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Atmospheric Chemistry and Physics
Discussions

Interactive comment on "Key factors affecting single scattering albedo calculation: Implications for aerosol climate forcing" *by* Duseong S. Jo et al.

Anonymous Referee #1

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This manuscript studied the sensitivity of SSA calculations to the physical properties of absorbing aerosols, namely Black Carbon (BC), Brown Carbon (BrC), and dust in the GEOS-Chem 3-D global chemical transport model using a post-processing tool for the aerosol optical properties (FlexAOD). Sensitivity studies were performed to study the influences of the physical parameters of BC, mixing state, dust size distributions, and the presence of BrC on the calculation of SSA. However, it seems that the authors only assessed the sensitivity of one small component of the model (FlexAOD) to selections of some parameters for a fraction of the filtered AERONET sites. Assessing the impact of most of these parameters has been widely done in the literature (e.g. Boucher and Anderson, 1995; Sokolik and Toon, 1996; Liao and Seinfeld, 1998; Haywood et al., 1997; Myhre et al., 2002). It seems that the present work does not add new information.

It does not provide a systematic estimation of the uncertainties in these parameters, does not reduce the uncertainties at a global scale by using the AERONET measurements, and does not reduce the uncertainty in the simulated SSA by combining the model and observation estimates (e.g., Bayesian). Thus, the present manuscript lacks the global significance and the broad scientific significances that can improve the simulations of SSA. I do not recommend publishing the present manuscript in the journal of ACP. Some detailed comments are below: Line 12, Page 6: The physical process is not clearly described. How does the model consider the conversion of hydrophobic to hydrophilic BC (or OA)? First, the authors did not explain how they compute the optical properties for hydrophobic and hydrophilic BC (or OA), which is particularly important in their simulations of internal mixture. Second, if the authors adopted a fixed aging rate for BC (or OA), it can affect the simulated concentrations of BC (or OA). Line 20, Page 7: Please specify the temporal resolution of GFED data used in this study. If the authors used the annual mean data, it should affect the simulated seasonality of BC and BrC. Line 9, Page 8: Regarding the homogeneous internal mixing, it is unclear how the authors treat this mixing case in their simulations (Maxwell Garnett or volume mixing?). Line 15, Page 8. As aerosol optical property calculation is important for the present paper, the authors can give more information. Line 25, Page 8. It is unclear how the authors changed the size distribution of aerosols in the model. First, it lacks a description of the method on how GEOS-Chem treats the size distributions in the model. Does it use a bulk scheme, or a sectoral scheme? If I understood it correctly, the model used by the authors uses a bulk method. When the authors change the size distributions in FlexAOD, did the authors also make the same changes in the GEOS-Chem transport model? This is important, because the size distributions also affect the lifetimes of BC and BrC in the transport. Please make it clear and justify the method. Line 25, Page 8. The authors can consider showing three maps for the site locations of the AMS, SPARTAN and AERONET networks. Even it is helpful to zoom in one or two regions to show the relationship (overlap) of these networks. Line 20, Page 9: Please change "X" to "$\times$". Line 19, Page 13. The authors need to cite a reference to support this statement. Line 6, Page 14: The authors should confirm that the two studies are using the same observational network before doing such a comparison. Line 10-20, Page 14: It is not clear how the authors “selected simulate results at AERONET sites”. There are two possibilities: first, they had run N simulations, but used only a fraction of these simulations to compare with the AOD and SSA at all AERONET sites; second, they had run N simulations, but compared all these simulations with the AOD and SSA at a fraction of AERONET sites. Please make it clear. Line 5-17, Page 15 and Figure 5: Regarding the AERONET data, it is unclear if the authors are using the Level 1 or Level 2 data. It is unclear if the authors are comparing the daily, monthly or the yearly mean SSA between model and measurements. It is also unclear if the authors are comparing the SSA for exactly the same days between model and measurements or not. Please make them clear. Line 10, Page 15: “the model underestimated the observed absorption (1-SSA) by -50 %”. According to this sentence, it seems to say that absorption is equal to (1-SSA). Thus, the authors neglected the fact that the absorption depends on the mass of BC as well as the SSA. It can be rephrased. Line 3, Page 16: The SSA should be sensitive to the imaginary part of the dust refractive index (Liao and Seinfeld, 1998), which is not considered. Line 20, Page 16: Better to show (1-SSA) than SSAs, since absorption is proportional to (1-SSA). References: Boucher O., and T. L. Anderson, 1995: GCM assessment of the sensitivity of direct climate forcing by anthropogenic sulfate aerosols to aerosol size and chemistry. J. Geophys. Res., 100, 26 117–26 134. Liao H, Seinfeld J H. Radiative forcing by mineral dust aerosols: sensitivity to key variables. Journal of Geophysical Research: Atmospheres, 1998, 103(D24): 31637-31645. Haywood J M, Roberts D L, Slingo A, et al. General circulation model calculations of the direct radiative forcing by anthropogenic sulfate and fossil-fuel soot aerosol. Journal of Climate, 1997, 10(7): 1562-1577. Myhre G, Stordal F, Berglen T F, et al. Uncertainties in the radiative forcing due to sulfate aerosols. Journal of the atmospheric sciences, 2004, 61(5): 485-498. Sokolik I N, Toon O B. Direct radiative forcing by anthropogenic airborne mineral aerosols. Nature, 1996, 381(6584): 681-683.

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