Response to Reviewer #2' Comments

Reviewer: Anonymous

General comments:

Taking the Pearl River Delta region of China as the study area, this paper reported the observational evidence of aerosol effect on precipitation using TRMM and PM_{10} datasets. Different precipitation types or regimes in particular the vertical structure of precipitation are differentiated for more explicit explanation. The findings from the study are convincing, and the technical details are sufficient to support the results. The impacts from other meteorological factors are also discussed in order to single out the aerosol effects on precipitation. The study is at the frontier of this research field, and I highly recommend the paper is published in ACP at current format. I only have a few minor comments and suggestions for the authors to consider if they are going to revise the paper further for improvements.

Response: We thank the reviewer for his/her positive comments on our work. We have tried as much as possible to address all concerns and have revised the manuscript accordingly. The comments are written in normal font, and our point-to-point responses to the comments are in bold italics.

Minor comments:

1. Page 6 L24: problems -> considerations?

Response: Revised as suggested.

2. Page 7 Line 25: tercile -> terciles?

Response: Revised as suggested.

3. P7L26: dirtiest -> most polluted?

Response: Revised as suggested.

4. P7L27: bins -> terciles?

Response: Revised as suggested.

5. Table 2: would it be possible to add PM_{10} information in this table as well? Such as Mean and Standard Deviation of PM_{10} for Clean and Polluted terciles?

Response: Done as suggested.

6. Page 8 L5-7: will such definitions of clean and polluted conditions match the terciles with each tercile having same number of samples?

Response: Yes, the number of samples under the clean and polluted conditions are the same. In other words, we got the same numbers of localized precipitation events, instead of profiles, for further analysis, as detailed in Table 2. In order to clarify

this issue, more related discussion has been added here in this revised manuscript.

7. Figure 1 caption: is PM_{10} in (a) collected over the same period of $PM_{2.5}$? If not, it is better to be specific.

Response: Yes, both of PM_{10} and $PM_{2.5}$ measurements are taken during the same period from November 2013 to October 2014. We clarify this issue by revising Figure 1 caption: "Spatial distributions of (a) ground-based mean PM10 (in μg/m3) and (b) the ratio of mean PM2.5 to mean PM10 simultaneously measured for the period from November 2013 to October 2014. The red box outlines the PRD region, the dots show the locations of the PM measurement sites."

8. Figure 2 reminds me how the seasonal cycles in the datasets are treated. For example, PM_{10} are collected from different months, did you deseasonalize the datasets before the three terciles are determined? This will help avoid high tercile PM_{10} are mostly collected from one season, and low tercile are from another season. It is therefore worthwhile and critical to check whether your samples from each tercile are biased to seasons.

Response: We appreciate your critical and constructive suggestions. You are totally right, there exists some kind of seasonal bias in our samples. Therefore, we double check the seasonal distribution of the number of localized precipitation events. More importantly, the potential influence caused this possible bias has been discussed in this revised manuscript, by adding the following two new sub-sections in the Supporting Information, which is shown as follows:

"1. Seasonal distribution of the number of localized precipitating events

Figure S1 show the seasonal distribution with regard to the number of localized precipitating events used in the main text. For each rain regime, blue and yellow bars represent clean and polluted conditions, respectively. For the shallow regime, the numbers of localized events under clean/polluted conditions are 11/7, 9/6, 9/16, and 7/7 for spring, summer, autumn, and winter, respectively. By comparison, for stratiform regime, they are 7/3, 3/5, 5/5, and 4/6; for convective regime, they are 9/5, 6/8, 7/13, and 8/4, respectively. This indicates that there are not dramatic seasonal difference in terms of sampling. This is because our study region is in the tropics with much weaker seasonal variation than high latitudes.

4. Uncertainties of aerosol effect on the vertical structure of precipitation caused by sampling variation with seasons

To check its potential impact induced by the number of precipitation events by seasons (Figure S1), Figure S5 presents the analysis results in the same way as in Figure 5 in the main text, but for summer (June, July, and August). Note that the dominant precipitation falls over the PRD region in summer. The similar

differences of normalized contoured frequency by altitude diagram (ΔNCFAD) pattern as shown in Figure 5 suggest limited seasonal contamination. That is mainly because we focus on localized precipitation only, therefore strictly control on weather patterns are performed and large seasonal differences have been excluded. Furthermore, the potential influences of different dynamic and thermodynamic conditions during different seasons have been mostly revealed in section 3.4 in the main text. "

In addition, related description has also been added to discuss the potential effect induced by variation of samples with seasons in section 2.3.1.

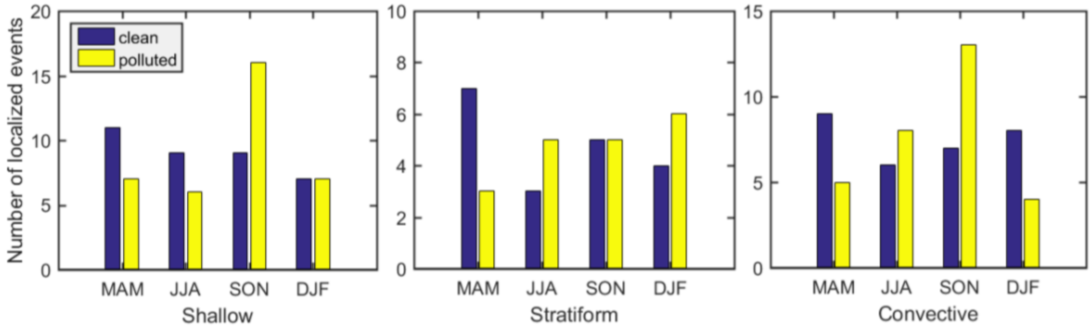

Figure S1. Seasonal distribution of the number of localized precipitating events for spring (March, April, and May), summer (June, July, and August), autumn (September, October, and November), and winter (December, January, and February). For each precipitation regime, blue and yellow bars represent clean and polluted conditions.

9. P13 L12: Figure4c -> Figure 4(c).
Response: It has been revised to Figure 4c to make it consistent with other instances throughout our manuscript.

10. PM_{10} datasets availability: Did PM_{10} data end in December 2012 and then replaced by $PM_{2.5}$ in 2013? Why we don't have any PM_{10} any more after 2012 to extend the study period longer? It is strange they stopped measuring PM_{10} after they switched to $PM_{2.5}$ in 2013.
Response: Good point! Actually, there are simultaneous $PM_{2.5}$ and PM_{10} observations after 2012. The study period stopped in the end of 2012 simply due to extremely large data volume acquired from Precipitation Radar onboard TRMM. More importantly, 6 years of data already show us robust results.

11. Figure 6: did you conduct the similar thing for shallow and stratiform precipitation?
Response: No, we did not do it, considering their relatively weak rain intensity. As shown in Figure 5a-b, either shallow or stratiform precipitation has relatively lower

radar reflectivity (less than 40 dBZ), compared with convective precipitation. In addition, it is hard for both of these two precipitation regimes to develop deeply to high altitudes. This further makes us not be able to do a similar analysis to convective precipitation.

12. Figure 7 and 8: I am not sure I understand them completely. But I do like the discussions associated with them.

Response: To improve the scientific importance and implications of Figures 7-8, we reorganized the structure of "Section 3. Results and discussion", please see our revised manuscript for more details.