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Interactive Comment

Interactive comment on "Absorption Ångström coefficient, brown carbon, and aerosols: basic concepts, bulk matter, and spherical particles" *by* H. Moosmüller et al.

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It is recognized that the optical properties of atmospheric soot containing aerosols determine its anthropogenic radiative forcing. Recent climate model analysis suggests that it could be the second most important warming agent after CO2, and its control would immediately reduce human forcing of climate. However, the optical properties of brown carbon (black carbon mixed with other light organics that absorb at shorter wavelengths) are complex and conceptual models such as the ones developed and reviewed here go a long way in helping us hone our intuition of what fundamental physical (size) and chemical (composition-band gap) capture the wavelength dependent light absorption properties of carbonaceous aerosols to facilitate realistic forcing estimate. Relationships to optical properties (refractive index) of bulk systems provide valuable constraints that can be used for this. By using highly idealized systems, the paper compares and clarifies issues with other approximations and their limitations that have been published. Hence it is very important that this be published, even though the results are presented on ideal systems.

In order to make the paper more useful, testable and climate relevant I urge that the authors add to their conclusions that their framework could be tested and developed in the laboratory. This could be done by using spherical carbon mimics (e.g. dyed spheres, sphero-carb, soot spherules?) and coating them with organic substrates that absorb say at 300nm (and 325 nm, 350 nm and 375 nm) and also varying the band-gap parameters. The model could then be tested to develop a robust framework that would then be developed further to tackle the more complex morphological issues with fractal soot networks.

Some other suggestions that are necessary make this more useful to the community would be

(1) Explain and elaborate on the "frequently noisy specta" in a brief paragaraph in introduction? Is this an instrumental limit or the nature of the complex brown carbon-including spectral structure? AAE essentially analyze low frequency component of the structure, has this been done in other fields like electronic molecular spectra, continuum, dissociaton etc (ot would be good to site). (2) Please cite field observations of optical properties and analysis of AAEs of brown carbon and note that AAEs etc also depend on chemical composition (UV absorbing components like nirates and hetero-N rings) and your mode could capture the "mean field" represented by them: Optical-chemical-microphysical relationships and closure studies for mixed carbonaceous aerosols observed at Jeju Island; 3-laser photoacoustic spectrometer, particle sizing, and filter analysis B. A. Flowers, M. K. Dubey, C. Mazzoleni, E. A. Stone, J. J. Schauer, S.-W. Kim, and S. C. Yoon Atmos. Chem. Phys., 10, 10387-10398, 2010. A

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question for the authors to answer is can their idealized bottom up framework capture the the variations (chemical and mixing and morphology) even in a mean field sense from field data? (3) The “curvature” in extinction AEs vs wavelength and its use in dissecting bimodal size distributions from remote AERONET spectra is very relevant and analogous to the AAE approach developed here and the paper by Schuster, Dubovic and Holdben, JGR 111, D07207, 2006 would be valuable to site in the introduction for pedagogic completeness (4) It should be noted that reliable multiple (3 wavelength) photoacoustic absorption measurements are now becoming routine (e.g Flowers et al 2010, Chakravorty et al 2010) and the AAE framework developed here will allow us to gain mechanistic insights on the nature and optical properties of brown carbon. (5) Please do not limit to 2 wavelength AACs but think of the more general case of curvature and multiple wavelengths. (6) A key outstanding question to mention upfront is How do UV absorbing materials (e.g. with bulk absorption peaks at 275-375 nm) effect light absorption by aerosols in the solar actinic region that is important for both climate forcing and photochemistry ? This paper provides a path towards discenting the effects of the UV absorpion on AAEs in this region. I think a follow up paper that quantifies this via sensitivity studies and also laboratory studies will provide tremendous insights into this outstanding problem. (7) Equations 1 b and 3 have an extra open bracket (8) The conclusions should be more firm and critical on the other conceptual models that give unphysical or unobserved behavior, and also provide the next steps to develop this conceptual framework into quantitative and validated tool to use AAEs coupled with size and chemical measurements to get to the heart of the brown carbon problem (e.g. Flowers et al 2010) with modern state of the art messurements (optical-photoacoustic, size-SMPS/laser-optical etc and chemistry-AMS) (9) Figure 8 needs to be updated by authors and made more legible in the final manuscript.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 24735, 2010.