Review of “Future changes in North Atlantic winter cyclones in CESM-LE – Part 2: A Langrangian analysis” by Dolores-Tesillos and Pfahl.

This manuscript uses back trajectories to better understand how the potential vorticity structure and thus the dynamics of extra-tropical cyclones will change in a warmer climate. The main conclusions are that in a warmer and moister climate, enhanced ascent and latent heating in warm conveyor belts leads to a stronger low-level PV anomaly. In contrast, upper-level PV anomalies response in a much more complicated manner which the authors show is due to changes in advection and hypotheses that changes to radiative cooling near the tropopause are also important. Overall, the manuscript is well written, easy to follow, and the conclusions are well supported by the presented evidence. I have two concerns with this manuscript which I describe below, and numerous rather minor comments also listed below.

Major comments:

1. Almost all of the results are presented as averages over all extreme cyclones. Cyclones are highly variable in their structure and dynamics. The impact of this variability is not taken into consideration in this study. Specifically:

    a) Line 137-138 “*we evaluate various parameters averaged over all trajectories initialised in the cyclone area, in a radius of 10 degrees around the SLP minimum*” – this is a huge area and includes air masses with very different properties e.g., the cold sector, the warm convector belt. This huge variability is seen in Figure 2. Does this make scientific sense to average so many different trajectories together? However, in the other extreme, the authors then proceed to show trajectories from just one grid point (Figures 4, 5 and 6) which potentially are not representative. I strongly encourage the authors to re-consider their approach as I expect that much clearer and informative results may be obtained if trajectories only from certain areas of the cyclone were averaged together. Another recommendation, if the approach in Figures 4 – 6 is kept, is to include a measure of uncertainty on these figures, similar to what is done in Figure 2.

    b) How do the magnitudes of the changes detected relate to the amount of variability in the control simulation? Or stated another way, are these results statistically significant? Figures 3 and 7 should include information showing where the changes are significant.

2. Section 3. Some additional details of the simulations should be added here as it is not reasonable to expect a reader to read part 1. Even some basic information such as what time periods the simulations cover (this is in the abstract but could be repeated here), what resolution the simulations are performed at (the coarse resolution is noted as a limitation of this study in the conclusions, but a reader is not told what it is) would be appreciated. I also suggest that a few more details are given about the strongest 1% of cyclones – how many cyclones are there in absolute numbers in both the historical and future climate simulations? Do they all occur in a certain part of the north Atlantic or do they cover a huge geographic area? What metric is used to measure intensity?

Minor comments:

1. Line 52. Units Wm-2 is missing the negative sign.
2. Line 58. “This PV ascent and descent”… This is rather strange, suggest revising it.

3. Line 69 – 70. This second branch of the cold conveyor belt is never mentioned again in the results section / the analysis so does it really exist on average or is this a rare feature?
4. Line 163, these values of specific humidity seem to be very small, however, it may be due to the large area that they are averaged over. Is this a valid hypothesis?
5. Lines 170 – 200. This section discusses many of the processes we would expect in the warm conveyor belt, yet the results being discussed include all of the cyclone areas. This section should at least reminder a reader that the average trajectories also include those arriving in the cold sector.
6. Line 210 – could the location of these points be added to a composite map?
7. Figures 3 and 7. The units on the colour bar on panel (c) are missing. It might also be a good idea to state in the caption here how many cyclones these composites were created from.
8. Line 282 – typo “th” → the
9. Figure 7e. There is a small area of negative PV tendency in the control simulation. I don’t think this is discussed in the text. Is this related to negative PV tendencies about the localised heating maximum in the warm conveyor belt?
10. Line 310 – 327. There are many references to figures / results in part 1. This makes it quite difficult for a reader to follow without going to find the figures in part 1. Could this be revised so a readers’ understanding does not require part 1?
11. Line 405-406. Can the references to the figures be added here? e.g., figure 2 for the Lagrangian composite at 700hPa.
12. Line 424. Could add here what intense really means e.g. top 1% which is X numbers of cyclones.