

Reply to comments by Reviewer#3 on “Multi-dimensional satellite observations of aerosol properties and aerosol types over three major urban clusters in eastern China”

July 13, 2021

We thank the reviewer for the thorough reading of the manuscript and the thoughtful comments which are helpful not only for this manuscript but also for our future research. Our replies to all comments are shown below in red.

Comments

1. The words in some subfigures overlapped the plots, e.g., SON and DJF in Fig.10.

Answer: Thank you for this suggestion, it will help readers to read the manuscript easier. So we made this change in all relevant figures in the revised manuscript and supplement.

2. Verification and correction of CALIPSO-based aerosol products is key to atmospheric environment and climate change. However, CALIPSO often cannot detect the full profile of aerosol for the low instrument sensitivity near the surface. Note that CALIOP may lose detection capability, if attenuated backscatter signal of aerosol is below $2\sim4\times10^{-4} \text{ km}^{-1} \text{ sr}^{-1} \text{ km}$. Particularly, the aerosol profile near the surface (below 1.5 km) always have higher uncertainties, and may contributed more errors to CALIPSO AOD. In recent decades, China has undergone rapid economic growth with high aerosol concentrations significantly increased over China, especially in PBL, implying that all the aforementioned large uncertainties in PBL should be discussed in section 2.3 or section 3.3.3.

Answer: We made the following change in the revised manuscript (see pg. 8 line 264-269 in the revised manuscript).

The text “CALIOP often cannot detect the full profile of aerosol due to the low instrument sensitivity near the surface, i.e. CALIOP may lose detection capability when the attenuated aerosol backscatter signal is smaller than $2\sim4\times10^{-4} \text{ km}^{-1} \text{ sr}^{-1} \text{ km}$ (Winker et al., 2009; Huang et al., 2013). In particular, the aerosol profile near the surface (below 1.5 km) has high uncertainties which may increase the error in the CALIPSO AOD (Guo et al., 2016a). The uncertainties can be constrained through data screening to some degree.” has been added in section 2.3 in the revised manuscript (see pg. 8 line 264-269).

3. In addition, some words are not uniform in section title ,e.g., setction titles 3.6, 3.7 and 4.

Answer: We made the following changes in the revised manuscript. The title “3.6 Air mass trajectories and origin of aerosol over the three study regions” has been changed to “3.6 Air mass back trajectories and origin of aerosol over the three study regions”, the title “3.7 Discussion” has been changed to “4 Discussion”, and the title “4 Summary and Conclusions” has been changed to “5 Summary and Conclusions” in the revised manuscript.

References

- Guo, J., Liu, H., Wang, F., Huang, J., Xia, F., Lou, M., Wu, Y., Jiang, J. H., Xie, T., Zhaxi, Y., and Yung, Y. L.: Three dimensional structure of aerosol in China: a perspective from multi-satellite observations, *Atmos. Res.*, 178-179, 580-589, 2016a.
- Huang, L., Jiang, J. H., Tackett, J. L., Su, H., Fu, R.: Seasonal and diurnal variations of aerosol extinction profile and type distribution from CALIPSO 5-year observations. *Journal of Geophysical research: Atmospheres*, vol. 118, 4572-4596, doi: 10.1002/jgrd.50407, 2013.
- Winker, D. M., Vaughan, M. A., Omar, A., Hu, Y. X., Powell, K. A., Liu, Z. Y., Hunt, W. H., and Young, S. A.: Overview of the CALIPSO Mission and CALIOP Data Processing Algorithms, *J. Atmos. Ocean. Tech.*, 26, 2310-2323, doi:10.1175/2009JTECHA1281.1, 2009.