

Review of “Grid-Spacing Sensitivity of Rossby Wave Breaking to Mesoscale Diabatic Processes”

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Andreas F. Prein**

Summary: Overall, this manuscript is excellent. The positive attributes of this research include: i) Examining different flow regimes associated with forecast busts; ii) Testing the benefits of higher model resolution and ensemble behavior to reduce the occurrence of busts; iii) Providing linkage between busts and mesoscale convective systems, the extratropical transition of tropical cyclone, Rossby wave dynamics and warm conveyor belts. The breadth of this research including bust events and Rossby wave breaking provides a nice path forward for future research. The figures are also excellent!! Great work!!

Minor Comments:

- 1) Please consider including a more direct cautionary statement that investigating only three forecast events each representing a type of flow pattern is a great step forward but should be treated with some caution.
- 2) A slightly deeper dive into showing why forecasts are not improved for the tropical cyclone transition would be worth doing. You might only need to add a sentence or two and a figure in the supplementary materials.
- 3) One issue to consider adding, again that would be very brief, is does this work provide any guidance on convective parameterization. Besides the magnitude, as the horizontal model grid resolution changes does the height of the upper outflow of convection also change? You mention the magnitude, but does the height also change. If so, this result could be useful to modifying convective parameterization.
- 4) The research that explores dynamics of different types of bursts and grid spacing is a great step forward. It is also great to see a link of this research to the likelihood of large errors in climate modeling.
- 5) The methods are also sophisticated. The paths utilized are using higher resolution and ensembles for 8 days, plus initial conditions of SSTs, sea ice, precip etc. Please clarify if these initial conditions are different than employed in the ECMWF forecasts and, if not, does your use of these fields have an impact on forecasts.
- 6) This comment is minor, but my experience in examining the role of convection in impacting Rossby waves relies on relatively large long-lived mesoscale convective systems and is not impacted by isolated convection. Hence, consider becoming more specific on the stating you are looking at the role of MCSs and not just convective clouds. Shallow convection, isolated deep convection (i.e., supercells) and short-lived MCSs generally do not create major changes to Rossby waves.
- 7) Pg. 4 — Small correction needed (?Prein et al., 2017)
- 8) A minor point to the introduction (or perhaps the conclusion) is to note that since we are looking at three cases with different dynamic patterns, the next step would be a more

systematic and larger exploration of the overall benefits of high resolution modeling. For example, a follow-up approach would be a systematic look at the far more bust cases.

- 9) Current research in a soon to be submitted manuscript from a U Reading PhD student found that using ACCs alone is a better approach to investigate busts as some forecast failures can have very low ACCs and relatively good RSMEs. Your work takes the approach of “substantial phase error, as captured by the ACC, and a significant amplitude error, as quantified by the RMSE”. Hence, one could state that you are examining only a subset of forecast busts so that you are likely to only be concentrating on a dynamical subset of busts with specific dynamic structures. Not sure if a revision is needed before this other paper is published or if this finding has come out elsewhere.
- 10) Personally, I think that turning off the convective parameterization at 10 km is not a good forecast path, but it is good that you included this work as some previous research that supports this odd finding..
- 11) The research that shows that one bust is still relatively poorly predicted at high resolution is interesting and consider proposing more clearly why you think that this result is happening.

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