Authors' response to
'Comment on egusphere-2024-3435', Anonymous Referee #1, 10 Dec 2024

We thank the referee for taking the time to review our manuscript. We believe the suggestions made by the referee greatly improved our manuscript. Below you will find the referee's comments in **bold**, our replies in blue, and *italics* for the text that has been modified/added to the manuscript. The additions are highlighted in turquoise in the revised manuscript.

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Garin et al. (2024) uses a regional climate model over two 30-year periods to examine the effects of climate change (under RCP8.5) on ET events in the North Atlantic. The authors find no significant change in the frequency of ET events in the future but a shift in their location (increase off the northeast coast) and increase in potential destructiveness.

Given the limited number of studies on ET and climate change, I appreciate this addition to the literature. The model simulations used in this study are high enough resolution to adequately capture TCs and ET events and storm tracking methods are in line with previous studies. I would, therefore, rate the scientific significance of this manuscript as "excellent-to-good".

The overall presentation quality is also "excellent-to-good" in the sense that the manuscript is concise and easy to follow. The scientific quality, however, is "good-to-fair" as substantial discussion of how the presented results compare with previous studies is omitted and should be included before publication. Additionally, I noted several omitted references for the authors to include in their introduction and/or to help put their findings into context.

Thanks for your encouraging words and appreciation of our manuscript.

1. **Here are some additional references that should be included throughout the introduction and results. The Bieli et al. references are of particular interest to the current study:**
    - **Arnott et al. (2004): https://doi.org/10.1175/MWR2836.1**
    - **Baatsen et al. (2015): https://doi.org/10.1007/s00382-014-2329-8**
    - **Bieli et al. (2019): https://doi.org/10.1175/JCLI-D-17-0518.1**
    - **Bieli et al. (2020): https://doi.org/10.1029/2019MS001878**
    - **Haarsma et al. (2013): https://doi.org/10.1002/grl.50360**
    - **Kitabatake (2011): https://doi.org/10.2151/jmsj.2011-402**
    - **Kofron et al. (2010): https://doi.org/10.1175/2010MWR3180.1**
    - **Wood and Ritchie (2014): https://doi.org/10.1175/JCLI-D-13-00645.1**

    Thank you for your suggestions, we have added the aforementioned references in the introduction and results as suggested by the referee.

2. **Of biggest concern is the lack of comparisons to previous studies throughout the results section. While there is some comparison on the Discussion and Conclusions section, the manuscript could benefit from additional comparisons and related discussion throughout. For each presented result, consider:**

    - **How do these results compare to previous studies?**
    - **What could account for the differences (e.g., methodologies, model environments, etc.)?**

We added comparisons with the literature throughout the manuscript as suggested by the referee. Please find below some *examples* we have added in the manuscript. The revised manuscript is provided in Track changes mode thus highlighting all changes made.

In Section 3.3, we have added the following sentences:

"*Our results are consistent with Bieli et al. (2020) which did not reveal any statistically significant change in the ET rate in the North Atlantic. However, our findings contrast with the studies by Liu et al. (2017) and Baker et al. (2022), which reported a slight increase in ET frequency in the North Atlantic basin.*"

In Section 3.5, we have added the following sentences:

"*Our results slightly contrast with Bieli et al. (2020) that show a equatorward migration of the ET onset latitude, this shift being small in the North Atlantic basin. The differences in the ET tracking methodologies might explain this difference.*"

In Section 3.6, we have added the following sentences:

"*This result contrasts with the findings of Jung & Lackmann (2019) which revealed an extended ET period. However, this conclusion applies only to a specific storm, and the characteristics of its track may influence the results. Our findings are, nevertheless, consistent with the results of Michaelis & Lackmann(2021) who found no statistically significant difference in the ET duration time between present-day and future climate simulations*."

