Weather Clim. Dynam. Discuss., referee comment RC2
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Comment on wcd-2021-4

Anonymous Referee #2

Referee comment on "Acceleration of tropical cyclones as a proxy for extratropical interactions: synoptic-scale patterns and long-term trends" by Anantha Aiyyer and Terrell Wade, Weather Clim. Dynam. Discuss., https://doi.org/10.5194/wcd-2021-4-RC2, 2021

Summary and overall assessment:

In this study, IBTrACS and ERA-Interim data on NATL tropical cyclones from 1966-2019 are used to investigate the synoptic-scale patterns that are associated with different characteristics of TC acceleration. Three major synoptic-scale patterns are identified: Rapid tangential acceleration of TCs occurs in cases with a developing extratropical wave packet, resembling a development typically observed during ET. Rapid curvature acceleration of a TC is linked to a dominant anticyclone east of the TC, initiating its recurvature. For rapid tangential deceleration and small (near-zero) curvature acceleration, the synoptic pattern resembles a cyclone-anticyclone dipole. Further, a statistical assessment on the characteristics of TC acceleration and speed is conducted, using quantile regression approach. The statistical analysis reveals that the extremes in tangential acceleration (both rapid acceleration and deceleration), the maximum of curvature acceleration, as well as the translation speed of TCs have decreased somewhat (negative trend) over the past five decades. The most robust negative trend has been found for a 20-50°N band during August and September.

This manuscript focuses on the characteristics on TC motion/acceleration during the interaction of a TC with the midlatitude flow in the NATL. It thus could help to complement the findings from previous work, which put a focus on the characteristics of the midlatitude flow and its wave packets during the interaction. In this context, the manuscript compares the results of this study with the findings of Riboldi et al., who focused their investigation on the translation speed of the upstream trough. Overall, the manuscript is well organized and written in a clear manner, and fits well into the scope of WCD, as it investigates both the dynamics perspective of the interaction as well as climatological aspects. However, the comparison to the results in the context of the work by Riboldi et al. is, in its current version, not fully convincing to me (see major comment 1). Furthermore, some parts could benefit from some more clarity in the description/discussion, and in other parts, information on the approach that has been used is lacking. Once these comments has been addressed during the revision of the paper, it will make a very suitable contribution to WCD.

Major comments:

- The discussion of the results in the context of the study by Riboldi et al (2019) needs revision. First, from the discussion in paragraph 258-267, it is not clear whether the reference is made to the ACCEL or DECEL scenario of Riboldi et al., this information (reference to DECEL) is only made in the Discussion (l.421). On the one hand, it sounds reasonable that the deceleration of a trough, during phase-locking, also manifests in a deceleration of the TC. However, I am not fully convinced yet by the reasoning and figures that are presented in this manuscript. The DECEL scenario of Riboldi et al. is conducive to baroclinic interaction and leads to a (strong) amplification of the downstream wave pattern (TC acts as a "wave maker", Keller et al. 2019). For such a synoptic configuration, I´d expect to see a stronger upstream trough in Fig. 7f-j directly upstream of the TC, as e.g. in Fig. 10 a, c, e of Riboldi et al. Further, when comparing Figs. 4 f-j and 7 f-j with the DECEL scenario in Fig. 10 of Riboldi et al., the position of the TC with respect to the ridge appears to be different. While in the DECEL scenario, the TC becomes positioned in the western part of the ridge during the development, ahead of the upstream trough, where it supports ridge amplification. In Figs. 4 and 7, the TC rather appears to be placed south to the center of the ridge. From the figures provided, its contribution to ridge building is not directly obvious. Please expand on the discussion of these findings in the context of the work by Riboldi et al. This could e.g. include a tracking of the upstream trough to demonstrate the phase locked configuration, additional analysis of the PV (or eddy kinetic energy budget) to analyse the contribution of the TC to the amplification of the ridge, or another suitable means.

- I am a bit confused by the explanation of the rapid curvature acceleration marking the point of the recurvature of a TC. The explanation in ll. 234-241, on the one hand, sounds reasonable to me. On the other hand, it appears that the (composite) TC in the case of rapid tangential acceleration also undergoes recurvature, as it is e.g. obvious from Fig. 5, but also from Figs. 4 compared to Fig. 7. Please further expand on the differences between the cases of rapid tangential acceleration and strong curvature acceleration to make this point on recurvature clearer. In this context, it could also be of help to see the individual tracks of the TCs included in the composite (e.g. plotting the tracks of all cyclones in the composite after the shift of the grids has been performed).
- ll. 218-224: Please add information on how the ridge of the extratropical wave packet has been tracked. It would also be good to add information on why the track of the ridge has been used here, instead of the upstream trough, which wraps around the TC, pointing also to a merging of the TC with the extratropical wave packet.

