The Australian fires have recently drawn lots of attention, especially the three-month long and gigantic one last year. The manuscript presents a topical research to characterize the aerosol properties during the fire season in Australia, with a focus of the 2019-2020 extreme case. The authors' efforts in collecting and analyzing several observational and modeling data from multiple sources (e.g. MODIS/CALIPSO satellites, ground-based AERONET, MERRA2 reanalysis) are commendable. The manuscript is easy to follow and fit to the scope of ACP very well. I recommend its publication with ACP, while I also have minor comments below for the authors to address.

1. The authors have done a good job in analyzing the aerosol distribution in both spatial and temporal domain. As a step forward, it would be interesting to examine the spatiotemporal variations of the absorbing capability of the aerosols from the wildfires in Australia. Since the AERONET has single scattering albedo (SSA) as a product, it would be a low-hanging fruit to analyze it. In particular, how well the BC and OC from MERRA2 are correlated with the observed SSA is of great interest.

2. Please label out years in Figure 2.

3. How are the aerosol volume size distributions measured by the AERONET? If they are from remote sensing retrievals, how reliable they are? Some references are needed here.

4. About the comparison of AOD between MERRA2 and AERONET, I assume AERONET only report AOD in the non-cloudy days, while MERRA2 can calculate AOD anytime. Such a sampling issue needs to be mentioned.

5. Fig. 8, please clarify at which level the mass concentrations are. Near surface?

6. MERRA2-Aero has black carbon and organic carbon separately. Does the term "carbonaceous" in the paper refers to the summation of those two species? Please clarify.

7. What is the source of dust detected at heights from 2 to 5 km in November 2019, January, and February 2020? From fire or from the desert in the west?