

Review of “Aerosol-cloud interactions in mixed-phase convective clouds. Part 1: Aerosol perturbations” – Miltenberger et al. (2017)

This paper presents an analysis of high-resolution simulations conducted over the southwest of the UK for convection observed during the COPE field campaign. This work has the potential to contribute to the growing body of literature on aerosol-cloud-precipitation interactions in the context of convective clouds. However, there are some serious issues that need to be addressed before moving forward with publication in ACP. Some of these issues include but are not limited to the paper length (and correspondingly, number of figures), the presentation quality, grammar, and lack of justification for claims in the text. More details on these major issues are provided below.

Major Concerns

1. **Grammar:** I found the text to be quite difficult (if not impossible) to follow in places due to the very large number of significant grammar errors. While I would typically provide a detailed list of such errors and corrects; the number of mistakes is too large for such details at this point in the review processes. Thus, I provide a list of items for the authors to review:
 - a. **Oxford comma:** The Oxford comma is inconsistently used in the paper, making the intended meaning often difficult to determine. I suggest that the authors consider using it throughout to make it very clear that a list is being defined versus a sub-clause that further defines a term or concept.
 - b. **Hyphens:** Hyphens are also used inconsistently throughout the paper. For example, “cloud-top” and “cloud top” are used. There are also places where hyphens are needed, e.g., “upper-level stable layer” instead of “upper level stable layer”. Please review the use of hyphens, especially in compound adjectives.
 - c. **Subject-verb agreement:** There are numerous sentences in the manuscript in which the subject is singular and the verb is plural (or vice versa). For example, on Page 1, Line 25, the subject is “response”, which is singular, and the verb is “suggest”, which is plural. Moreover, the singular form of verbs is used when the term “data” is the subject; however, “data” is plural. Please review and make changes throughout the paper. Also note that “reflectivity” is singular.
 - d. **Punctuation:** In particular, commas are used incorrectly throughout the paper (in addition to the Oxford comma discussed above). In many cases, it makes it very difficult to read the sentence and gain a coherent understanding of the intended meaning. In some cases, the lack of commas results in run-on sentences. There were several sentences in the text that I had to read several times before I was finally able to understand the authors’ intention. For example, when using a phrase that introduces a sentence, a comma should follow, such as “According to their analysis, the balance between...”, a comma should precede the reference on Page 3, Line 27, “After about 11 UTC, clouds organized...”. These are just examples. Another set of examples in which commas are misused but create run-ons is as follows (just examples), “The CASIM module provides options for one- or two-way coupling between aerosol properties and cloud properties, and simulations are performed in both modes” and “Boundary layer processes, including surface fluxes of moisture and heat, are parameterized with the blended boundary layer scheme (Locket et al., 2015), and sub-grid scale turbulent processes are represented...”.

- e. **Incomplete sentences:** Please ensure that all sentences are complete (subject and verb). For example, the text on Page 7, Lines 29-31, form two incomplete sentences.
2. **Lack of supporting evidence and number of figures:** There are many places in the text, primarily in the discussion of the results where a conclusion is drawn without supporting evidence. My initial suggestion would be to at least plot the fields of interest to confirm that the conclusions are true; however, there are already too many figures in the paper (not to mention that it is hard to follow the analysis because the referenced figures switch back and forth from those presented in the main text and those in the supplementary material). I suggest that the authors think very carefully about what figures are absolutely important to telling their story. If a figure is mentioned in passing, remove it in favor of a figure that shows that the conclusions are robust. For example, on Page 9, Line 22, it is noted that convection deepens with larger convergence forming along the sea breeze lines. Can you show this in the simulations? Not all figures need to be direct model-obs comparisons; the model can be used to justify your conclusions and fill in the gaps where the observations are lacking sufficient information.

Furthermore, some of the figures selected for the manuscript are difficult to read (partially due to the incomplete information given, e.g., units—see comment below regarding units in general—and even just a lack of axis titles). For example, Fig. 4 and the corresponding text on Page 11, first paragraph, are very difficult to follow. Perhaps another figure format would better convey the results? Moreover, conclusions are drawn regarding process rates but these values are not shown. These rates are predicted by the model. Did you look at the rates to confirm the conclusions?

Along these lines, I suggest that as the authors consolidate the figures, that the text be consolidated. The paper is long (my best guess is ~10,000-12,000 words), and this is just Part 1. My opinion is that less is more in some cases; you do not need to discuss every variable; instead, focus on the results that are most relevant to the story that you want to tell and the biggest conclusions. Otherwise, the important implications are muddled.

