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Interactive comment on "Absorption closure in highly aged biomass burning smoke" *by* Jonathan W. Taylor et al.

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In their manuscript, Taylor et al. conclude that the contribution to aerosol light absorption at 405 nm by brown carbon (BrC) is roughly 10%, as inferred from the difference in the measured light absorption at that wavelength and the value extrapolated from measurements at 514 and 655 nm together with the assumption that the absorption due to black carbon (BC) over all three of these wavelengths is inversely proportional to the wavelength. We wish to point out that this is not necessarily a valid assumption. We are not suggesting that they did not measure absorption from BrC (which they discuss in more detail later in their manuscript), but merely want to state that the absorption from black carbon particles is not always inversely proportional to the wavelength; or, alternatively, that the absorption Angstrom exponent (AAE) for BC is not exactly equal

to unity.

To demonstrate that this is the case, we calculated (see Fig. 1) the AAE for the 405-514 nm and the 514-655 nm wavelength pairs for monodisperse aerosols of pure BC spheres, using the index of refraction used by Taylor et al. (2.26-1.26i). The AAE for the 405-514 nm pair increases from 1.0 for very small diameters (< ∼20 nm) up to a maximum of 1.54 for 80 nm diameter particles, after which it decreases to 1.43 for 100 nm diameter particles, 0.2 for 150 nm diameter particles, and -0.19 for 200 nm diameter particles, remaining below zero for larger ones. The behavior of the 514-655 nm AAE is similar, but the diameters are shifted to larger values. For diameters less than ∼90 nm, the AAE for the 405-514 nm pair is greater than that for the 514-655 nm pair, and the argument of Taylor et al. would attribute some of the BC absorption at 405 nm to BrC. Similarly, for diameters greater than ∼90 nm, there would be a deficit of absorption at 405 nm.

For BC particles with associated substances (commonly referred to as coatings) the situation is perhaps more extreme. We also performed calculations for BC coated with a nonabsorbing coating in a concentric core-shell configuration, using 1.5-0i for the index of refraction of the coating, a BC core mass-equivalent diameter of 100 nm (corresponding to a mass of 0.94 fg), and a coating:core mass ratio of 20 (corresponding to a coating thickness of 104 nm, using a core density of 1.8 g/cmˆ3 and a coating density of 1.3 g/cmˆ3). Such particles are in the center of the hot spot of their 2-D distribution shown in Fig. 5 of their manuscript. For such a large coating:core mass ratio the assumption that a core-shell configuration accurately yields the absorption of the particle seems not unreasonable. The AAE for the 405-514 nm wavelength pair is 0.49, whereas that for the 514-655 pair is 1.53, neither of which is near unity. Furthermore, extrapolation of the latter AAE to 405 nm would result in less absorption than measured.

We realize that BC particles are not spheres, and perhaps not concentric core-shell configurations, and certainly not monodisperse. However, the assumption that the

AAE is identically unity for BC absorption, which is the premise of one of the arguments made by Taylor et al. to infer BrC absorption, is not necessarily true.

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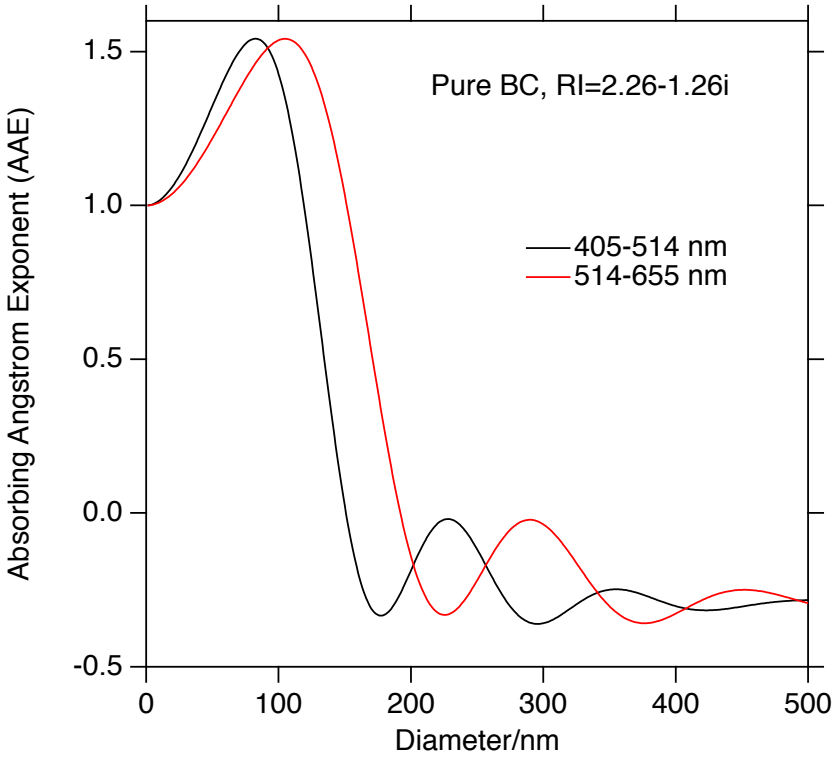

Fig. 1. absorbing Angstrom exponent of pure black carbon spheres