

Interactive comment on “Biomass burning aerosol properties over the Northern Great Plains during the 2012 warm season” by T. Logan et al.

Anonymous Referee #2

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In Logan et al.’s “Biomass Burning Aerosol Properties over the Northern Great Plains during the 2012 Warm Season”, the authors examine differences in aerosol optical and physical properties retrieved AERONET for six biomass burning plumes. Specifically, the authors use volume size distributions as well as spectral AOD, AAOD, and a calculated “co-albedo” parameter to distinguish between the six case study days. Differences in the spectral shapes of the AOD and AAOD were primarily influenced by differences in particle size distributions. On the other hand, variations in the spectral dependence of the co-albedo was attributed to differences in the carbonaceous aerosol concentration and type (i.e., strongly versus weakly absorbing). Finally, a relationship between plume transport time and variability in the spectral dependence of the three optical parameters was sought.

Though the manuscript presents an interesting approach to examining AERONET data, it has some significant shortcomings that need to be addressed prior to publication. In general, both the methods and results and discussion seem underdeveloped and lack both detailed explanations and robust comparison to previously literature. For instance, there is no direct mention of how the six case study days examined were chosen. It is suggested in paragraph 2 of section 3.1 (starting on page 32275, line 6) that HYSPLIT was used after the case study days were chosen to identify biomass burning source region. However, presumably HYSPLIT was actually used, along with AOD440, to identify case study days. A more detailed description of the process involved in case selection needs to be included in the methods. Additionally, reasons for calculating the co-albedo as the ratio of AAOD to AOD are unclear. Why not just use $(1-SSA)$ for the co-albedo (should be the same value since $AAOD=(1-SSA)*AOD$)? Even if the calculation and usefulness of AAOD/AOD is explained elsewhere (e.g., Logan et al., 2013), the reason for its use should still be mentioned here. It is also not clear which values for AAOD, AOD, and size distributions are used in the analysis. Are daily mean values or one “representative” hourly measurement for each day plotted in Figure 4 and discussed in Section 3.2? This should be explained in both the discussion of Figure 4 as well as in the Figure 4 caption. Additionally, assuming there is more than one AERONET measurement for each day, the variability in each parameter for each day should be noted both in the text and by the addition of error bars to Figure 4.

The results seem a bit over interpreted at times, primarily due to the absence of any statistical analysis. For instance, while there appears to be a relationship between size distributions and the Angstrom exponent for some of the case study days, all values fall within a fairly narrow range (1.54-1.98) and indicate the presence of smaller particles. It is possible that despite apparent differences, these values are not statistically different therefore eliminating the need to explain trends. Similarly, the absorption Angstrom exponent (AAE) values fall around 1 for all cases (though Case VI is a bit lower) suggesting BC is the dominant absorber. As with the Angstrom exponent, it is possible these values are statistically similar and therefore differences between case study days are

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simply due to random noise and not differences in carbonaceous aerosol as suggested by the authors. If there is more than one measurement per case study day, statistical analysis should be performed to assess the actual differences in daily mean Angstrom exponents, AAOD, and co-albedos. Further, it would be helpful if values reported by the same AERONET station for non-biomass burning days were reported and included in the statistical analysis to highlight the claim that these biomass burning cases consist of aerosols with unique properties.

It is incorrect to attribute all absorption at 440 nm to OC as BC is noted to absorb strongly at all wavelengths. Thus, changes in the co-albedo at 440 nm may not solely reflect changes in the OC as is suggested on page 32277, lines 19-22. Distinguishing between strongly and weakly absorbing OC should therefore be avoided without supporting chemical measurements. Further, based on the AAE values reported in Table 1 (nearly all 1) as well as the positively-sloped spectral co-albedos plotted in Figure 4d, OC appears to have a minimal influence on absorption for any of the plumes. It is possible that cases study days with more “spectrally-flat” co-albedos (e.g., II and V) have a larger contribution from OC to total absorption however this is merely speculative without chemical measurements. The authors note that interpreting OC and BC contributions to absorption from AERONET data is difficult (lines 17-22, page 32276), yet there is considerable effort made to explain trends in spectral optical properties using changes to OC and/or BC. The authors need to be more cautious about making such conclusions, especially since it is not known whether or not the differences in co-albedo and AAE values are statistically significant.

Finally, a more complete comparison of the results presented here to those previously published for biomass burning aerosol needs to be included to validate the claims made by the paper. Specifically, the Angstrom exponents, AAODs, and co-albedo should be compared to those values measured previously for biomass burning aerosols, especially those for which the combustion conditions are known (see publications on the FLAME 1, 2, and 3 experiments). Comparisons to previous literature should include

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both daily mean as well as max and min hourly values.

A few more editorial comments:

-The first paragraph in Section 1 (pg.32271, line 1-12) seems out of place. The introduction should instead start with paragraph 2 (currently starts pg 32271, line 3) and the first paragraph should be moved down, either placed above or merged with the paragraph starting on line 18 (pg 32272).

-Omit “solar” on line 3, pg 32272.

-Omit “of the retrievals” on line 7, pg 32274.

-“Will use” should be “used” (pg 32274, line 14).

-Include co-albedo and transport time values in Table 1.

-Figure 3 needs a more descriptive caption (i.e., what are the data shown? Model results? Concentrations?).

-All figures need larger axes labels and titles.

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