Minor comments:

l. 94-96: The statement on improved reliability of TC data during the satellite era is partly a repetition of paragraph ll.64-70. Consider revising.

l.140-141: Could you add a statement on what this implies?

l.160: Centroid position of *all* storms?

l.168: Given the distribution of curvature acceleration in Fig. 2, the 32 km/h per day as the "near-zero" curvature acceleration seems a bit high. Should this be 3 or 2, instead of 32?

l.170: For completeness, please also state how many unique storms fall into the category of rapid and slow curvature acceleration.

ll.177-181: This information is already contained in the figure caption (same applies to l 200-202). Consider revising.

l.199 and later: The use of the word „system" to refer to the synoptic structure was a bit confusing to me, as system is typically also used to refer to e.g. a tropical cyclone. Consider revising throughout the manuscript

l.210: Consider adding also information on day +2, as it is included in Fig. 4.

l.211: The downstream trough has not been discussed before. Consider mentioning to already during the discussion of the wave packet in the paragraph above.

l.213: From the figures presented, the strengthening of the geopotential gradient north of the storm is rather hard to detect (a tightening of the geopotential height isobars can somehow be identified in both the left and the right panels).

ll.215-216: Downstream dispersion of energy may occur in both cases (if the TC interacts with an existing wave packet, as well as if it excites a new one)

l.239: Consider adding a bit more information on the study/findings of Aiyyer (2015) here.

l.307: The "all storms" in Fig. 10 are shown in pink/magenta, but text and figure caption state grey.

l.309 and others: Thiel-Sen should read Theil-Sen

l.309: According to figure caption, it should read 20-50°N band.

l.320: This section could benefit with a brief introductory sentence on its aim (even if it is just a sub-section), as e.g. the start into sections 6, 7 and 8, or like the sentences in L. 329-331. Consider adding.

l.325: bottom row -> There is just one row in Figure 12

l.325-327: The shifts in the CDFs for curvature acceleration are there, but not as clear as for the tangential acceleration, e.g. for 0-20N the 1988-1997 period appears to be characterized by more rapid acceleration that the prior and later period.

l.326: Consider adding "not shown" already after the sentence on the CDF over the entire year.

l.327: Could you comment on what might cause this increase in shifts seen in the CDFs, when October and November are omitted. October typically shows the highest percentage of TCs undergoing ET in NATL, e.g. Hart and Evans 2001.

l.360: Could you comment on why the restriction has been made to August-September here, instead of e.g. September-October (same reason as above).

l.362: I do not understand the reference to Table 1 (tau=.5) here. Do you refer to the 0.68 median tangential acceleration in Table 1 for "Full basin"? Please clarify.

l.382: I am a bit confused by the statement that the OLS estimate of the trend is nearly the same value as it was for the annual-mean speeds. From Table 5, the OLS trend for the entire Atlantic and all months is -0.01, but from Table 2, for full basin and all storms, we get a trend of 0.029 (LR) and 0.028 (MK-TS), but maybe I am comparing the wrong information. Consider adding a more specific comparison (e.g. number) for clarity.

ll.405-408: Please be more specific here on how the impact of phasing is evident in the rapid curvature acceleration (as you did above for the rapid tangential acceleration). The aspect of phasing is not discussed in the section 5.2.2.

l.409: “for rapid tangential deceleration and near-zero curvature acceleration”, as there is no curvature deceleration. Same applies to l.421 (rapidly decelerating TCs) and other instances. Consider revising throughout the manuscript.

ll.476-477: For the negative trend in in translation speed and in curvature acceleration this statement sounds convincing, as well as for the negative trend in rapid tangential acceleration. However, could it also serve as an explanation for the observed decrease in rapid tangential deceleration?

l.481: three (?) broad sets of synoptic-scale patterns

Figures & Tables:

Fig. 11 and 12: Labels are hard to read, consider enhancing their size.

Tab. 4: The OLS 95% confidence bounds are put in brackets here, but not so in Tab. 3 and 5. Consider harmonizing.

Typos:

11 T->t

48 shown->show

169: There is a bracket missing.

250: There is a superfluous space in the bracket for Fig. 7.

258: 8a->8b

259: …poleward, the(?) tropical

Several instances: To my knowledge, it is more common to use “storm track” instead of “stormtrack”