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Atmospheric Chemistry and Physics Discussions

Interactive comment on "The effects of cloud-aerosol-interaction complexity on simulations of presummer rainfall over southern China" *by* Kalli Furtado et al.

Anonymous Referee #1

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This manuscript presents numerical simulations of a heavy-rainfall event over south China with a focus on how the configuration of initial/background aerosol conditions influence the development of clouds and precipitation. Two sets of numerical experiments were conducted: One with the aerosol particle number concentrations kept constant, and another with full aerosol-cloud interactions. For the later case, the aerosol particles are allowed to complete due to nucleation and regeneration after evaporation of hydrometer. The study is interesting and could be an important contribution to understand how deep convection is affected by anthropogenic aerosols. However, I think that the experiments designed in the present manuscript are unable to show unambiguously the mechanisms behind different response of cloud and precipitation

to different configuration of initial/background aerosol. This is because, in the case with fully coupled aerosol-cloud interaction, the background aerosol concentration was variable, not a constant as in other tests. So, I suggest it might be wiser to add another test with the concentration of aerosol varying but without recycling after evaporation of hydrometeor. In addition, the manuscript is also lack of necessary explanations of the physical mechanisms induced by different aerosol loading. Therefore, I think the article needs a major revision before it can be considered publishable in ACP. More specific comments are as follows.

Specific comments:

1. Page 1, line 4-6: "simulations with aerosol concentrations held constant are compared with a fully coupled cloud-aerosol interacting system to isolate the effects of processing on a line of organised-deep convection": It is difficult to draw conclusions about differences between such experiments, because not only the aerosol particle number concentrations are different, in the case with processed aerosol, coarse mode particles are added due to cloud processing, resulting in more effective giant CCN. To investigate how aerosol particles processed by clouds influence the development of future clouds and precipitation, I suggest to run the model with the coupled cloud-aerosol system but without recycling of aerosol back to the clouds.

2. Page 7: the caption of Fig. 2 should be in more concise form;

3. Page 8: in the first line of caption Fig.3, Also in some other places, "hydrometeor" should be cloud droplets. Hydrometeor also includes ice phase particles. At the top of figure, "cloud number" should be cloud droplets number;

4. Page 9: line 7-8: "The rain maxima are coincident with peaks in cloud-water 15 content (Figs 4(d-f)), indicating that condensation of liquid cloud is also most active in the 4–5-km layer": what does this mean? where is (d)?

5. Page 9: line 8-10: from Fig. 4, it can be seen that rain mass is to a large extent

depends on snow, so the statement in these lines could be misleading;

6. Page 9: line 11-12: what do you want to tell?

7. Page 10: Fig. 4: why in (a) -(c) the number concentrations of cloud droplets are almost constant from about 8 km to the ground?

8. The last 2 lines in Page 10: "...shown in Figure 5a support the conclusion that (for this case) aerosol concentration affects the simulated clouds by modifying the rate at which liquid cloud converts to rain drops": in mixed-phase convective clouds, the conversion of cloud droplets to rain is not straightforward, it needs a detailed analysis, not just a guess.

9. Page 10: Fig. 5: what are the black symbols representing for?

10. Page12: Fig. 6: what are the parameters of the left axis?

11. Page 15: line 9-10: This needs a detailed analysis.

Technical corrections:

1. Page 3, line 34: change "are" to "and";

2. Page 8, line 9: "F5e6" should be "5e6F"?

3. Page 10: in the caption of Fig. 4, "d-f" should be "e-g"; "2x2°" should be "2°x 2°";

4. Page 15: Fig. 8: The unit of rain amount is not mm/h.

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