Responses to reviewer comments

Anantha Aiyyer[1] and Terrell Wade[1]

[1]Department of Marine, Earth and Atmospheric Sciences, North Carolina State University

Correspondence: A. Aiyyer (aaiyyer@ncsu.edu)

We are grateful to the reviewer for their time and effort in helping improve the content of the paper.

1 Point by point response

This is a well-written manuscript, and I find it enjoyable to read. I have no major comments except some suggestions. I hope these suggestions would be helpful for the authors to improve the presentation of their findings.

Response: Thank you for taking the time to read and provide comments.

Title: This paper covers both the acceleration and deceleration of tropical cyclone motion. It is not clear whether "acceleration" here indicates general changes of motion speed or just an increase of movement speed. It might be helpful to rephrase the title to avoid confusion. A clarification in the abstract and/or main text would also be helpful.

Response: The acceleration here refers to the change in speed of the TC (i.e., motion) and not the change in the sustained winds associated with the TC (i.e., intensity).

Line 2: "While… has not". This sentence does not appear essential here.

Response: You definitely have a point here. We kept it to emphasize the novelty of our work. The bulk of TC motion studies have focused on translation speed and tracks. To the best of our knowledge, this is the first attempt at examining the curvature and tangential accelerations of TCs and their trends.

Line 2-4: This sentence probably needs some clarification. What are the interested "synoptic-scale patterns"? Are these patterns related to tropical cyclones or extratropical wave packets? It might also be useful to describe "tangential and curvature components of their (??) acceleration" more clearly.

Response: Since this is the abstract, it is not practical to provide all the details. The key aspects of synoptic-scale features are mentioned in the following lines. The definitions of tangential and curvature acceleration are provided in the text.

Line 18: Chan (2005) and references therein provide useful information on this topic.

- Chan, J. C. (2005). The physics of tropical cyclone motion. Annu. Rev. Fluid Mech., 37, 99-128.

Response: Agreed. This paper has been referenced by us.

Line 51: Some recent modeling studies present evidence suggesting that changes in extratropical weather could affect TC motion. These studies could help to better motivate this theme of investigation.

- Zhang, G., T. Knutson, and S. Garner, 2019: Impacts of Extratropical Weather Perturbations on Tropical Cyclone Activity: Idealized Sensitivity Experiments with a Regional Atmoshperic Model. Geophys. Res. Lett., 46, 14052– 14062.

- Zhang, G., Murakami, H., Knutson, T.R., Mizuta, R. and Yoshida, K., 2020. Tropical cyclone motion in a changing climate. Science Advances, 6(17), p.eaaz7610.

- Hassanzadeh, P., Lee, C.Y., Nabizadeh, E., Camargo, S.J., Ma, D. and Yeung, L.Y., 2020. Effects of climate change on the movement of future landfalling Texas tropical cyclones. Nature communications, 11(1), pp.1-9.

Response:: Thanks! We have added these citations.

Line 86-87: "... remain independent of modeled products to characterize the storms". The classification of recent storms by forecasters is partly based on models. But as recognized later, reanalysis datasets have issues with tropical cyclones, so the IBTrACS is still a reasonable choice.

Response: Agreed

Line 100: It would be helpful to conceptually link tangential and curvature changes of storm motion to physical factors (e.g., steering flow).

Response: That is a good point and would be a useful follow up exercise. Some aspects of the steering flow can be gleaned from the composites of geopotential height shown in this paper.

Fig. 3: Is it possible to mark the mean vectors and/or tracks of storm motion? This will help to infer how environmental flow affects the storm motion. Also, HGT1000 can be below sea level due to the low central pressure of TCs. It might be more

intuitive to use sea-level pressure here. Finally, the values of the colorbar are hard to read because of the small font size.

Response: A sense of storm motion has been provided in the composites. Please see the "+" symbols in Figs. 4, 6 and 7. Also, Figs. 5 and 8 show the track of the composite TC.

Fig. 5: For the acceleration case, it might also be helpful to plot the trough anomalies to support the argument that "tropical cyclone merges with the extratropical stormtrack" (Line 219). After all, trough anomalies are commonly discussed in the context of extratropical storms.

Response: Agreed. Anomalies are provided in Figs. 4, 6 and 7.

Line 257: During vortex interactions, a merger usually happens between vorticity anomalies of the same sign. It is a little odd to discuss a merger of positive and negative HGT/vorticity anomalies.

Response: Thanks for this. We have edited this line to avoid the misinterpretation highlighted by you. We were discussing the merger (or lack thereof) of the cyclonic anomalies of the TC and the upstream trough. The edited line now reads:

By Day+2, we do not observe a merger of the TC and the upstream trough that happens in the case of rapid tangential acceleration (Fig. 5a).

Section 6 and 7: The discussion is supported by the same figure and probably can be consolidated into one section.

Response: You have a point, but we have kept them separate for ease of readability.

Section 8: The transition from the discussion of translation speed to the discussion of acceleration is abrupt around Line 320. If this discussion of translation speed is deemed important, it probably should be consolidated with the discussion of Fig. 15 and Table 5 to keep the logic flow smooth. Otherwise, the results between 301 and 319 could be briefly summarized.

Response: The last couple of lines of section 7 serve as a clear end to the discussion on translation speed and then the stage is set for the acceleration.

Line 474: A weakening of extratropical cyclone activity is also projected by CMIP models (e.g., Chang 2013).

Chang, E. K. (2013). CMIP5 projection of significant reduction in extratropical cyclone activity over North America. Journal of Climate, 26(24), 9903-9922.

Response: Thanks for this reference. It has been included now.

Line 459-461: This part probably can be moved to the beginning of Section 8 to better motivate the trend analysis.

Response: We tried your advice but reverted back to the original text as it flowed better. Nevertheless, thank you for this suggestion.

Citation: https://doi.org/10.5194/wcd-2021-4-CC1