Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2018-781-RC1, 2018

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Core and margin in warm convective clouds. Part II: aerosol effects on core properties" *by* Reuven H. Heiblum et al.

Anonymous Referee #1

Received and published: 26 October 2018

Review of: "Core and margin in warm convective clouds: Part II: aerosol effects on core properties."

Authors: Reuven Heiblum, Lital Pinto, Orit Altaratz, Guy Dagan, Ilan Koren

General comment:

This paper follows from Part I which sought to examine the various methods of defining the cores and margins of convective clouds by using buoyancy, RH, and vertical velocity to define the core. They showed that these core diagnostics can be subsets of one another, but that this varies in space and time. This follow-on study examines the impacts of varying the aerosol concentration on the core definitions. Given that aerosols can change the cloud DSD, the condensation/evaporation rates can change,

Printer-friendly version

Discussion paper

and thus the field RH, latent heating, and W. The authors effectively demonstrate the aerosol effects on the evolution of the convective cores and margins.

Two main concerns that can readily be addressed are the need to: (1) better state the goals and hypotheses of the study and state what makes this study novel compared to similar ones in the literature, and (2) better reference past studies in the introduction relative to many of the scientific statements that are made regarding aerosol effects on cloud droplets.

Specific comments:

1. Line 72-73: The warm phase convective invigoration process has brought about some lively debate in the community in recent years. It does seem however that lately more papers are being published on the matter. I would suggest adding a few additional references that may include the following:

Sheffield, A.M., S.M. Saleeby, and S.C. van den Heever, 2015: Aerosol-induced mechanisms for cumulus congestus growth. J. Geo. Res., 120, 8941-8952.

Saleeby, S.M., S.R. Herbener, S.C. van den Heever, and T.S. L'Ecuyer, 2015: Impacts of cloud droplet-nucleating aerosols on shallow tropical convection. J. Atmos. Sci., 72, 1369-1385.

2. Lines 80-82: Perhaps add more recent references regarding impacts of aerosol and smaller cloud droplets on condensation and evaporation rates in clouds and along cloud edges.

Grant, L.D., and S.C. van den Heever, 2015: Cold pool and precipitation responses to aerosol loading: modulation by dry layers. J. Atmos. Sci., 72, 1398-1408.

Storer, R.L., and S.C. van den Heever, 2013: Microphysical processes evident in aerosol forcing of tropical deep convective clouds. J. Atmos. Sci.,70,430-446.

Saleeby, S.M., S.R. Herbener, S.C. van den Heever, and T.S. L'Ecuyer, 2015: Impacts

of cloud droplet-nucleating aerosols on shallow tropical convection. J. Atmos. Sci., 72, 1369-1385.

3. Lines 86-88: This would be a good place to address the concept of "microphysical buffering". This has become much more prominent of a concept in the past few years.

4. Lines 97-99: Figure 17 of Khain et al. (2008, JAS) addresses this aerosol impact on various cloud types and cloud systems. This should be referenced.

5. Lines 100-110: This paragraph should cite Reutter et al. (2009) with respect to the "aerosol-limited" vs "updraft-limited" regimes. Looks like you already have this paper in your reference list, but it would be good to add the citation in this paragraph.

6. Line 140: Here you are transitioning from the paper introduction to the methods section. Your introduction is very thorough, but you haven't yet stated the goals or science questions of the paper. Please make sure you tell your audience the purpose of the paper and why it is important and novel.

7. Lines 239-244: Things get a bit confusing when you refer to precipitation and evaporation of droplets. It's not clear if you're referring to "cloud droplets" or "rain drops". It would be helpful if cloud hydrometeors are always referred to as "droplets" and rain (precipitation) as "drops". So, are you indicating here that the clean case leads to larger cloud droplets and larger rain drops?

8. Lines 308-316: This is just a comment, but I appreciate your analysis here and how you allude to polluted clouds essentially mimicking a saturation adjustment with respect to condensation, and how clean clouds allow substantial supersaturation to be carried about. Given that saturation adjustment schemes are still often used in microphysics parameterizations, this re-emphasizes that use of such a scheme can be very inappropriate except under specific circumstances.

9. Section 4: Moving into this section reminded me to ask about how your aerosols are treated in the model following initialization. Are the initial aerosol concentrations

homogeneous in 3D, do the aerosols advect around the domain, are aerosols removed upon nucleation and regenerated upon droplet evaporation? Are there aerosol sources and sinks? This could certainly be of most importance in a field of clouds.

10. Figure 5: Why is the inversion layer base height higher in the clean case? I don't recall this being addressed in the paper. Is it initially the same in all cases and then changes over time due to microphysical and dynamical interactions?

11. Line 579: When you refer to evaporation throughout the paper are you referring to partial evaporation as a process or fully evaporated droplets? This could be clarified a bit in the paper. Many past papers including some cited herein often refer to net evaporation of drops/droplets as a distribution without specific concern for full evaporation of droplets.

12. Summary section: I find the summary to be a bit over-comprehensive. It's helpful to the reader to keep this concise and to the point. Keep to the main conclusions and main mechanisms. Details can be seen in the bulk of the paper.

Technical corrections:

Figures: My main comment about the figures is that most of the them need to be larger, especially the fonts, so that they are easily readable.

Line 302: Should read as "and enables it to live for. . ." Line 426: Should read as "segments which shed off the main. . ." Line 449-451: I find the wording here to make the sentence confusing. Please try clarifying this sentence. Line 521-522: This is a bit of a run-on sentence with a comma separator. Line 656: This should read as "However, except for the. . ."

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2018-781, 2018.