a drought but should be linked to the tsunami.

This paper is interesting, easy-to-read and well organized. There is no fundamental problem on the methodology and results analysis (as long as I can say from my tsunami expertise) but, however, it needs to be substantially improved by considering the following comments to be published in NHESS.

- **General comments:**

The manuscript lacks recent references about the study of tree-ring in earthquake assessment (e.g. Allen et al., 2019; Fu et al., 2020 about the 1950-Zayu-Medog earthquake, etc.) and in tsunami assessment (e.g. Buchval et al., 2015 for Greenland tsunami of Nov. 2000; Lopez et al., 2017 for the Tohoku tsunami; Kubota et al., 2017 for the effect of saltwater on trees, etc.). The state-of-the-art should be improved to show the common practices and methodologies in the domain and explain why they chose one way to study instead of another one.

Concerning the tsunami modelling results, the figures exhibit clearly a modelling problem due to boundary effect. It should absolutely be fixed to be sure that this problem does not have consequences on both the inundation extent from the shoreline and the flow speed. It would be interesting to see the results of maximum water level and flow speed on the other nested grids to proof there is a correct junction between them. Also, it would be a good thing to add the version of MOST that has been used, with the related references (there are more recent ones available than the 1997 paper from Titov and Gonzalez). Also, as further indicated, the friction choice to set land and sea with the same value must be explained with references.

The title of each part should be numbered with 1., 2. 3., etc. But not with 1.0, 2.0, 3.0.

One figure showing the geographical extents of each of the 4 grids used for tsunami modelling would be much appreciated.

Replace “L” sized earthquake by large earthquake, it is more understandable.

- **Detailed comments:**

Abstract:

- 9: Douglas with only one “s”
- 9: add latin name *Pseudotsuga menziesii*
- 10: add “(CSZ)” after Cascadia subduction zone
- 13: “0 to 10 m”
- 14: “shows that several trees experienced”
- 19: why do you indicate 110 years and not 320 or more ? it should be clarified for the reader even in the abstract – maybe better to indicate between 1660 and 1780, referring to the period you analyzed
- 19: remove “.” after “location”

1.0 Introduction:

- 24: “along the Sumatra and Japan coasts”
- 26-29: there is plenty of recent interesting papers, especially from Japanese teams, dealing with those subjects; you must add references here.
- 29: not sure that the term “suppression” means what you want to write. Please review this carefully.
- 36: “Cascadia Subduction Zone” – add (CSZ) and use it in the rest of the paper.
- 38: Sometimes you talk about the 1700 Cascadia Subduction Zone earthquake, sometimes to the 1700 megathrust earthquake, etc. Please standardize.
- 40: “in the coastal range”
- 43: replace “the ring widths of trees” by “the width of the tree rings” (and use the same wording everywhere)
- 45-47: and elsewhere? There are papers and technical reports available focusing especially on tree-ring analysis in earthquake research in other parts of the World that could help your demonstration (Arsdal et al., 1998; Wells and Yetton, 2004; Stoffel and Bollschweiler, 2008 in the same journal : https://nhess.copernicus.org/articles/8/187/2008/ , etc.). Please refer to some of them to show at least a summary of the state of the art.
- 48: remove space after “.”
- 50: you indicate that the tsunami may cause physical damage to trees but what about

the chemical damage? Probably a way to explore in Yoshii et al. (2012; https://link.springer.com/article/10.1007/s00024-012-0530-4)

- 52: "and where there is"
- 53: where are these "large population and municipal infrastructure" ? please locate on one of your figures and refer to it in the text.

