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Interactive comment on “Sources of uncertainties in modelling Black Carbon at the global scale” by E. Vignati et al.

Anonymous Referee #3

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This is a good paper, and suitable for publication in ACP. Here are my suggestions for certain sections of the paper.

Major issues: – Page 5, line 2 I enjoyed the discussion about the BC/EC differences, but I disagree with this sentence:

"Regrettably however, these discrepancies are usually disregarded in the literature and the terms elemental carbon and black carbon are used interchangeably as synonyms of soot."

The measurement community is very good about using the conventional operational definitions. The modeling community uses both terms interchangeably, but that is ok since both measurement techniques are attempting to measure the same thing (i.e.,

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the nearly graphitized portion of soot). –

Page 5, line 6 The authors state:

"Of the three, the term black carbon is the one most commonly used in the climate modeling community for soot/black carbon/elemental carbon, as it refers to the optical property, which is that relevant for climate."

I disagree that BC refers to an optical property; BC is *derived* from an optical property, but it doesn't really refer to an optical property per se (i.e., units are still mass of BC per unit volume of air). Since the optical properties of BC changes as BC becomes internally mixed with other aerosols (and the instrument does not account for this because it uses a single specific absorption for conversion), the optical information is essentially unknown.

I suspect (but do not know) that the modeling community has converged on the term BC because they often compare their results to aircraft measurements. Since thermal methods are generally too slow for aircraft measurements, modelers often use the term BC. –

Page 11, line 26: What and where are the long term campaign measurements of EC and BC? Some info about these campaigns should be included, as well as info about the instruments that are used to measure BC. –

Page 14, lines 12-20: Regarding "It is difficult to point to the right reason for this underestimation..."

Strictly speaking, organics can affect EC measurements if some of the organics are charred in the heating process. Organics don't affect BC measurements at 880 nm (the Aethalometer wavelength) though, and have little affect at 565 nm (PSAP wavelength), per Andreae and Gelencser (2006); hence, they should *not* affect BC measurements. However, there is some evidence of large carbon spheres with significant absorption throughout the visible and NIR wavelengths, but the prevalence of these highly absorb-

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ing spheres in the atmosphere is presently unknown (Alexander, 2008; Posfai, 2004). It seems that they are associated with biofuel and biomass burning.

I have another hypothesis for model underestimation in biomass burning regions: BC is typically measured with an Aethalometer, which converts an absorption measurement to a mass retrieval via a single conversion factor. This conversion factor is related to the absorption efficiency (m^2/g) of BC, which varies with EC mass fraction for internally mixed EC (see Petzold, 1997; Neusub, 2002). Since biomass burning aerosols have larger than average EC mass fractions (and consequently, lower absorption efficiencies), the "standard" Aethalometer conversion factor may be too high for those aerosols. –

Page 17, line 25: The absorption of OC at the Aethalometer and PSAP wavelengths is essentially nil, according to Andreae and Gelencser (2006). Dust absorption at these longer wavelengths is negligible as well. However, Andreae and Gelencser (2006) discuss some issues associated with all filter measurements that are relative to this paper. –

Minor issues: + There are several run-on sentences that make it difficult for the reader to follow (p10, line 9-11; p10 line 25 through p11 line 3; p12, line 11-14; p17, line 10-14; p18, line 19-22, to name a few). The readability of the paper could benefit with some light technical editing.

+ Page 14, line 8: does "other" mean "other than IMPROVE and EMEP"? This should be stated explicitly.

References: Alexander, D., P. Crozier, and J. Anderson (2008), Brown carbon spheres in east asian outflow and their optical properties, *Science*, 321, 833-836.

Neusub, C., T. Gnauk, A. Plewka, H. Herrmann, and P. Quinn (2002), Carbonaceous aerosol over the Indian Ocean: OC/EC fractions and selected specifications from size-segregated onboard samples, *J. Geophys. Res.*, 107 (D19), 8031,

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Petzold, A., C. Kopp, and R. Niessner (1997), The dependence of the specific attenuation cross-section on black carbon mass fraction and particle size, *Atmos. Environ.*, 31 (5), 661-672.

Posfai, M., A. Gelencser, R. Simonics, K. Arato, J. Li, P. Hobbs, and P. Buseck (2004), Atmospheric tar balls: Particles from biomass and biofuel burning, *J. Geophys. Res.*, 109, D06213, doi:10.1029/2003JD004169.

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