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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Effects of internal mixing and aggregate morphology on optical properties of black carbon using a discrete dipole approximation model" *by* B. Scarnato et al.

Anonymous Referee #1

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This study shows the effects of black carbon (BC) shape and mixing states on its light absorption. When BC mixes with NaCl particle, it has higher mass absorption coefficient, lower single scattering albedo, and higher absorption Angstrom exponent, compering to "bare" BC aggregate. The exact values depend on BC shape and sizes. They observe these particles using electron microscopy and calculate the optical properties using discrete dipole approximation. This study reveals importance of BC morphology and mixing states for its light absorption and has implication in climate modeling and remote sensing measurements. This paper shows interesting results, but some more works will enhance the importance.

1: Why NaCl particles are chosen? Although the reasons are explained in p 26407 and 26413-26414, yet mixtures of NaCl and BC are not dominant in the atmosphere since they are emitted from totally different places (sea surface vs burning of carbonaceous materials). Mixtures of sulfate, organic aerosol, and nitrate would be more important for the atmospheric implication (e.g., Moffet et al., 2008).

2: The mixed particles were obtained from a solution in water. However, the forming process unlikely occur in the atmosphere, and it is probable that the morphologies of the mixed particle differ from those from ambient air. Although most calculations were obtained from the modeled particles, explanations or comparison with other studies that show ambient particle shape of such mixtures are needed.

3: In Fig. 3a, there is almost no difference on MAC at wavelength $\sim$550nm, which is the most important for the BC absorption. It seems that this result contradicts much of the discussion in this study. It should be noted that, although there are huge differences for MAC in each particles at wavelength <500 nm (especially around 200 nm), solar radiation is relatively weak at the wavelengths.

4: P26413 line 8-14. Simulated particles A to E in Fig. 2 have different monomer sizes and number, fractal shapes, and volumes. Thus, it is difficult to discuss the effects of compactness, monomer sizes, or number of monomers on the optical properties separately. It should be effective to change only one factor and keep other factors unchanged to discuss each effect.

5: P 26414 line 7-18. The discussion about BC and its coating (effects of BC position and coating) is systematically discussed in Fig 4 by Adachi et al. (2010) using fractal BC particles, and the reference would enhance the discussion. The meaning of L13-14 "(i) the larger refractive index of the NaCl surrounding the BC (Bohren, 1986; Flanner et al.,2012)" is unclear, i.e., larger than what?

6: P26416 L21-23: "The amplification factors of the MAC, attributed to the mixing state of BC with NaCl, vary between 1.2 and 2.7 and are largely independent of wavelength in the visible spectrum:" Please show more discussion regarding the values of the amplification factor. How is "1.2" obtained? In P26414 L6, there is "2.2-2.7" but not 1.2.

References

Moffet, R. C., de Foy, B., Molina, L. T., Molina, M. J., and Prather, K. A.: Measurement of ambient aerosols in northern Mexico City by single particle mass spectrometry, Atmos. Chem. Phys., 8, 4499-4516, doi:10.5194/acp-8-4499-2008, 2008

Adachi, K., Chung, S. H., and Buseck, P. R., Shapes of soot aerosol particles and implications for their effects on climate, J. Geophys. Res., 115, D15206, doi:10.1029/2009JD012868, 2010.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 26401, 2012.