

## ***Interactive comment on “Effects of wintertime polluted aerosol on cloud over the Yangtze River Delta: case study” by Chen Xu et al.***

### **Anonymous Referee #1**

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The manuscript addresses an interesting question about aerosol effects on the winter-time clouds in the urban area of China. Three-month satellite and surface measurements of aerosols and clouds are analyzed to examine their possible relationships. However, the whole manuscript is poorly written and structured, which largely hampers its logic flow and readability. There are numerous sentences I couldn't follow. I strongly suggest the authors should get help from some native speaker to polish the English of the paper. I also have some serious concerns with the methods and explanations in the manuscript, so I cannot recommend its publication on ACP at the current stage.

My major concern is the causality in the AOD-cloud relationships based on the statistics used in this study. It is well known that teasing our aerosol effects from co-varying meteorological conditions in the satellite measurements is challenging. It seems that authors simply pair the AOD and cloud properties at a coarse grid box of MODIS mea-

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surements and perform statistical analyses without controlling any meteorological factors. A more rigorous approach should be to carefully control the distance between the aerosol and cloud pixels to minimize the potential contamination in the retrieval. Also, the aerosol-cloud relationships should be obtained under some controlled meteorological conditions. Moreover, several key technical details are described in a confusing way. For example, the manuscripts stated “AOD and cloud properties from CERES-SYN” in several occasions. However, CERES doesn't directly measure aerosols and clouds. Those are from the MODIS measurements on board of Terra and Aqua. Those instrument-data relationships should be clarified in the “Data and Methods” section. A table with that information can be helpful.

The whole manuscript lacks of insightful thoughts on the observed relationships. For example, what causes the different behaviors of aerosol effects over the four sub-regions (they are not far away in geospace)? What are the possible mechanisms to explain the non-monotonic responses of cloud properties to aerosol perturbations as shown in Figs 2-4? How to differentiate aerosol radiative and microphysical effects? What are the special aspects of aerosol-cloud interactions in winter of the YRD compared to other seasons and other regions? Without answering those questions, this study fails to advance our understanding in the complicated aerosol-cloud interaction research.

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