**Response to David Giles**

We would like to thank David Giles for the useful comments. We have responded to each specific comment in detail as well as updated the manuscript according to the suggestions, which we believe has helped to strengthen and clarify portions of the study. Comments are in blue and italics, and our responses are in black.

*Some areas for consideration and revision are below.*

*1. Please find these papers (and references therein) which use AAE and EAE as well as other methods for aerosol classification using AERONET data.*

*Giles, D. M., B. N. Holben, T. F. Eck, A. Sinyuk, A. Smirnov, I. Slutsker, R. R. Dickerson, A. M. Thompson, and J. S. Schafer (2012), An analysis of AERONET aerosol absorption properties and classifications representative of aerosol source regions, J. Geophys. Res., 117, D17203, doi:10.1029/2012JD018127.*

*Giles, D. M., et al. (2011), Aerosol properties over the Indo Gangetic Plain: A mesoscale perspective from the TIGERZ experiment, J. Geophys. Res., 116, D18203, doi:10.1029/2011JD015809.*

Thanks for pointing those papers out. We included references to the papers in the introduction section.

*2. On page 3454-3455, in regards to AERONET data, AAE is computed using SSA by first determining the absorption aerosol optical depth (AAOD), where AAOD = AOD(extinction) * [1-SSA] for each wavelength. Please also mention how you obtained the scattering AOD (e.g., AODsct = AODext-AODabs).*

In section 2.1 we included the following sentence:

"This way, AAOD = AOD*(1-SSA) and SAOD = AOD*SSA."

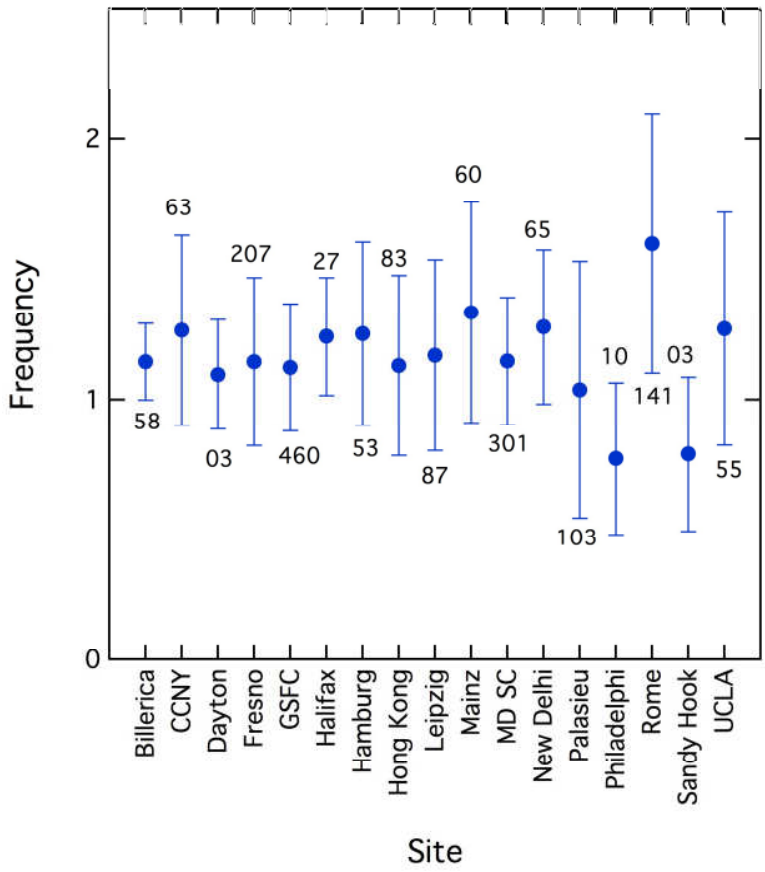
*3. In Table 2, using AERONET sites such as "Philadelphia" and "Sandy_Hook" have a very small contribution when compared to nearly two decades of GSFC data. Please discuss why these sites were chosen or consider using sites with larger data volume.*

The AERONET network itself does not classify its sites, as such we relied on the classification of Xia et al. (2008) to identify the urban and non-urban sites used to determine the AAE for fossil fuel dominated aerosols.

The reviewer does however bring up an important point – that the ensemble may be dominated by measurements from a single site due to a large imbalance in data coverage. The following figure illustrates the average AAE at each of the sites

used, along with the number of valid AAE measurements (since AERONET needs a threshold of AOD for a valid SSA retrieval, the set of AAE measurements is much smaller than the total set of measurements).