2.0 Evidence for megathrust earthquakes and tsunamis:

- 57: "On January 26, 1700" or "On the 26th of January, 1700" and remove "in the year 1700 AD"
- 58: either write "plate boundary" or replace with "plate interface"
- 61: replace "The 1700 earthquake" by "It" (apply this in other parts of the document)
- 63: please add the map locating approximately the epicenter of the earthquakes
- 64: "comprise" – strange word, please change it.
- 65: Simplify your sentence, for example : "The 1700 Cascadia earthquake ground motion and ... are modelled from ~05 to 1.2 g ... . The shaking during this event should ... ".
- 69-70: This sentence is a bit strangely located. You should detail which timing you're looking for. If it is the date, what I expect, please indicate why.
- 71: "the dates have been obtained from"
- 73-75: it would be interesting to have a map of those coastal forests – maybe add their location on one of your figures.
- 81 and after: you discuss about the liquefaction but you should above all highlight that the main question to which this study tries to answer is: what has been the impact of the 1700 earthquake? And for this, different methodologies have been applied, like looking for liquefaction features, and looking at the tree-ring growth.

3.0 Model of AD 1700 tsunami

- 98: provide the coseismic subsidence value from Satake et al.
- 104: prefer "nested" or "imbricated" to "telescoped"
- 105: "The tsunami simulation model MOST (Method of Splitting Tsunami; Titov...) used in this study is based ..."
- 106: "wave generation and propagation".
- 108: "wave dispersion"
- 109-110: "the digital elevation model (DEM)" ... (last grid level)
- 111: the spatial resolution is already indicated L.105
- 113-116: not really clear – try to make it simple or add a scheme
- 115: "above the actual MSL"
- 124: why is the Manning's coefficient chosen identical for sea and land as it should be different. Also provide reference for the 0.03 value.
- 128: is that possible to present a ancient map or drawing of the coast showing the lack of jetties or a document justifying your choice to remove them?
- 134: the elevation reached by sea water is commonly called "run-up height" and not "tsunami water level"
- 142: "than in most"

- 144-145: please refer to the articles dealing with the impact of current on trees, especially in Japan during the 2011 Tohoku tsunami
- 147-153: you discuss about the splay fault but do not indicate if they are considered or not in your modelling finally; this is not clear.

4.0 Impacts of Earthquakes...:

- 160: add references
- 169: remove space after "."
- 171: "Fort Tejon"
- 179: add the latin name *Picea sitchensis* – end of sentence not clear, please rewrite.
- 201: which reaction? Please develop.
- 205-208: what about the effect of salt in the soil and thus in the tree growth? Several studies available to deal with this problem.

5.0 Tree ring growth...:

- 229: detail what is COFECHA on one sentence to show that is adapted for such verification.
- 233: idem for ARSTAN
- On L.226 you indicate that two cores were collected from each tree but only 12 from 8 trees at L.235... please clarify.
- 250: show the 5 growth reductions on the figure (only 4 arrows)
- 251: (arrows on Figure 4a)
- 252-253: you must show a comparison between the two dataset – maybe adding the curves on the same figure / two separate figures are not easy to compare
- 268-271: idem – show figure with comparison

6.0 Discussion:

- 276: "to other inland sites"
- 278: same remark about "suppression" – please change word
- 294: "another mean to"
- 291-294: check and refer to Perkins et al. (EOS, 2018)

Summary:

- Replace “summary” by “conclusion”
- 316: it would be great to add a final sentence like this one: Coastal trees, especially old ones, should be preserved from logging to help to reconstruct the seismological and tsunamical history of a region, as well as they provide natural coastal protection.
- 320: “in this study will be added in ...”

References:

The list of references must be standardized referring to NHESS guidelines. Also, the DOI linked should be added when it is possible (this is the case for most of the references).

Figures:

Figure 1:

- Add a small map located Oregon, at least in the US.
- 427: add altitude value of the stand (mean value) - “data points compiled”

Figure 2:

- a) and b) must have different colour scales to avoid confusion
- There is a serious boundary effect on the left edge of the grid which leads to strange high frequencies pattern on both water level and flow speed maps. You should fix the problem before publication.
- Also, it should be indicated whether it shows representation of the maximum water level reached on each point of the grid upon the simulation time, as well as the maximum flow speed, or if it corresponds to values at a time = i.
- Coordinates should be out of the maps to clarify

Figure 4a and 5a: the y axis should be the same on both figures to help the reader to compare easily. But my previous comment was to show the two on only one figure.