Replies to new Referee Comments on "Evolution of squall line variability and error growth in an ensemble of LES " [1]

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1 General

We thank the referee for filtering out and formulating their pointwise summary and feedback [2].

2 Comments

'Introduction: lines 51 – 78: I found this section confusing and hard to follow. The first paragraph in this section describes the potential impact of this study, but the details about what exactly is done in this study is not really discussed until the second and third paragraph. And when it is discussed, it is scattered throughout the paragraphs. I suggest reworking these paragraphs. Start with clear statements of what exactly will be done and what is the objective of this work. Then discuss possible implications of this work. The discussion of the implications of this work could also be fully or partially moved to the conclusions section. '

In case the paragraphs on the relation to predictability studies (e.g. [3, 4]) are not reader-friendly yet, we have considered moving those to the implications section the best option. Additionally, we have made some improvements and restructured the other paragraphs to something that should be more reader-friendly too.

'2. Section 3.2: a. Line 281: What are you comparing the supercell to? The multicell case? Please specify in the text. b. Line 284: Are the boxes in the supercell and multicell only similar in size or are the boxes the same size for all the cases? How does this impact the results since it is later mentioned that results are sensitive to whether just the convective cells are included or if some region outside of the convective region is included? c. Lines 285 – 288: Can you provide the x,y location of these regions influenced by the boundary conditions? I am thinking it is the vertical bands are +/- 50-40 x. If that is true, could the slightly arched bands in the finite squall line between +/- 40-60 x and +/- 20 y also be boundary artifacts? 3. Section 3.3: a. Line 304 – 310: I got confused in this section. Can you review it and make sure the text is referring to finite or infinite correctly as well as review the panel labels. b. In the text, instead of simply stating that the spread is larger based on the spaghetti lines, could you provide a standard deviation or variance of the ensembles to quantify and be more exact? c. Figure 4: I understand the importance of the white lines between 4-8 km. However, the white lines above 15 km are never discussed. Those lines tend to make the figures busier and more confusing. Could you remove those upper lines or add text. 4. Section 3.4: b. Line 349: Is this supposed to say "finite"? Please review this entire paragraph to make sure it is referring to the correct case. c. Lines 350 – 355: Please define exactly what is the end point region? Is this comment based solely on the last point in finite distribution and, if so, why is it ok to use a possible outlier as the end point? In my interpretation the end point region would extend from 4000-6000 latent heating flux, and, in that case, the mass divergences are not similar. e. Line 391: Least affected by what? Please be specific.'

To all these points further specification of details has been added, to complete and clarify the information requested by the reviewer.

'4. Section 3.4: a. Lines 344 – 348: Are the slopes here calculated only using the first and last point in this region? This is not an adequate approach; a linear regression must be made using all points in this region. I expect that the slopes will be more similar if a true linear regression is conducted.'

Here, a semantical issue has been resolved. The implicit (silent...) assumption was made by the authors, that each point in Figure 5 [1] is connected to a point at (0, 0) in the Figure. This has not been mentioned

and was confusing.
As detailed on in the previous round of review (see pages 5-6 of that reviewer reply), no regression analysis could be done. Instead, each record in Figure 5 [1] is supposed to represent an individual mass divergence-latent heating ratio; the collection of these points behave in a way as explained in the work. In the updated manuscript we refer to this ratio between mass divergence and net latent heating, also defined as normalised latent heating, to circumvent this purely semantic issue: the suggestion of regression analysis and fitting procedure by specifically mentioning the word "slope(s)".

'4. Section 3.4: d. Line 360 – 383: The introduction of 2D and 3D seemed very abrupt and out of place to me. I had no idea how the 2D and 3D idea came about and how it related to these cases. Lines 373-380 nicely describe how each case fits the 2D and 3D models. I suggest moving these lines up and then stating lines 360-370. '

We accommodated these changes and made additional minor changes to improve the specific part of the manuscript.

'5. Section 3.5: a. Lines 410 – 412: i. I don't see the v-component in the southern end initially. I suggest not mentioning. ii. Is there any implication for the northern v divergence magnitude being similar to the v convergence in the center of the line? iii. It may be worth noting that the u and v divergence magnitudes at the northern end are similar in magnitude to help strengthen the idea that it is'

The first point (i) of the reviewer is partly correct. Nevertheless, when one zooms in at the mentioned Figure 6 [1], an area that exceeds the threshold of the first, lowest, divergence threshold is found. However, this area is very small (probably hard to spot, even when zooming). Effectively, the notion that divergence is negligible suffices indeed. Therefore, the updated manuscript accommodates suggestion that it is not needed to be mentioned.
With regards to the second sub-bullet(ii), this is difficult to answer, as in this region the convergence is generated by the divergence collision of multiple individual ascents, for which a separation is no longer possible. Therefore, it cannot be answered directly; however, the overall meridional divergence in the infinite length squall line is similarly close to zero as it initially is in the centre of the finite length squall line (see Fig. 6b of the manuscript.) We agree with the statement of sub-bullet(iii), which is also confirmed by Fig. 6 .

References

[1] Edward Groot and Holger Tost. Evolution of squall line variability and error growth in an ensemble of les. *EGUsphere*, 2022:1–34, 2022.

[2] Anonymous referee comment on "divergent convective outflow in large eddy simulations", submitted on 17 mar 2023.

[3] Mark J Rodwell, Linus Magnusson, Peter Bauer, Peter Bechtold, Massimo Bonavita, Carla Cardinali, Michail Diamantakis, Paul Earnshaw, Antonio Garcia-Mendez, Lars Isaksen, Erland Källén, Daniel Klocke, Philippe Lopez, Tony McNally, Anders Persson, Fernando Prates, and Nils Wedi. Characteristics of occasional poor medium-range weather forecasts for europe. *Bulletin of the American Meteorological Society*, 94(9):1393–1405, September 2013.

[4] Marlene Baumgart, Paolo Ghinassi, Volkmar Wirth, Tobias Selz, George C. Craig, and Michael Riemer. Quantitative view on the processes governing the upscale error growth up to the planetary scale using a stochastic convection scheme. *Monthly Weather Review*, 147(5):1713–1731, May 2019.