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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Cloud's center of gravity – a compact approach to analyze convective cloud development" *by* I. Koren et al.

I. Koren et al.

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We would like to thank the referees for their important comments and suggestions that have made this paper clearer.

We will address here the referees' comments one by one:

Reviewer 1

1. Introduction: The first paragraph appears to be not closely related to the central topic of the paper. I'd suggest removing it entirely or merging it into the later paragraphs. Also, "Cloud-resolving numerical models" (Line 5 of p.14089) and the second paragraph of p.14089 should be merged and those duplicating sentences could be removed.

1. The first paragraph serves as a short background on the key role of numerical

models in cloud-aerosol-climate studies. We have shortened and focused the first paragraph and as the reviewer suggested we merged it with the next paragraph and removed duplicating sentences. The new first paragraph (merge of the original two paragraphs) is: "The effect of aerosol on clouds and precipitation poses the largest uncertainty in the estimation of the anthropogenic contribution to climate change (IPCC, 2007; Levin and Cotton, 2007). However due to the sparse distribution and short lifetime of aerosol, the inherent complexity of cloud microphysics and dynamics, and the strong coupling with meteorology, it is challenging to estimate the overall effect. Although observations and in-situ measurements provide direct evidence of physical phenomena, they cannot provide a comprehensive description of processes and their feedbacks, due to lack of information in time and/or in space. Models, provided they adequately resolve physical processes and their couplings, are the main tool with which all the information can be integrated, and with which the effects of aerosol can be studied from the microphysical to the whole-cloud dynamical scale. Cloud-resolving numerical models are probably the only tool that can separate cause-and-effect and give a more complete physical interpretation of the observed correlations. However such analyses may require many simulations and intensive statistical analysis (e.g., Teller and Levin 2008). The capacity of numerical models is improving significantly, as computers become more powerful. Today, with clusters of many CPUs, models representing many physical variables can be run at high spatial and temporal resolution over large domains. However, a barrier that limits the full potential for progress is that the huge output is often not easy to interpret and sometimes the physical meaning of the results is lost in the large and detailed dimensionality."

2. In p.14090, Line 24, the point of "The COG representation ... sensitivity ... to the initial and boundary conditions, ..." was not adequately demonstrated in the paper. I'd suggest removing it from the text. Otherwise, the authors need to provide an in-depth discussion to support their point.

2. The line was taken out.

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3. In p.14092, Line 17, "a multi-dimensional measure for the mass distribution" could be changed to "an abstract measure of the multi-dimensional mass distribution".

3. Changed to "an abstract measure of the multi-dimensional mass distribution".

4. In p.14093, Line 18, "with different cloud condensation nucleus (CCN) concentrations", based on my understanding of the model configuration, this should be expressed as "with different specified cloud droplet number concentrations".

4. Changed, as the reviewer suggested, thanks.

5. In p.14095, Line 6-20, the authors should define the aspect ratio (Sz/A?) first. The values of horizontal spread showed in Figure 3a are only a few meters (much smaller than the model's horizontal resolution). Is this a typo? Otherwise, the authors need provide an in-depth discussion on the result.

5. As the reviewer suggested we added a definition and equation for the aspect ratio in the theory part. The results in figure 3a are a typo. We forgot to multiple by the grid size (50m). We corrected the figure - thanks you.

Reviewer 2

Specific and technical comments:

1. p. 14093, l.10 and l. 15: If instead of "drops"; the word droplets would be used, confusion with raindrops could be avoided.

1. Changed to droplet, thanks.

2. p. 14093, l.16: Is the unit of CDNC really 1/kg? And if that is so, what mass does it refer to, since for neither the mass of water nor the mass of air the amount of droplets seem to be reasonable.

2. This is a typo. We corrected it to be 200 per cm3 and 1600 per cm3.

3. p. 14099, figure 1a: The label of the x-axis should read "max updraft".

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3. Changed to "max updraft".

4. p. 14101, figure 3: The letters of the sub-numbering (a, b) are missing, even though it is referred to in the text.

4. We have added the sub-numbering (a, b) to the figure.

5. p. 14101, figure 3: The magnitude of the horizontal spread seems too low. A magnitude of just a few meters of horizontal spread would suggest that the horizontal extension or radius of the cloud is also in the order of meters.

5. We forgot to multiple the results by the grid size (50m). We corrected the figure - thanks you.

6. p. 14102, figure 4: The letters of the sub-numbering (a, b, c,d) are missing.

6. We have added the sub-numbering (a, b, c, d) to the figure.

Interactive comment on Atmos. Chem. Phys. Discuss., 8, 14087, 2008.

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