A couple small changes to the figures would be helpful to increase readability:

- **All box plot figures: Could be helpful for the reader to add grid lines and/or explicitly state the mean/median values either on the plots themselves or in the text.**
- **Figure 1: Add legend on plot as in other figures.**
- **Figure 3: Could be helpful to indicate which intensity ranges are significantly different in the future.**
- **Figure 6: The information provided in this figure could be better suited for a table instead.**

We have explicitly stated the mean/median values on the plots themselves. Figure 6 has been replaced by Table 3 and a legend has been added to Figure 1. With respect to Figure 3, we have clarified that the mean pressure in the future is significantly deeper. For each intensity range, we have performed a statistical test between the present-day simulation data corresponding to this intensity range and the future climate simulation data corresponding to this intensity range. The intensity ranges with a significant difference have been hatched in the figure.

Specific Comments

L93: The "ET" acronym was already defined in L28.

Thanks for having pointing out this, we have corrected it now.

L106: In addition to precipitation validation, what data set was used to evaluate model TC tracks? I see some evaluation of the ET ratio in section 2.8 compared to IBTrACS and ERA5, but what about for the TC and ET tracks themselves? In particular, I would be curious to see how CRCM5/GEM 4.8 handles TCs in the eastern North Atlantic main development region.

The model TC tracks have been evaluated with IBTrACS. We have added the results of this evaluation in appendix A of the manuscript.

With respect to ET tracks, we have added the table below and the following short discussion in Section 2.8:

"*ET in IBTrACS is determined subjectively by various forecasters based on real-time observational data. In addition, IBTrACS' phase transition occurs at an instantaneous point in space and time and provides no information about the path of ET (Zarzycki et al., 2017). To assess the ability of the model to spatially reproduce ET, we have compared the latitude and the longitude of ET onset with the results of Bieli et al. (2019) in Table 2 [Table R2 below]. The comparison shows a northward shift in our simulated ET onset latitude compared to Bieli et al. (2019). This difference may be explained by our methodology, which in the case of multiple transitions, considers only the final transition. The eastward shift in the ET onset longitude is a consequence of the northward shift in the ET onset latitude, as storms tend to go eastward at higher latitudes*."

Simulation	Mean Latitude ET Onset	Mean Longitude ET Onset
GEM 4.8/CRMC5	35.5	-52.4
JRA55 (Bieli et al., 2019)	33.2	-58.4
ERA5 - Interim (Bieli et al., 2019)	28.9	-56.2

Table R2: ET onset mean latitude and longitude

L108: Is the precipitation comparison shown anywhere in the manuscript? What does a reasonable precipitation comparison mean for the model's ability to represent the TC/ET climatology?

The precipitation comparison was a general evaluation of the model and indeed does not provide meaningful information in terms of the model's ability to represent TC/ET climatology. We have pointed this out in the manuscript when presenting the precipitation climatology. As stated previously, IBTrACS has been used to evaluate the ability of the model to represent the TC/ET climatology in Appendix A.

L108: Is it possible to evaluate over the full 30-year simulation period? If not, please clarify and state this limitation.

The evaluation of the TC tracks has been evaluated over a full 30-year simulation period and we have added the results of this evaluation in Appendix A.

L222: Remove extra space between "to" and "cold-core".

Thanks for having pointed this out; we have corrected it.

L261: As noted in General Comment #2 above, it could be helpful to compare this model's simulated ET percentage to that from other modeling/observational studies.

We have added a table of the mean annual ET ratio from other studies in the manuscript (Section 2.8)

L274: Are 14.3 and 18 the annual averages? Please clarify.

Yes, these numbers are annual averages. It now reads:

"*The annual average number of TCs, including tropical storms, is significantly lower (-3.7) in the future climate simulation (14.3) than in the present-day simulation (18).*"

L280: Remove extra parenthesis after "studies".

This was done.

L299–301: Reference?

We have added the following references:

Barnes & Polvani (2015)

Francis & Vavrus (2012)

Harvey et al. (2014)

Serreze et al. (2009)

L304–305: Reference?

We have added the following references:

Barnes & Polvani (2015)

Harvey et al. (2014)

Lorenz & DeWeaver (2007)