

Interactive comment on “A water vapor modulated aerosol impact on ice crystal size” by Bin Zhao et al.

Anonymous Referee #1

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This study investigates the impact of aerosols on ice crystal effective radius (R_{ei}) by using satellite data and parcel model. It reveals the different dependencies of R_{ei} and aerosol optical depth (AOD) under high relative humidity (RH) regime and low RH regime. The mechanisms to cause the difference are discussed and approved by parcel model. The results would help better understand ice cloud microphysical process and better estimation of climate effect of aerosols. In general, the manuscript is well organized. Thus, I suggest a minor revision before publication. The suggestions are list as following:

1. R_{ei} from satellite data retrievals are based on the reflectance of two wavelength (Platnick et al., 2015). Satellite data retrievals need some assumptions and may have some uncertainties. For examples, the surface spectral albedo data is needed to get

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the retrievals results. This study focuses on East Asia and surrounding areas, for which most regions are land area. Land surface albedo data may have larger uncertainty, compared with ocean surface albedo. Moreover, a gamma particle size distribution consisting of severely-roughened aggregated column is used in satellite data retrievals (Platnick et al., 2015). Single scattering albedo (SSA) and asymmetric factor needed for retrievals are based on this assumption. Do you think how do these uncertainties affects the results in this study?

2. The particle in ice cloud may have different types and morphologies. For example, in WRF-CHEM, cloud ice, snow, and graupel are used. Platnick et al. (2015) also mentions “solid bullet rosettes” and “solid aggregate plates”. Optical properties of each types of particle are quite different. τ_{Rei} is based on gamma distribution of aggregated column in satellite data retrievals. Thus, the shift of τ_{Rei} may be caused both by shift of particle size distribution and change of particle type. The types of ice particle formed by homogeneous nucleation and heterogeneous nucleation might be different. Do you think the different type of particle would also be a possible reason, besides the shift of size distributions?

3. There are many small figures in Figure 1, Figure 3, Figure 4 and Figure 5. Some of them are used to support similar conclusions. Maybe the author could consider placing some of them into supplemental information for better understanding of readers.

4. The criteria for low RH and high RH in Figure 1 and Figure 3 are 45% and 65%. But the criteria for Figure 4 is 43% and 58%. Is there any reason for the differences? Will the criteria affect the statistic results?

5. In parcel model results part, water vapor mass mixing ratios and aerosol number concentration are used, which are different from satellite data part, i.e., AOD and RH. Is it possible to use same variables for better comparison?

References

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Platnick S., King M. D., Meyer K. G., Wind G., Amarasinghe N., Marchant B., et al. MODIS cloud optical properties: User guide for the Collection 6 Level-2 MOD06/MYD06 product and associated Level-3 Datasets. 2015.

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