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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The propagation of aerosol perturbations in convective cloud microphysics" *by* Max Heikenfeld et al.

Anonymous Referee #1

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This paper runs simulations of two different supercells using a suite of microphysics schemes and CCN/CDNC concentrations. They added outputs of microphysical process rates for two of the three microphysics schemes to investigate mechanisms of convective invigoration. Aerosol-induced convective invigoration is currently not well understood, and this paper contributes to the ongoing discussion in the literature on this topic. I recommend minor revisions.

Major Comments:

1. The microphysical process analysis (section 3.2) seems largely disconnected from the cloud mass and centre of gravity analysis (section 3.3). It would be nice if the microphysical process analysis could be used to help explain the results in section 3.3 more. Such a linkage also seems to be part of the goal of the paper which as stated

by the authors is "to unravel the microphysical mechanisms responsible for . . . aerosol effects on convection".

Minor Comments:

1. The authors may consider changing the title. After reading the paper I understand what is meant by the title, but I don't know that I understood it beforehand. Just a suggestion.

2. I think that the goal of the paper could be stated more clearly. It isn't explicitly stated until the conclusions that the primary aerosol effect that the authors wish to investigate is convective invigoration.

3. I don't understand how fixing the CDNC helps to "isolate" the impact of microphysical pathways. Can the authors clarify what they mean?

4. The description of the cell tracking algorithm is brief. Can the authors comment on how they handle splitting and merging of convective cells? Splitting is of particular importance to this paper given that they are simulating supercells.

5. I generally like the use of the pie charts on the cross-sections for quickly assessing the relative importance of various processes or hydrometeor amounts. That said, the authors spend a good deal of time discussing the specifics of these figures. I found myself spending a lot of time squinting at the panels, and they were difficult to use for more quantitative analysis. I'm not sure that there is a way to avoid these issues, so I just want to raise them as a comment.

6. Most of the processes in the figures are self-explanatory, but can the authors define "ice processes"?

7. Page 9, Line 1: I struggle to identify two distinct regions.

8. Page 11, Line 2: By "cloud droplets" do the authors mean number or mass?

9. Page 11, Line 4: Can the authors comment specifically on how the definitions of

hydrometeor classes differ and how these differences influence the results?

10. Page 11, Line 7: I assume that the authors track the right-mover of the supercell, but this is not stated explicitly.

11. Page 11, Lines 12-18: Try as I might, I can't see deposition anywhere on Figure 4 (or Fig. 2) so it is difficult to assess the accuracy of these statements.

12. So Figure 9 shows the results from all tracked cells? Why the switch now from looking at just one cell to all the cells?

13. Page 22, Line 15: It was very difficult to tell from the analysis as presented whether there is a near complete transfer of (liquid) condensate mass into the ice phase or not.

14. Many studies have been performed that investigated the impact of aerosols on deep convection, including some that have shown microphysical process rates. I think that generally the authors could do a better job of discussing how their results agree or disagree with these previous studies.

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