

Nat. Hazards Earth Syst. Sci. Discuss., referee comment RC3  
<https://doi.org/10.5194/nhess-2022-120-RC3>, 2022  
© Author(s) 2022. This work is distributed under  
the Creative Commons Attribution 4.0 License.

## **Comment on nhess-2022-120**

Anonymous Referee #3

---

Referee comment on "Coastal extreme sea levels in the Caribbean Sea induced by tropical cyclones" by Ariadna Martín et al., Nat. Hazards Earth Syst. Sci. Discuss.,  
<https://doi.org/10.5194/nhess-2022-120-RC3>, 2022

---

### *General comment:*

This study investigates the storm surge and wind-wave components of extreme sea levels in the Caribbean Sea induced by tropical cyclones. The approach applied in this study is different from previous studies as it is based on a large set of synthetic tracks of tropical cyclones while also taking wind-waves into account. Previous large-scale studies generally excluded wind-waves because of the high model resolution that is required to model the wind-wave component. The study finds that tropical cyclones in the Caribbean come from two well-differentiated families with very distinct intensities and genesis locations. Also, the contribution of each of the forcing mechanisms to the total water level has been investigated. Finally, return levels of wind-waves and sea-surface are provided in a dataset.

Overall I find the study scientifically relevant. However, in my opinion still some substantial improvements are required before this manuscript can be considered for publication in NHESS. My main points of concern are addressed under specific comments. In addition, there are quite some spelling errors. I would advise to let a native English speaker check the manuscript. Some of the writing mistakes that I found are listed under technical corrections, as well as some suggestions to improve on the clarity of the text and figures.

### *Specific comments:*

- I am not convinced that the selected subset of 1,000 TC tracks represents the complete 10,000 years of TC activity from STORM. You are arguing that figures 1e, and 1f look very similar. However, I disagree as the patterns don't match. In addition, in the discussion you mention that SSE is very dependent on the morphology of the

coastlines. This tells me that even just a very minor shift in storm track could potentially result in a completely different storm surge. The way you checked whether your set of 1,000 TC events represents the STORM dataset (complete 10,000 years) doesn't take this into account.

- Linked to this, the historical dataset IBTrACS that contains observed tracks of TCs shows that the north coast of South America experienced basically zero TCs in the past 40 years. In the STORM dataset there are multiple, even within just a decade of data. Most likely due to the way the STORM model was set up, which leaves some freedom to the TCs to travel in a certain random direction, next to the most common north-west direction for the Atlantic basin. How is the uncertainty related to this represented and illustrated in your results?
- The different settings that you used for the hydrodynamic model are described in the methods section. However, I am missing an explanation why you chose those settings. For example, why did you use the Pond & Pickard formulation to calculate the wind stress?
- Hurricanes Wilma and Thomas are used to validate the numerical simulation set-up. However, no observations are available from nearby tide gauges at the time of these two tropical cyclones. Does this mean that validation of the hydrodynamic model is completely lacking? I don't understand why you pick these events if observations from tide gauges are unavailable? Would it be possible to simulate some other tropical cyclone events for which tide gauge observations are available?
- Suggestion: did you compare SSE return periods, so excluding waves, with the COAST-RP dataset from Dullaart et al. (2021)? It would be interesting to compare because the input dataset, being STORM, is the same. However, this study used 3,000 years of TC activity from the STORM dataset instead of 1,000 events like you did. I realize that COAST-RP includes tidal levels as well, but because the tidal range is very small in this area a comparison could be of added value.
- The relatively coarse coastal resolution of the model grid results in an underestimation of the wave set-up (line 204). This is a major limitation of this study correct? Then why isn't it discussed later on in the discussion section?
- At this point, I am not convinced that performing the study again will result in the same findings. I believe this is crucial for all scientific studies. Improving the clarity of the methods section could be the first step here.

#### *Technical corrections:*

- You refer to the hydrodynamic model as 'hydrodynamic' or 'numerical' model. Please be consistent.
- Line 12: "Here we focus in" -> "here we focus on"
- Line 13: "TC" -> "TCs". Please check throughout the manuscript.
- Line 20: "small islands" -> "small island"
- Line 23: "GPD" -> "GDP"
- Line 58: What do you mean by maximum speed distribution?
- Line 85: I believe this paragraph could be improved. It might help the reader to see a figure of the wind field generated using the holland model. In addition the last sentence requires some explanation. Why do you reduce the velocity by 20% over land areas? Do you maybe have a reference for that?

- Line 110: How do you know that the selected domain is large enough to allow for a correct generation and propagation of the wind-waves originated by hurricanes affecting the Antilles? Did you perform a test run for this?
- Line 203: This sentence seems incomplete.
- Line 219: Shouldn't this be part of the methods section?
- Line 251: In this paragraph you are describing some storm characteristics. I don't believe this belongs in the summary and discussion section. Instead, maybe put it under the introduction?
- Line 288: duplicate of "to"
- Figure 1: This figure is very hard to digest. The letters indicating the subpanels are sometimes hard to see due to the dark background colours. I would suggest you put them just outside of the panel. For consistency it would be nice if you do the same with the other figures. Also, it would be good to reduce the number of subpanel titles and make sure that they are in the same location each time. So for example, in the top left. Last, the figure caption includes f) and g) which should be e) and f). I believe c) is missing.
- Figure 2: black lines and text on a dark blue background is not a great match.
- Figure 3: panel b shows a percentage correct? So a positive 100% means that for every tropical cyclone with Caribbean origin, there are 0.5 cyclones with an Atlantic origin? If so, the percentage will exceed 100% in some locations correct? Right now the maximum value is 100% according to the colour bar. In addition, you mention "radius of maximum speed". Do you mean radius of maximum winds? Rmax is more commonly used as an abbreviation for this.
- Figure 5: caption -> What do you mean by 'poor shore resolution'?

I hope the authors find these comments helpful.