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Interactive comment on "Measurements of Black Carbon Specific Absorption in the Mexico City Metropolitan Area during the MCMA 2003 Field Campaign" *by* J. C. Barnard et al.

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1. Overall comment

This paper combines several types of measurements to infer the optical properties of absorbing aerosols in an area dominated by anthropogenic emissions, Mexico City. The calculations are carefully done, the topic is an important one, and the authors demonstrate knowledge of important issues and appropriate calculations. The paper is well written and organized. However, I agree with other comments that specific

absorption does not appear in this work. This paper should be published, but only after some very careful thought, and extensive revision, about exactly what claims can be made using the procedure in this paper.

The authors interpret the mass of BC from optical data in two ways, and then determine specific absorption from optical data. For example, the iteration discussed on page 4093 (Method II) can be re-described as follows: (1) State some assumptions about aerosol form and material optics; (2) Find the black carbon fraction that matches the observed single-scatter albedo; (3) Calculate the mass-specific absorption. But there is only one degree of freedom in this calculation–black carbon fraction–and that is used to match the single-scatter albedo. The specific absorption is then fixed by the procedure and is not independently determined.

The aethalometer data ought to be subject to similar scrutiny. As Dr. Baumgardner mentioned in his comment, the "calibration coefficient" of the aethalometer is known to vary. Actually, it should be proportional to the specific absorption, if the aethalometer measurement were perfect. If specific absorption increased by 20%, then the aethalometer response would increase by 20%. So if Method I worked well, one would expect no change at all in the predicted "specific absorption."

Such analysis might provide some useful constraints, but it certainly does not provide the specific absorption of a conserved mass of BC, which is a quantity needed for use in climate models. Schuster (2005) points out that the values "correctly describe the surface radiance field" and this may be their primary significance.

2. Specific comments

Page 4086, line 2. "BC aerosols observed here will be aged compared to those freshly emitted in traffic." The term "aging" may mean different things to different communities.

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Interactive Comment

To some, it may mean that the aerosols are hours or days old. How high was the building? These aerosols may not be more than a few minutes old, and I suggest using another term.

Page 4087, lines 14-15, "imaginary refractive index is relatively constant from the ultraviolet to the infrared." Marley (2001) indeed shows this, but several other studies do not; for example, Dalzell and Sarofim (1969) demonstrate a strong increase at infrared wavelengths). Since the interest here is primarily visible wavelengths, I suggest that the authors confine their claim to the visible range where it is more consistent with observations.

Page 4089, lines 2-3, "the pollution burden should mirror the amount of emissions on a given day." This is a rather strong statement, and since it's not the main focus of the paper, I suggest softening it. It doesn't seem proven either that the emissions are completely removed, or that the Mexico City basin is perfectly mixed, with the site atop a building representative of the entire megacity.

Page 4090, lines 8-9, "BC is the only atmospheric absorber..." This may be true if no dust is present. Presumably there is confirmation of low dust loadings, which could be referenced here.

Page 4091, lines 2-3, "The use of a surface measurement of BC as a proxy for the concentration throughout this mixed layer..." Can the nighttime lidar data, which show the vertical profile of extinction, quantify the correctness of this assumption for at least one condition?

Page 4092, lines 18-19, "The coefficients needed for Eq (3) [size distribution] are listed in Table 1 of Dubovik et al. (2002)." Is there not an AERONET station in Mexico City that could provide daily size distributions? Certainly these will change with conditions, and the use of climatological data could introduce some errors.

Page 4096, first paragraph. I agree with Referee 3 that this paragraph is confusing and

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with Dr. Schmid that the aethalometer data support λ^{-1}. Moosmuller (1998) didn't suggest that the wavelength dependence is $\lambda^{-2.7}$; they merely reported a measurement. Mie calculations with an accumulation -mode aerosol, using a constant refractive index, are nearly guaranteed to give λ^{-1}. And this paragraph doesn't do a credible job of rejecting the Kirchstetter (2004) values, so the discussion should either be expanded or eliminated.

Reference (others were cited in paper)

Dalzell, W.H., Sarofim, A.F., 1969. Optical constants of soot and their application to heat-flux calculations. Journal of Heat Transfer 91, 100-104.

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