First, we find that other than Philadelphia (10 points), Sandy Hook (3 points), and Dayton (3 points) the other 14 sites all have more than 50 retrievals, with a comparable size of data set at each one. For the AAE value itself, the outliers are Philadelphia (0.77), Sandy Hook (0.79), and Rome (1.59), with the other 14 sites showing consistent measurements of AAE. Based on this figure we are confident that the ensemble average accurately represents "Urban" sites, and is not unduly balanced by any one site.




*4. On page 3456, more discussion and references to previous work are needed with respect to the classification thresholds shown in Figure 1. For example, could you provide more discussion on the thresholds (e.g., AAE of 1.0 and 1.5 and SAE*

*of 1.0 and, 1.5 and diagonal mixed category (AAE 1.5, SAE 1.5 to AAE 1.0, SAE 1.0)) used for determining the aerosol classification?*

In the supplemental material of Bahadur et al. (2012), a threshold value of AAE=1.5 was found to demarcate the dust dominated region fairly well, containing 72% of all measurements in dust-dominated regions, but only 17% of measurements in fossil fuel dominated regions. Therefore, we use AAE=1.5 to delineate only aerosols that have an enhanced absorption at shorter wavelengths (i.e. dust and OC); and their external mixtures. All smaller values of AAE are then considered to have an influence of EC leading to more complex mixtures. Similarly, SAE of 1.5 was found to reasonably delineate the fine mode aerosols (EC and OC); and their external mixtures. All smaller values of SAE are then considered to have an influence of larger particles (such as dust or coated large particles), again leading into the mixture containing regions of the phase space.

In section 2.1, when presenting the Angström matrix we included the following clarification:

"This partition is based on a simplified division published by Bahadur et al. (2012). In the supplemental material of Bahadur et al. (2012), a threshold value of AAE=1.5 was found to demarcate the dust dominated region fairly well, containing 72% of all measurements in dust-dominated regions, but only 17% of measurements in fossil fuel dominated regions. Therefore, the condition of AAE>1.5 has been retained to delineate the aerosols that have an enhanced absorption at shorter wavelengths (i.e. dust and OC) with smaller values of AAE considered to have an influence of EC leading to more complex mixtures. Similarly, SAE of 1.5 was found to reasonably delineate the fine mode aerosols (EC and OC) with smaller values of SAE considered to have an influence of larger particles (such as dust), again leading into the mixture containing regions of the phase space. In our partition, the inclusion of mixtures changes some of the phase boundaries. Thus, the phase boundaries for large particles and "EC dominated" particles were relaxed to the more intuitive value of 1.0."

*5. How do you explain AAE values less than one? Please see Giles et al., 2012.*

As suggested by Lack and Cappa (2010), and also mentioned on Giles et al. (2012) we believe that AAE values less than 1.0 corresponds to BC particles that are internally coated by a sulfate shell or, also they might represent situation of dust polluted with a strong absorber.

We included a clarification when the Angstrom matrix is presented:

"The lower-left quadrant has been labeled as "coated large particles" indicating that it contains a species with AAE<1 but larger in size. Lack and Cappa (2010) showed that

black carbon particles with a sulfate coating might present those optical properties, and polluted dust with strong absorbers might also present the same spectral response"

*6. Can you provide uncertainty estimates on the AAE and SAE derived from in situ aircraft data?*

AAE and SAE are calculated using the direct measurement of the scattering and absorption coefficient at several wavelengths, knowing the uncertainty of these measurements, we can calculate the uncertainty of the AAE and SAE using error propagation. The error will depend on the magnitude of the scattering and absorption coefficient, but using a mean value, the uncertainty is estimated to be 0.06 for AAE and 0.003 for SAE. These values are negligible compared to the error of obtaining the AAE and SAE by inversion.

*7. AERONET principal investigators should be acknowledged based on the AERONET data usage policy. http://aeronet.gsfc.nasa.gov/new_web/data_usage.html*

We included the appropriate acknowledgement.

**References**

Bahadur, R., Praveen, P.S., Xu, Y.Y. and Ramanathan, V.: Solar absorption by elemental carbon and brown carbon determined from spectral observations. P. Natl. Acad. Sci. USA. 109(43), 17366-17371 , 2012.

Lack, D. A. and Cappa C. D.: Impact of brown and clear carbon on light absorption enhancement, single scatter albedo and absorption wavelength dependence of black carbon. Atmos. Chem. Phys., 10, 4207-4220, 2010.

Xia, X.G., Eck, T.F., Holben, B.N., Phillippe, G. and Chen, H.B.: Analysis of the weekly cycle of aerosol optical depth using AERONET and MODIS data. J. Geophys. Res.-Atmos. 113(D14):11. 2008.