

Review comments

The manuscript titled “Numerical reconstruction of a rapidly developing bow echo over northeastern Poland on 21 August 2007 using near-gridscale stochastic convection initiation” presents a high-resolution numerical simulation of a severe bow echo, using the COSMO model and an ensemble-based stochastic convection initiation scheme. The topic is of clear relevance to the field of mesoscale meteorology, and the study addresses an important and persistent challenge in convective system forecasting.

The paper is well structured, and it clearly outlines both the scientific motivation and the modeling approach. The use of stochastic perturbations to simulate coldpool-driven convection within an ensemble framework is innovative and shows promise in improving the forecast of such simulations. The manuscript also benefits from a comparison with observations, and the additional experiment including sensitivity to wind shear adds useful insight.

However, the manuscript is overly long, in part due to the high number of figures with multiple panels. Some streamlining would enhance the clarity and readability of the paper. Additionally, while the methodology is generally well-described, the manuscript would benefit from a more thorough discussion of the limitations of the experimental setup, particularly with respect to the convection initiation scheme and the ensemble configuration.

In the following, I address specific issues in more detail with a list of comments, together with suggestions for improvements.

Major Comments

1. Throughout the manuscript: I recommend not to reference figures in the supplement. The manuscript should contain all the figures that are necessary to show the main results and prove the main points. A sentence can be added in each chapter, informing the readers that more (complete) figures can be seen in the supplement and “not shown” should replace most of the referenced supplement figures. Alternatively, less important statements, especially if they don’t bring additional insight, can be completely omitted.
2. L77-85. A sentence or two should be added on these studies’ success in alleviating the problem and a better connection to the proposed scheme should be made. How does the proposed scheme address the limitations of existing schemes?
3. L377-380. The paragraph on the shallow convection parameterization can be omitted completely, since its effect is negligible, together with all the related experiments in Table 1 and the related figures and references.
4. Table 2 and 3. The presentation of results would improve if tables 2 and 3 were combined. For example, columns with alternating EX and EM members. The authors could also add text colors or shading of cells based on the values to enhance the differences.
5. L640-641. The ending of this chapter requires more discussion and a better justification for keeping chapter 8. Did the authors see something new, something

expected, something unexpected, in the development of the RIJ? The results presented in this chapter are interesting, but it is unclear which scientific question is being answered.

6. The conclusions would benefit from some more discussion on the limitations of the experimental setup and the CI scheme (e.g. conservation requirements). Moreover, the ensemble properties and its limitations should be discussed (ensemble size, reliability). Considering the high uncertainty of such convective events, is it expected that, even after introducing additional perturbations, all of the ensemble members produce a bow echo?

Minor Comments

1. L1. Consider changing the word “reconstruction” with “simulation” in the title and throughout the manuscript.
2. L14-15. Reword, e.g. “The implementation of a new stochastic convection initiation scheme in a 9-member ensemble enables the reconstruction of the event as a cold-pool-driven convective system, with peak gusts closely matching the observed values.”
3. L17. Add “wind” to “vertical shear”: “vertical **wind** shear”.
4. L22. Specify: “delay” with respect to which reference? (reference simulation or observations).
5. L42. Remove “the” in “*the* cold-pool-driven systems”.
6. L92. “coincides **with** the scale of contemporary NWP...” – remove “the” (second).
7. L93. Reword “allows...” with e.g. “the scheme facilitates the representation of a high impact...”
8. L104. Why are only surface observations being assimilated? Is it because of a lack of other kinds of observations (e.g. radiosondes)?
9. L108. Add “an” to “After **an** analysis...” or reword “After analysing...”.
10. Figure 1. Keep only panels b, d, e, f: the two other pressure levels do not give much more insight, the description in the text is enough. Use different color palettes for panels b, d, as they show different variables and using the same palette can cause confusion. Write the time instead of the pressure level in the top right corner. Increase size of letters M, L indicating the locations. Add latitude and longitude ticks and labels, as the reader might not be familiar with the area of interest.
11. Figure 2. panel b: consider keeping only abbreviations for Mik., Ket. and Leg.
12. Figure 3. Keep panels for 1100, 1130, 1200.
13. Figure 4. I suggest omitting the figure. If the authors want to keep it, they should show only 1 or 2 panels (e.g. 1400 or 1500). Keep K, M in all panels for better orientation.
14. L229-232. The paragraph describing the observations in Kaliningrad is not relevant, omit it.
15. Figure 5. Adjust the color scale to make the complete Mediterranean blue.
16. Table 1. Too long and detailed for the experiments. Remove EXSC, EMSC and EXOS. Consider renaming E7-D to E7-CM and EM to EXM (EXM0 to EXM8) for a more systematic structure.

17. Figure 6. I suggest switching E7-A with E2-A for panel a. It would be a more appropriate comparison with the other experiments shown in the figure, as it has the same resolution.
18. L310-314. Are lake effects relevant for the discussion or the experiments in general? I suggest omitting this paragraph or shortening it to a sentence.
19. L330-334. Which corrections were chosen and applied?
20. Figures 7, 10, 17. Increase the size of M (text and dot). In the bottom row of panels, increase contrast of text, e.g. make it white.
21. Figure 8. Omit or move figure to supplement. If kept, a figure showing anomalies with respect to a reference (e.g. the EX experiment) would be more informative.
22. L394-396. Rewrite the information in brackets as a full sentence.
23. Figure 9. Omit figure or move to appendix. The structure of perturbations is clear from the description.
24. L408-409. Why is the 10-minute pause needed?
25. L429-433. This sentence seems out of place or without a clear connection to the previous sentences. A sentence could be added, e.g. "These mechanisms were not studied and are beyond the scope of this paper".
26. Figures 11, 18. Move to supplement. Figure 12 (or 19) is sufficient for the discussion.
27. Figure 12. I suggest choosing 3 members/panels (e.g. best, worst, average). The authors could combine it with figure 19 for a direct comparison (showing the same 3 members). The same applies for figures 13 and 20.
28. Figures 14, 21. Move to supplement. The short discussion does not justify keeping the figure.
29. Figure 15. Consider showing the two fields and trajectories in one panel or keeping the same geographical area in both panels for clarity.
30. L512-513. "horizontally uniform over the area": the figure suggests that this is not true for temperature perturbations. Please clarify.
31. Figure 16. Consider omitting this figure (referenced twice), not essential for the discussion.
32. L531. A figure in the main manuscript clearly showing the effect of modifications on the vertical wind shear amplitude would be insightful (e.g. following the suggestion in the previous comment).
33. L544-547. Omit, see major comment number 3.
34. Figure 17. This figure could show the difference with respect to the EX0 ensemble member.
35. Figure 22. Consider keeping only one panel (e.g. 1500). A possibility would be to add one panel from figure 20 and 21 to show the impact on wind gusts.
36. L647. It is better not to reference figures in the conclusions.
37. L662. "The simulations **respond well**..."