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Comment on nhess-2021-251

Anonymous Referee #2

Referee comment on "Tropical cyclone storm surge probabilities for the east coast of the United States: a cyclone-based perspective" by Katherine L. Towey et al., Nat. Hazards Earth Syst. Sci. Discuss., https://doi.org/10.5194/nhess-2021-251-RC2, 2021

Review "Tropical cyclone storm surge probabilities for the east coast of the United States: A cyclone-based perspective"

General comments

In their manuscript "Tropical cyclone storm surge probabilities for the East Coast of the United States: A cyclone-based perspective", the authors seek to identify relationships between tropical cyclone (TC) characteristics and storm surge heights along the US coastline. While I believe this is a relevant topic to study, I recommend additional analyses to improve on the novelty of the research. Please find below my reasoning:

1) The authors consider the TC distance to tide gauge station, TC intensity, and TC angle at landfall in their analysis. I feel it's debatable whether the distance to a tide gauge station is something that can be truly attributed as a TC characteristics (why not consider TC size?). In addition, various past studies have (extensively) discussed similar characteristics. Many of them are already cited in the text (Lines 44 – 52) so I will not repeat them here, but these could be added for a more comprehensive overview of what's already been done:

- Needham & Keim (2014) (https://doi.org/10.1175/2013EI000558.1) who assessed the influence of storm size on hurricane surge;

- Ramos-Valle et al (2020) (https://doi.org/10.1029/2019JD031796) who extensively studied the influence of TC landfall angle on storm surges along the Mid-Atlantic Bight;

- Bloemendaal et al (2019) (https://doi.org/10.1007/s00382-018-4430-x) who also assessed the influence of various different TC and geographical characteristics on storm surges;

- Peng et al (2006) (https://doi.org/10.1016/j.ocemod.2006.03.004) on the asymmetry of storm surges and TC wind fields;

- Akbar et al (2017) (https://doi.org/10.3390/jmse5030038) on the influence of wind drag coefficients and bottom friction on Hurricane Rita's storm surge height

While I welcome research seeking additional answers to explain storm surge heights, I would strongly recommend the authors to improve on the novelty of the research to make this research truly stand out compared to the literature that's already out there. This can be achieved through (for example) 1) including more TC and landfall (coastal slope/coastal complexity/terrain features near the tide gauge station) characteristics 2) extensively seeking for multivariate relationships 3) and to also trying different types of relationships rather than just a linear one.

2) Throughout the manuscript, it seems like the authors are solely looking at TCs in their analysis. However, in the Methods-section, they say that they also include TCs that have undergone extratropical transition. These systems can no longer be considered tropical by nature (rather, extratropical), hereby having different characteristics than TCs and they should thus be excluded from the analysis.

3) The authors use daily maximum storm surge heights and couple this with 6-hourly TC data. I don't see the added value of using daily maximum storm surge heights when the tide gauge data is provided in hourly data (see line 85) and TCs are characterized by strong spatial and temporal gradients that can strongly vary within hours.

4) The results-section could benefit from some in-depth discussion of why the spatial differences emerge in relation to typical TC behavior/patterns.

Introduction – specific comments

Nowhere in the introduction is there any mention of the TC characteristics that will be under consideration in this manuscript. Please add this description.

The introduction (more specifically, the second paragraph, lines 33 – 44) makes it seem

like there will also be a focus on ETCs. Please make it explicitly clear you will solely focus on the TCs.

Line 24-25: exposure is not the same as vulnerability

Line 29-30: The amount of destruction is also influenced by changes in exposure and vulnerability

Line 30-31: What do you mean with this sentence?

Line 35: Could you please elaborate on what these differences exactly are?

Line 36 – 38: Please explain to the reader why these cities have less TC-related storm surge extremes (along the lines of ocean waters are colder + more wind shear, so less favorable for TCs), that will also help the reader understand why this Boston example is noteworthy.

Line 38 – 44: Please fill in the gaps that are left in this paragraph: 1) what are the differences in storm dynamics? 2) What are the different characteristics of the flood exceedance curves? 3) What exactly is the frequency of TCs compared to ETCs? 4) How can they cause more damage?

Line 45 – 54: Could you please summarize this in a few sentences? Also: the term "noisy" is very vague. I also feel like the literature is very tailored towards US case studies and misses some other relevant studies (see my earlier comment)

Line 54 – 56: I strongly disagree with the wording here. The authors make it seem like they will overcome the regional scale, but they still perform a regional assessment (namely, the US East Coast).

Line 59 – 60: Perhaps good to also mention coastal complexity here (Bloemendaal et al 2019)

Methods – specific comments

Line 86 – 87: This is quite a bold statement to make, without any additional clarification. How big is the contribution of TC waves to total water levels?

Table 1: Please round the pressure to one decimal place

Line 104: What do you mean with wind intensity? Wind speed? What is the time reference for this wind speed? (1-min, 10-min, 3-sec?) Please also add units with every TC characteristic listed here.

Line 105: Please state the exact dimensions of the "specified distance"

Line 123: Why are you solely testing for linear relationships?

Line 130: Please explain to the reader what these results are

Figure 2: Why are you differentiating between a radius of 250 km (in Figure 2) and 500 km (in the text)? Also, how did you derive the track angle? To me it seems like one of the green tracks for Charleston has a N-NNW angle upon approaching the landfall location, but it is listed as SW.

Results – specific comments

To me, a 0.5-yr return level of 0.8m seems like a lot. This implies that (assuming the authors correctly identified individual storm surge events) Sandy Hook is affected by TC storm surges of this height on average twice per year! Could you please validate these results against other studies?

Please quantify the statistical significance and correlation throughout the results-section.

A lot of results aren't shown (indicated by "not shown" in the text). Could you please add these results to the supplementary materials, so that the reader can have a look at these results?

The continuous switching between a 500 km and 250 km radius is highly confusing –

please re-read this section carefully and try to homogenize this usage of radii.

Conclusions

Line 329 – 333: Please check the work of Ramos-Valle et al (2020); they synthetically changed details of various storms in the Mid-Atlantic Bight.