Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-596-RC1, 2019

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 #3

Received and published: 1 October 2019

1). general comments The paper entitled "The effects of cloud-aerosol-interaction complexity on simulations of presummer rainfall over southern China". Paper analyzed the model simulations separately using the one-way fixed aerosol and two-way coupling aerosol system to evaluate the effects of cloud-aerosol interaction complexity on one heavy rainfall event. Also, the model simulations were validated with the radar and satellite observations. This study fellow the work of Miltenberger et al. (2018) to focus on one different precipitating system over China and might contribute to the fields. But the analyzing results in the paper left some to be improved (please see specific comments) so I would recommend a minor revision before it can be considered to accept for publication.

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2). specific comments 1. Page 2-3, please illustrate the new thing/work of this study compared to the work of Miltenberger et al (2018) since both you are using the same microphysics scheme with the two-way aerosol coupled system to evaluate the effects of cloud-aerosol interaction.

2. Page 4 Line 42-44, the greater/lower number concentration is not easy to tell from Figure 2(a),(b) attributed to unclear and unlabeled colored contours;

3. Page 6 Figure 3, please add the plots of cloud droplets size in terms of three model runs for further comparisons. Also, please list another label (upper) to the color maps of panels (a),(c),(d),(f),(g),(i);

4. Page 6 Line 23-25, "the amount of rain ..... by the minimum cloud-droplet concentrations .....". Please check whether cloud concentration or size is the dominant parameter for the parameterization of auto-conversion from cloud to rain in CASIM microphysics scheme;

5. Page 6 Line 27-29, please add the initial vertical profile of aerosol concentration for checking. Perhaps the depletion of aerosol near melting layer was resulted from great droplet activation over there;

6. Page 7 Figure 4, please correct the labels of panel(d),(e),(f) and add the aerosol mass vertical profile in panel (f). Also, please check why the vertical profile of cloud number concentration was ceased between 105 and 106 per kg.

7. Page 7 Line 14, please explain the factor of 1/8.

8. Page 7 Line 55-58, please prove that lower cloud droplet number giving rise to smaller raindrops. Actually, lower CCN number could result in larger cloud droplets and higher collision efficiency, and then enhance auto-conversion and accretion processes together with more warm rain. Thus, the shifts of reflectivity factor and rainfall-rate toward smaller values in the cleaner model runs should be related to less cold rain production (like less cloud water, reduced freezing, and riming rates). Please modify

the sentences.

9. Page 7 Figure 6(b), please check the lower limit of surface rain rate for model simulation was identical to the observation (∼0.1 mm/h).

10. Page 7 Figure 6, please explain that the most polluted simulation (5e8F) produced the good agreement in the TOA SW against the observation, but obtained the poor results over reflectivity factor and surface rain rate. Also, please discuss the role of 1s0dp simulation, is any difference between the one- and two-way aerosol coupling model run?

11. Since the title/motivation (Page 3 Line 8-16) of this study was to evaluate the effects of cloud-aerosol-interaction complexity, some further comparisons to depict the different impact between one- and two-way coupling aerosol systems are required. What is the benefit to adopt the two-way aerosol coupling on model simulations?

12. Pages 10-11, please give suggestions to the future operational weather forecast models if adopted the fully coupled cloud-aerosol-interacting system as illustrated in Page 3 Line 8-16.

3). typing errors 1. Page 2 Line 44-45, grammar typo; 2. Page 12 Line 63, 78-80, please complete the information of cited papers.

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