

Review of manuscript doi:10.5194/acp-2016-1000

Satellite observed indications of aerosol effects on warm cloud properties over Yangtze River Delta of China

by Y.Liu et al.

General comments:

This study investigates the relationship between aerosol and meteorological parameters and low warm clouds properties using satellite observations. The authors focus on summertime periods during 2007-2010 over the Yangtze River Delta, a region characterized by a large variability in aerosol amount and composition. The research questions addressed in this work are highly relevant for an improved understanding of mechanisms of aerosol-cloud interaction and ultimately of aerosol indirect effects. The topic discussed is thus relevant to ACP readers. The manuscript is overall well written and the results are clearly presented. However, major aspects of the paper need to be revised as described in the following general and specific comments to be considered suitable for publication.

- Why only years between 2007-2010 are considered? Given the low availability of satellite observations during these years, as it appears for example in Figures 2-3, to draw more robust conclusions would require a larger sample size. An idea could be to analyze data for the whole acquisition period of CALIPSO (i.e. since 2006).
- It would be beneficial to have a figure/table showing satellite retrieval availability over the analyzed domain and in all figures the sample size should be also reported.
- The uncertainty in the analyzed satellite retrievals should be discussed and related to the significance of the relationships identified between AOD/CDR and other cloud properties. Further, more than half of the reported correlation coefficients are either not significant or very low. I don't see a strong evidence of most of the identified relationship between the analyzed variables, based on such a small sample size, considering the uncertainty in the used retrievals and the absence of significant regression parameters.
- The way results are presented could be improved to have a more fluent and connected discussion on aerosol effects on warm clouds properties instead of presenting a description of each figure as a separate paper section. The authors should integrate all findings in a more general framework including a wider discussion on all analyzed properties and how they relate to each other.

Specific comments:

- Page 4, line 4-11: what are the spatio-temporal scales of variability of aerosol and cloud properties and how are they represented by the satellite observations you are analyzing?
- Page 4, line 6-7: how did you analyze "the response to the increase in aerosol loading"? Did you look at AOD temporal trends? Or do you only mean you aim at analyzing the sensitivity of cloud properties to different aerosol loading? By extending your analysis to multiple years you could also look at trends in aerosol loading (if present and if enough data are available).
- Page 5, line 16: Why are you using Collection 5.1 instead of 6?

- Page 6, line 20: What is the vertical resolution of CALIOP/CALIPSO aerosol products?
- Page 9, line 5: Why such few data are available in Figure 2 compared to the other figures (i.e. from Figure 4 on)? A correlation coefficient R of 0.08-0.23 correspond to a coefficient of determination R^2 of 0.6-5% which indicate that your regression model is able to explain between 0.6 and 5% of the variability in the data. Further these correlations are not significant. These results need to be better interpreted in the manuscript and the robustness of your finding to be discussed. For example it is very hard to justify that “the correlation between these parameters is negative but weak” at line 14, based on the results presented in Figure 2a. Analysis of longer time series of satellite observations may help in strengthening your conclusions. In all figures the sample size should be also reported.
- In all figures: how are the data aggregated in time? Does each dot represent a daily observation?
- Page 9, line 8: you should include a reference describing the pollution classification based on AOD values.
- Page 9, line 11: this sentence needs to be rephrased. It is not clear what it means the “significance of the difference” and what the p-value refers to.
- Page 10: Are your results consistent with the literature? What type of significant relationship was found between COT/CWP and CDR in other studies? Given the lack of strong evidence in your results a wider discussion on what has been found so far in the literature is necessary.
- Page 11, line 8: why in all panels of Figure 4 there are many more points than in Figure 2 even considering only the mixed aerosol-cloud layers?
- Page 12, line 4: Please be more clear in explaining how you infer that “CDR is ~ 3times stronger...”
- Page 12, line 5: the discussion of pollution levels as a function of AOD should be introduced earlier in the paper given it is used since the first analyses presented. You should also discuss why you are choosing a threshold of 0.3 instead of 0.4 and in the cited reference.
- Page 14, Figure 5: Why do you not separate cases with $AOD > (<) 0.3$ in all panels? At least in panel b there could be a different relationship if this threshold is applied.

Technical corrections:

- Page 4, line 21: Figure 1 is not referenced in the manuscript, so it could be added where you introduce the analyzed domain.
- Page 6, line 7: the CALIPSO acronym needs to be defined
- Page 8, line 2: -2 needs to be superscript
- Page 5, line 12: Since you are using only data from MODIS Aqua, the reference to the Terra satellite should be removed everywhere in the paper.
- Page 11, line 12: a space is missing between “and” and “ σ ”
- Page 11, line 15: remove “a” before “cloud parameters”
- Is there a way to differentiate the figures? Using only red and blue in all figures/panels is misleading since the reader may associate a specific color to a specific property.