3. **References:** There are several places in the text where references should be included but are missing. For example, on Page 2, Lines 11-12, a reference or several references should be included for this “concept”. In the discussion of aerosol regeneration, several references could be included but are omitted. Consider referencing Xue et al. (2010, J. Atmos. Sci.) and Mitra et al. (1992, J. Aerosol Sci.), just to name a few. Moreover, there are errors in the list of references that should be addressed (e.g., n/a for page numbers)
4. **Analysis:** There are several places in the text where the authors simply describe a figure but provide not reasoning for the differences depicted in such figures. For example, in Section 4.3, I just kept asking myself “why?” If details regarding why differences are observed are omitted, then I suggest shortening the discussion of the relevant topics and focusing on other aspects of the simulations.

Furthermore, regarding the analysis of G and L, it appears that this is only applicable for a closed system. Based on my understanding of the simulations, this is not the case because moisture could (and should) be advected through the inner domain’s boundaries. Thus,

vapor may condense in the domain but be lost through the boundaries; it appears as though this is not accounted for; moreover, it is unclear how important this is in terms of the main results of the paper.

Minor Concerns

1. In general, please be consistent with the verb tense in the paper. Present and past tense are used throughout the discussion of the results, making it hard to determine if the authors intended for a sentence to be a general idea or specifically related to the case study.
2. In general, the units are kind of a mess in the paper. There are many places where spaces are not present, making it difficult to figure out what the units are supposed to be. Also, the units in figures are missing in places or change from figure to figure (e.g., degrees east versus degrees west longitude; the later is preferable for the study area so that negative coordinates are not needed). Consider using inverse units throughout the paper and in figures. Also, the use of “**” to represent an exponent is odd for a manuscript.
3. Please review the subscripts and superscripts in the figures. The variables are not consistent between the main text and the figures because of differences in the use of subscripts and superscripts.
4. The naming convention used for the runs changes from one figure to the next.
5. Page 1, Lines 15-18: The definition of invigoration is not in line with how it is commonly presented in the literature, i.e., related to enhanced lofting of liquid above the freezing level where subsequent freezing increases latent heating aloft and increases buoyancy. Please revise accordingly.
6. Page 1, Line 21: What are the thermodynamic constraints?
7. Page 5, Line 9: Why is the model top set to 40 km? Most modeling studies of even the deepest convection in the troposphere use model tops of 20-25 km. This seems as though a lot of computational cost is wasted simulating nearly the entire stratosphere.
8. Page 6, Line 19: The density selected for graupel is quite low, especially compared to what is commonly used in microphysics schemes. I believe some additional justification is needed.
9. Page 6, Line 28: Number density is not a conserved variable; please explain.
10. Page 7, Line 7: Is the Abdul-Razzal and Ghan (2000) activation parameterization particularly applicable to high-resolution simulations of convection?
11. Page 8, Line 19: Where are the satellite data?
12. Page 9, Line 17: What is meant by “sub-cloud evaporation in the radar diagnostic”? Do you mean that the simulated radar reflectivity is somehow accounting for the model-predicted evaporation rate?
13. Page 9, Line 20: Why did you choose 18 dBZ? Do you have a reference for such a choice? It is later stated that there is sensitivity (albeit small) to this choice; this should be expanded upon to convince the reader that the results are really robust.
14. Figure 7: Why not use a box-and-whisker plot (or something similar); the way the model output is presented makes it difficult to really understand the figure.

Other Concerns

1. Page 1, Line 8: Change “match to observed” to “correspondence with observed.”
2. Page 1, Line 1: Change “effect” to “affect”.
3. Page 1, Line 1: Remove “and” at the end of the line.
4. Page 1, Line 5: Remove “The” at the beginning of the sentence.

5. Page 2, Line 21: Change “processes involved” to “relevant processes”.
6. Page 4, Line 11: Remove either “including” or “e.g.” because including both is redundant.
7. Page 4, Line 14: Define “COPE”.
8. Page 4, Line 15: Add “the” before “UK”.
9. Page 4, Line 24: This sentence does not make sense.
10. Page 4, Lines 29-30: This sentence needs to be reworded.
11. Page 5, Lines 15-16: Consider just saying that the operational microphysics was replaced and omit the “in addition to the standard model code”; this should be obvious to the reader.
12. Page 5, Line 25: Change “simulations, because:” to “simulations because”.
13. Page 6, Line 15: I believe that these are the zeroth and third moments.
14. Page 6, Lines 14-15: This sentence is confusing (perhaps it is just the lack of an Oxford comma), but I am not completely sure. Also, the use of “relation” and “relations” is confusing. Is there a single relation for everything?
15. Page 6, Line 27: Insoluble is not hyphenated.
16. Page 7, Line 16: Change “traced” to “tracked”.
17. Page 7, Line 28: Change to “The initial aerosol conditions”.
18. Page 16, Lines 24-25: This sentence needs to be reword because it appears as though you are defining depths with units of m/s.