Response to Reviewer 1 （Anonymous Referee）

General comments:

This work investigated impacts of meteorology and aerosols on lightning activities in Africa based on products from TRMM, MODIS and MERRA and so on. Authors examined six meteorological variables to analyze the dominant role by thermodynamics and attributed the differences in lightning under clean and polluted conditions to aerosol effect. They separated the northern Africa and the southern Africa dominated by dust and smoke aerosols, respectively. And they found different radiative effects of different aerosol species. This work presents valuable information to understand aerosol effects on lightning. Some minor questions/suggestions need to be solved are listed in the following.

General response:

We thank the reviewer for the valuable comments and suggestions that have helped us improve the paper. Our detailed responses to the reviewer's questions and comments are listed below.

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?

Response:

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 cannot measure the magnitudes 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°×2.5°), all AOD (MODIS: 1°×1°) and meteorological (now called dynamic-thermodynamic) data (1°×1°) are resampled to 2.5°×2.5° resolution grids

in the analysis. For each variable, the value in each grid is the mean value of the closest grids within a 1.25°radius.

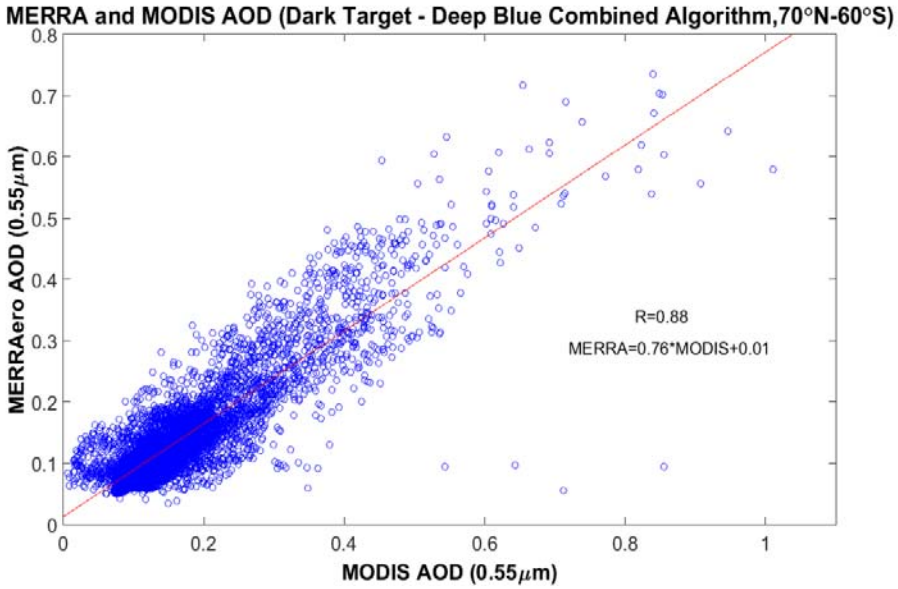

Fig. R1. Comparison of global MODIS and MERRA monthly aerosol optical depth (AOD) at 550 nm for the period 2003–2013 (May, June, July of each year). R is the correlation coefficient.

(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.

Response:

Indeed, these two papers are closely related to our study and have been cited/added to the reference list.

(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?

Response:

1) Yes, in unstable convection, two processes are involved: the dry process under the cloud base and the moist process above the cloud base. Potential temperature is conserved in the dry process, but in the real troposphere, it usually increases with increasing altitude. In this study, potential temperature is calculated to correct the effect of altitude on the 2-m temperature. Its horizontal distribution can reflect the thermal condition at the level of equal altitudes: In places with higher potential temperature, warm air rises. Although potential temperature appears to have nothing to do directly with the moist process, places with higher potential temperatures have larger updrafts when the moisture is fixed. Therefore, when there is enough moisture, places with higher potential temperatures are more favorable for convection.
2) The pseudo-equivalent potential temperature includes both temperature and moisture and may be the better choice when investigating the correlation between deep convection (lightning activity) and a thermodynamic parameter. But in our study, we examine the relative roles of several parameters and their total contribution to lightning activity, so we selected potential temperature to reduce the repeatability of humidity information. In an ongoing study, we are selecting parameters more carefully and evaluating them.

Response: 2018/7/23