

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

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Accept with minor revisions: Overall, the research is impressive and provides some important guidance to the operational numerical weather prediction community. However, the scientific impacts of this work manuscript need to include a deeper exploration and more meaningful conclusions on how the changes in grid spacing impact forecast improvements. As a reviewer, I had trouble deciding if the changes were minor or major. I leave that thought up to the editor.

Significant issues to consider:

- 1) The scientific focus in the list of main questions on page 4 could be improved.** For example, the 2nd and 3rd questions are focused on which diabatic processes are better simulated and are these diabatic processes the main cause. However, the research, as shown in the title, is focused on Rossby wave breaking and the questions listed generally do not touch on the impacts of the changes in grid spacing on Rossby wave structure.
- 2) A better understanding why changes in the horizontal resolution matters:** The manuscript clearly shows the impacts of grid-spacing and that higher resolution provides significant improvements. The findings state that the representation of mesoscale diabatic processes improve with higher resolution, which impacts the Rossby wave amplification. However, this finding is not sufficiently substantiated and a deeper exploration of why the resolution changes the accuracy of these simulations is needed. For example, the results should include showing how variations in the horizontal resolution impact Rossby waves through changing the height, continuity, location relative to the jet axis, and magnitude of the upper-level divergence from diabatic processes. While some insight is provided into these issues is included in the text, a deeper dive into how these characteristics (e.g., height, continuity, location, and magnitude of the upper-level divergence) vary with resolution is needed. An important issue is not only how does the continuity and magnitude of the divergence change resolution but does the height, horizontal extent, and temporal continuity of the divergence also vary as one moves from deep convective parameterization, to shallow convective parameterization only to resolved convection. These issues are touched on in your manuscript and in the Wave Amplitude Error in figure A1, but the authors should include a brief and deeper dive (e.g., height, location relative to the jet stream, continuity, etc). Hence, these changes would lead the reader to be informed on poor forecasts exist.
- 3) How do the Rossby wave characteristics in these simulations vary with resolution?** Another issue to be considered is does the wave number for the Rossby waves change at higher resolution. The question arises since past research has shown that deep convection near the jet stream can generation of high wave number Rossby waves with rapid propagation that can lead to Rossby wave breaking. These high wave number waves would likely require high resolution modeling.
- 4) Please clarify whether the issue of the relationship between the warm conveyor belt and the Rossby wave magnitude.** Isn't the warm conveyor belt an inherent part of the Rossby wave dynamics? If not, clarify this point and substantiate with references that have made this finding. If the

conveyor belt and Rossby waves are linked than modify your discussion to increase that linkages between these two dynamical processes and clarify how the wave magnitude increases.

- 5) **Improve the linkage between your results and the past research on forecast busts.** The discussion and conclusion section does not sufficiently link into the broad research discussed in the introduction. The text in the last section almost suggested that that authors have more knowledge of the coarse grid model climate modeling than an insightful look at convection and Rossby wave dynamics. You should consider including a brief, but more in-depth linkage to the broad past research that is mentioned in the introduction. This issue is clearly important as your study is only looking at three cases so one cannot get a firm, trustworthy conclusion without working harder on placing your research into the broader prospective.
- 6) **A possible point to consider:** The results show that coarse grid models have relatively poor accuracy in simulating these case studies. So to increase the impact of this research, the authors should consider including a sentence or two that has some speculation on how to improve convective parameterization in coarse models.