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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol Effects on the Development of Cumulus Clouds over the Tibetan Plateau" *by* Xu Zhou et al.

Anonymous Referee #1

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This study uses a cloud-resolving model with an aerosol-aware cloud microphysics to investigate the convective cloud responses to aerosol perturbations over the Tibetan Plateau (TP). Considering the special topographic and meteorological conditions over TP, this study really extends the current aerosol-cloud interaction (ACI) research into a new regime on the earth. It is also interesting to see the comparison of the ACI between TP and the North China Plain for the similar type of cloud. The sensitivity experiments by perturbing the initial cloud convective strength demonstrate the simulated cloud and precipitation responses are robust. I have some minor comments for authors to address before I can recommend accepting this paper.

1. Both CCN and IN effects are considered in the CR-WRF cloud microphysics. Can authors distinguish those two effects on the mixed-phase clouds simulated in this study?

2. It is a little surprising to see the so good monotonicity in the responses of water content and precipitation to aerosols. Lots of studies have reported the reduced LWP by increasing aerosols under relative dry conditions. What is the ambient humidity in the simulations? How to treat moisture sources in the initial and boundary conditions? I would assume the water vapor amount can be limited over TP.

3. In Figure 4, please plot where is the surface level and where is the freezing level (0 degree isotherm). Those are very important information, as your later explanation of the differences of aerosol effects between TP and NCP relies on them. With the lower freezing level at TP, does it also mean less liquid water content and less room for aerosol invigoration effect?

4. L258, how does aerosol increase raindrop size and then foster freezing efficiency? I would think the other way, i.e., aerosols invigorate the convection, produce larger graupel, and then the melting of the graupel gives you larger raindrop.

5. Table 1, the initial formation times of hydrometeors are not fully discussed. Why ice crystal formations time is shorten by aerosols in TP but prolonged in NCP?

6. For the aerosol concentrations shown in each plot, do they represent all types of aerosols in all size modes? How about using CCN concentration at 0.1% SS instead?

7. As the clouds in this study are precipitating, it is better called them cumulonimbus, rather than cumulus.

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