

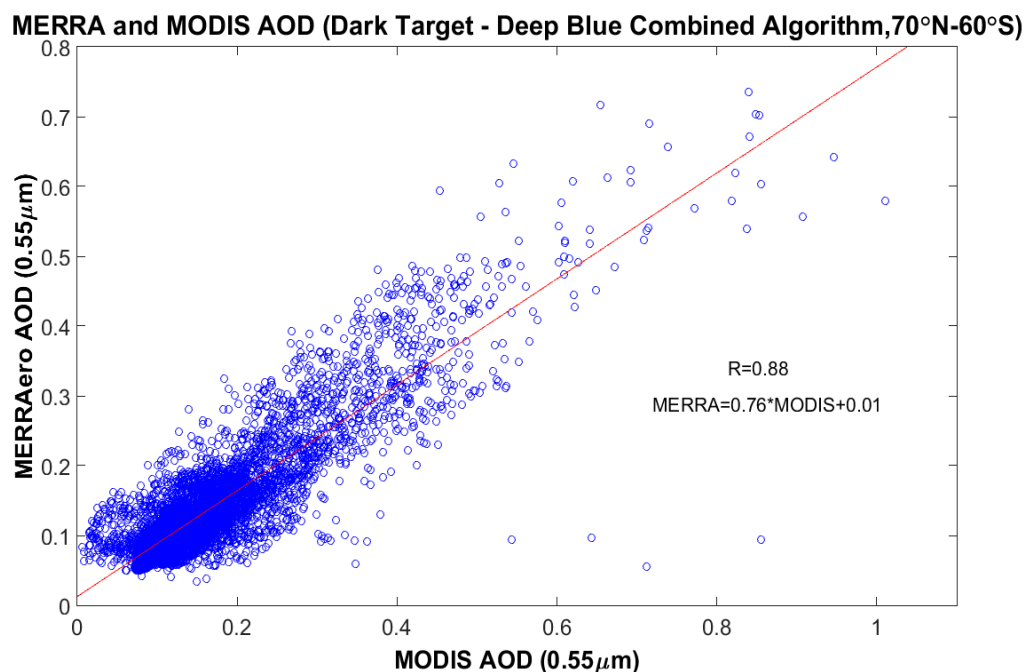
Anonymous Referee #1

Comment and Question:

1) Both MODIS and MERRA can provide aerosol optical depth and aerosol species, why did authors choose two datasets than one? How did authors combine aerosols, lightning and meteorological information from different platforms together?

Reply:

1.1) We did take into account which data to use, and compared MODIS AOD and MERRA total AOD (60°S~70°N), which shows a good correlation with $R=0.88$. For total AOD, these two products are well correlated. We believe that MODIS is closest to the real value among so many AOD products. So we used MODIS AOD in the statistical analysis. However, MODIS can't measure the magnitude of different aerosol species which contribute to total AOD. So in the process of determining study areas, we used MERRA total AOD and the AOD of different aerosol species, to ensure that dust and biomass burning aerosols are dominant in these two areas.



1.2) In order to match lightning data ($2.5^{\circ}\times 2.5^{\circ}$), all AOD (MODIS: $1^{\circ}\times 1^{\circ}$) and meteorological data ($1^{\circ}\times 1^{\circ}$) are resampled to $2.5^{\circ}\times 2.5^{\circ}$ resolution grids in the analysis. For each variable, the value on each grid is the mean value of closest grids within a 1.25° radius.

2) *Page 5, Line 85: Referring to dust effect on drought, following articles should be cited. Huang, J., T. Wang, W. Wang, Z. Li, and H. Yan, Climate effects of dust aerosols over East Asian arid and semiarid regions, Journal of Geophysical Research: Atmospheres, 119 (2014), 11398–11416, doi:10.1002/2014JD021796. Huang J., Y. Li, C. Fu, F. Chen, Q. Fu, A. Dai, M. Shinoda, Z. Ma, W. Guo, Z. Li, L. Zhang, Y. Liu, H. Yu, Y. He, Y. Xie, X. Guan , M. Ji, L. Lin, S. Wang, H. Yan and G. Wang, 2017: Dryland climate change recent progress and challenges. Reviews of Geophysics, 55, 719-778, doi:10.1002/2016RG000550.*

Reply:

Indeed, these two papers are closely related with our study that are added to the references.

3) The potential temperature is conserved for a parcel of air that is unsaturated and remains unsaturated as it rises and sinks. For deep convection condition, it is far away from adiabatic process. So why don't use the pseudo-equivalent potential temperature?

Reply:

In this study, we didn't consider specific convection process. We used temperature to characterize the surface thermal condition which may be conducive to the development of convection. As air temperature generally decreases with altitude and the underlying surface is not flat, we used the conserved variable potential temperature instead to describe surface thermal condition.