

Summary:

This study analyzes the relationship between upper – level divergence and latent heat/precipitation using numerous LES simulations of supercells, multicellular convection, or squall lines. It is found that the amount of upper – level divergence is primarily dependent on the amount of latent heat/precipitation and storm morphology. It was also found storm morphology determined whether the outflow was two or three dimensional. These results are consistent with linear wave theory. The authors point out that their model did not adequately simulate stratiform precipitation, so their results only apply to convection with small anvils and say nothing about how other heating modes would impact the results. I found this manuscript very difficult to read and follow the logic used in the manuscript. The analysis was unclear or lacking details and discussions were too overly broad. These points are highlighted in more detail below.

Specific Comments:

1. The manuscript has 5 figures and at least 5 supplemental figures and numerous references to material in the supplemental material. This was done to the extent that it seemed that an entire portion of the analysis is done in the supplemental. For example, section 4.2 discusses the impact of physics perturbations and almost entirely references Figure 5. However, Figure 5 only shows data by storm type. There is no indication of how the relationship changes with momentum or low – level stratification. Thus, I don't think Figure 5 can be cited as proof of the arguments in this section. I suggest either figuring out how to add this information to the figures included in the manuscript or break this manuscript into two separate manuscripts.
2. Line 71: It is mentioned that the manuscript the diabatic forcing and resulting flow will be tracked using the methodology from Baumgart et al. (2019). What exactly is that methodology? Baumgart is only referred to the Introduction and nowhere else in the manuscript.
3. How are model boundaries treated in the model? Are some of the wave patterns seen in the vertical velocity due to reflection off the edges of the model? I assume this is described in Groot and Tost (2022), but it is a very important detail related to these runs and should be mentioned here as well.
4. The abstract says nearly 100 ensemble members are created. The manuscript indicates several ways the simulations were perturbed, but I don't see how the ensemble and physics perturbations listed resulted in 100 ensemble members.
5. Are the regions over which the diagnostics integrated over the same area/size? If they are different, how could averaging over different areas impact your results? Could some of the regime differences be attributed to the area difference.
6. Figure 4 and its analysis is very confusing. When I looked at the figure several statements that were made in the manuscript did not seem consistent with the figure. For example: not everything developed intense convection within 30 mins (line 286) and not everything in the top and bottom row has strong convergence within 45 minutes (line 290). I also don't see the white line dipping down to 4 km (line 304). In general, I suggest referring to the type of storm in each panel not its row or column position. Please explain the white lines earlier. Additionally, is the data above 14 km really needed?
7. Section 3.4: Talks a lot about changes in slope. It is very hard to visualize. Please create the regressions, show the values of the slope, and prove that they are significantly different using R^2 .
8. One of the main conclusions is that there whether the outflow is two dimensional or three dimensional is determined by storm morphology. There was no figure that explicitly showed it. If something is included in the abstract and conclusions sections, it needs to be proven with a figure in the manuscript – not in the supplemental.

Technical Comments:

1. I found the sentence structure in this manuscript to be convoluted. The sentences are very long and use numerous commas. While present throughout the manuscript, the introduction was particularly difficult to read. I encourage the authors to break their sentences into small, more succinct sentences. Here are just a few examples:
 - a. Lines 46 – 51, Line 262 – 263,
2. I was a bit confused by the organization of the introduction. Lines 1 – 44 and 57 – 74 seem to be background information. However, lines 45 – 56 state the objectives of the paper. This organization felt jumpy and caused me some confusion. I suggestion combining lines 1 – 44 and 57 – 74 and then stating the objectives and outline of the paper.
3. I suggest using the oxford comma throughout the manuscript. There are numerous commas throughout the paper. However, without the use of the oxford comma I found myself getting confused as whether something was a list or an aside.
4. Sometimes it is suggested that 3 convective regimes are evaluated, but sometimes it is said that 4 convective regimes are evaluated. Please be consistent.
5. Lines 24 – 26: I disagree with this statement. It has been shown that, overtime, stratiform regions can create just as much or more latent heat release than convective regions. Stratiform regions have lower precipitation rate than convective regions. This is especially true for mesoscale scale convective systems, which often include squall lines. Also, what does “(intuitively)” mean, imply here?
6. Line 30: What is the name or type of the model used?
7. Line 53: Which three factors? Latent heat, momentum, and organization or the control, ensemble, or physics perturbations?
8. Line 70: What impacts is being referred to here?
9. Lines 144 – 148: Does this apply to all storm types or just a subset?
10. Line 186: Why was the simulated extended to 160 minutes when data was analyzed only out to 120 hours?
11. Line 194: This sentence seems out of place. It talks about area section, but the rest of the paragraph talks about time selection.
12. Please add labels or letters (“a”) to the panels in figures for easier referencing.
13. When referring to higher latent heating rates please be specific. What I deem high maybe different than you.
14. Line 333: What is the isolated convective regime? It has not been defined yet.
15. Line 353: remove the double “is”