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## **Comment on wcd-2022-46**

Michiel Baatsen (Referee)

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Referee comment on "Can low-resolution CMIP6 ScenarioMIP models provide insight into future European post-tropical-cyclone risk?" by Elliott Michael Sainsbury et al., Weather Clim. Dynam. Discuss., <https://doi.org/10.5194/wcd-2022-46-RC2>, 2022

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### **Comments on *Can low-resolution CMIP6 ScenarioMIP models provide insight into future European Post-Tropical Cyclone risk?* by Sainsbury et al**

The authors present a study that looks at both the performance of CMIP6 models to represent tropical cyclones in the North Atlantic, and a future projection of recurving PTCs impacting Europe.

I think most aspects of the study are relevant and new, as well as show useful results with opportunities for future work.

The methods are overall well explained, the manuscript is well-written and structurally sound, and the results properly assessed.

There is room for some improvement in the motivation of model choice and general assessment of their TC skill, to better understand their present and future skill regarding North Atlantic TCs.

Some more detailed comparison to existing studies using high resolution models in particular would be useful, showing which of the expected trends are consistent and therefore useful between different sets of models.

This may be at least partly the subject of some previous or future work, but in that case it should be better clarified.

Regardless, the manuscript is of high quality and would only require limited adjustments for publication.

#### **General comments:**

- A selection of CMIP6 models is used, based on the present TC frequency over the North Atlantic Ocean. While this is probably a good measure, it is tough to say whether these models accurately show TC frequency for the right reasons and even more so if they are able to correctly show future trends. Especially with contrasting mechanisms determining the trend, this may be an important concern. It would therefore be useful to show some general metrics of these

models, e.g. how they reproduce overall TC formation/intensification measures, or how they compare versus (limited) available high resolution simulations.

- I would like to see some more information regarding the thresholds used to define a TC, both for tracking as for impacting Europe (does this include wind speed, or just vorticity?).

Although previous methods are mostly being used and well documented, this could help avoid some confusion going through the results.

- In the results section, the first paragraph of most subsections is more of a motivation/methods part. This can be a deliberate choice, but makes the results section slightly more tedious and less focussed.
- The results cover different statistics about TC recurvature, frequency and track, which is very useful. There is, however, an important distinction between considering a fraction of North Atlantic TCs (recurving, impacting Europe etc. e.g. Table 2, Figure 10), or rather cyclones impacting Europe as a start (i.e. how many of those are PTCs e.g. Figures 5,9). This distinction could be made clearer and considered more deliberately at times, to avoid confusion.

### **Specific comments:**

- L46 and following: it is important to clarify that the Haarsma and Baatsen studies only focus on PTCs impacting Europe with storm-force winds, which is only a minor fraction of all PTCs.
- L123 & L130: Besides earlier work and data limitations, could you motivate the different choices between the datasets and the potential limitations for the results? (e.g. weaker vorticity signatures at T42)
- L166-184: It would be useful to perform some of these analyses (or just e.g. the GPI) on the full CMIP6 ensemble, to get a better understanding why the selected models are better representing TC frequency.
- L208: To test whether the models dissipate existing TCs too rapidly or rather convert too few seeds into TCs, you can also consider the average track length and duration of the considered TCs.
- L219: Can you explain this underestimation, while models seem to represent overall TC frequency well? Are conditions too hostile in the north or rather the models unable to represent physical processes correctly towards ET? Especially for cases of re-intensification after ET, it could be useful to check SST fields (and gradients) in the models.
- L237: It would surprise me if baroclinic forcing would play a major role over the Gulf of Mexico during much of the Hurricane season, as would model resolution differences between 10-20N and 25-30N. What about e.g. biases in SST, RH or wind shear?
- L256: As mentioned in the general comments, I believe a more detailed comparison would be insightful here, especially regarding the environmental conditions for TC formation and maintenance.
- L324: This seems to happen mostly towards the end of the 21st century, following an increase in intense storms that originate from the tropics but are not PTCs (Baatsen et al 2015).

### **Figures:**

- Figure 1: The HURDAT2 contours are rather tough to see, particularly as they conflict with the coastlines. Consider e.g. making the coastlines a lighter gray for clarity.
- Figure 1&2: As the lower values are masked out, it would make more sense to use a reversed colouring i.e. darker colours for higher values?  
The highest values run beyond the scale, which is probably chosen to make for an easy overview. Consider adding some larger steps to the top of the scale to be able to distinguish the maxima as well. Right now, one cannot tell whether this value is 10 or more like 50.
- Figure 5: It would be useful to include some information regarding total counts as well, both on the cyclone frequencies as on wind speed percentiles.  
It is unclear to me how the percentage given in each panel relates to the shown bins: I understand this is the total fraction of Europe-impacting cyclones that are PTCs during Hurricane season. In that case, the number should correspond to that of the 0th-percentile, as this would include all storms. Clearly it does not, so I am missing something here.
- Figure 6: This is an insightful and nice overview figure, it could benefit from a CMIP6 ensemble mean comparison.  
Figure S4 is a great addition in the supplement, so it would make sense referring here as well.
- L405: Term 3 seems a bit unintuitive, being the combination of terms 1 and 2? While still referring to the appendix for more detailed information, it would be nice to have a bit more explanation on how this combination works.

#### **Technical remarks/typos:**

- L17: similar occurring twice
- L276: 'is show'
- L291: consider making the list numbers bold font for clarity
- Table 3: this is quite an extensive table, is there a possibility to include some (simple) coloured shading to the cells to facilitate visual comparison?