



Interactive comment on “Tsunami damage to ports: Cataloguing damage to create fragility functions from the 2011 Tohoku event” by Constance Ting Chua et al.

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Received and published: 23 March 2021

In this work, Chua and collaborators present in a very clear and organized manner, the first assessment and proposal of tsunami fragility curves for port industries, hence following the conceptual approach that has been used for other types of buildings to characterize damage. Based on an extensive and well curated dataset from the impact of the Tohoku tsunami, and well sustained methods, they not only propose the fragility curves but also a measure of their accuracy. Moreover, the resulting data also allows them to explore inferring distinguishing between tsunami effects and prior sources of damage.

I found the work very well written, and it flows in a clear and very well organized manner. In general terms, I think it is on a very close state, suitable for publication and it could be an influential work.

With this in mind, I would like to explore a couple of aspects that appear to be bit loose on the article. The justify my "minor revisions" suggestion:

1. It is not mentioned whether tsunami damage by debris or others has been filtered or identified. This issue is particularly present at port facilities, where ships, containers, trucks and other materials relevant to port industries can impact structures. I have heard of work related that has attempted to quantify its impact (by Kentaro Kumagai, for instance).

The reason I mention this is that it could explain some of the features present in data. For instance, in Fig. 5 it is remarkable that DS4 levels can be attained by very small water depths, whilst no DS3 or DS2 states are present. This defies the "ordered" notion of damage that is the basis for the analysis.

Its clarification can also help in explaining some of the later results. The authors point in the paragraph L397-L409 to two main causes for the results: A design oriented to higher standards, that could help in explaining low damage at larger depths; and/or that there is a decorrelation with inundation depth. This is understood that damage is less dependent on water depth alone (at least it is implied in the text. The closing sentence leaves many doors opened and it is inconclusive), though it can be as well interpreted in the opposite way.

Interestingly, incorporating debris can also help in clarifying some of the other features in the data. For example: the authors analyze the variability or accuracy of their results. Typically, they observe that some industries have less data and that is the reason for the low accuracy (smaller data size, which is mentioned once or twice in the text) . However, in reviewing the data, it looks to me that the industries with less accuracy are characterized by a narrow range of depths (for instance, Warehousing does not

exceed 6.0m) whilst having a somewhat uniform distribution of damages. That is, the frequency count of DS1 to DS4 is relatively uniform. So, more damage can be found for a narrow range of small depths. The authors note this explicitly in Line 466, but they chose to use other explanation routes. To me, this also points to the decoupling of damage and flow depth, and could point to other sources of damage that have not been accounted for.

I would recommend the authors to expand a little bit on this regard, and explore its potential effect on their analysis. I think it is a relevant caveat of these studies, because what we see is the end result, and the chain of events that lead to the damage is often absent. It is quite the leap of faith to assume that this is only due to the tsunami hydrodynamics alone, and even from them, just to the water depth.

I have a couple of other suggestions:

Fig 5: The caption is a bit confusing, because it mentions outliers associated with damage first, but then they are related with water depths. At this point the relation is not established.

Figure 7: Perhaps in addition to the frequency count, use percentages. That would allow to compare more clearly among industries.

Line 411 mentions "mean value" but then L418 refers to the median. I tend to think we are referring to median. Please check for consistency throughout the text.

Fig 8: Perhaps gridlines would help to compare among subplots.

Interactive comment on Nat. Hazards Earth Syst. Sci. Discuss., <https://doi.org/10.5194/nhess-2020-355>, 2020.

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