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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Carbonaceous aerosols contributed by traffic and solid fuel burning at a polluted rural site in Northwestern England" *by* D. Liu et al.

Anonymous Referee #2

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This study gives a comprehensive overview over carbonaceous aerosols measured at a receptor site and their properties. It contains a wealth of information, and should certainly be published. Besides the main focus of the MS, I find the determination of BC mixing state and its variation with advection conditions very interesting.

There are a few points, however, which should be addressed in addition to the ones raised be Referee 1.

Major points:

For the determination of the submicron mass, obviously only the AMS data and the SP2 data were used. No info is given for the size detection limits of the AMS (what was the lowest detectable particle size?), and no mention is made that the data cannot be directly compared to usual published data from filter samples. The DMPS data could have been used to calculate total submicron mass. Reasonable assumptions about density are given in the MS anyway, so why not do it? It would be very instructive to see how the mass concentrations deduced from the AMS (and the SP2, see below) and those obtained from the DMPS compare.

What I find really problematic is the definition of rBC mass, which is only deduced from the SP2 measurements and then used for comparison with literature values. The instrument has a lower cut size of ca. 200 nm, which means that about half of BC cannot be determined (for mass size distribution of BC see e.g. Berner et al., 1996; JGR 101, D14, 19559-19565), so BC mass is severely underestimated by rBC mass. A MAAP had been running during the experiment, anyway – why wasn't it used for determining BC mass, for submicron mass and the comparisons with OC/EC ratios or the BC fraction of the aerosol? There is no mention of MAAP data in the whole MS. Optically determined BC of course has its uncertainties, but this is better than using data from an instrument which cuts off a large part of the mass that should be measured.

This definition of rBC influences the whole discussion on BC. Turpin et al., who are quoted on p. 25259 that values of OC/EC give indication of secondary particle formation use OC/EC ratios obtained from total filter samples, which of course contain all the small particles. Using OC/rBC values here is questionable. OC determined with the AMS probably has a lower cut size around 50 or 60 nm, while rBC refers only to particles > 200 nm. The values cannot be comparable to those obtained from thermal analysis of filter samples even if the usual uncertainties in the OC/EC cut point in thermal protocols are disregarded.

The data on mass fraction of BC found in the literature (Tsyro, Schaap, etc.) are also

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based on total filter samples, so the values in the MS do not “agree well”, because both the definition of total submicron mass and rBC are quite different, and as no estimate is given for the total submicron mass and as rBC severely underestimates BC, the data cannot be compared.

Minor points:

The sentence in the abstract starting on line 14 is very confusing – please separate the first part from the second one (“as the refractory BC component was characterized by. . .”)

p 25259: the diurnal variations of the geometric mean diameter of the size distribution are mentioned without reference to Figure 8. In Fig. 8, the hourly averages of the mean diameter have very large variations – is it really possible to describe a “pattern”? The same holds for the other parameters shown in the plot.

p 25261, line 6: HOA is no “source” but a “component”

p 25262, line 25: even at this wavelength, there still is some influence of brown carbon, so B_abs of BC may still be lower than deduced from the measurement.

p 25263, line 15: the statement that the diurnal variation of sigma_ap showed no wavelength dependence cannot be deduced from the graph (which is much too busy), and is actually surprising enough to warrant a discussion. I suggest plotting the diurnal variation of the Angstrom exponent, and if no diurnal variation is found then, discussing why it was not found. From the discussion of the data there seems to be quite a variation depending on whether the traffic source or solid fuel combustion contribute most to the aerosol.

Figure 9 is confusing – which line is the scattering coefficient?

p 25263, discussion of SSA: if there is a concern about the influence of brown carbon on the SSA (which is discussed at length in the text) why did you use 550 nm instead of longer wavelengths? The nephelometer has a channel at 700 nm, which is quite close

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to the PSAP channel at 660 nm or the wavelength of the MAAP (670)?

p 25263, lines 15 and 20: if one looks at the definition of SSA (=1-sigma_abs/sigma_ext), the fact that SSA is "modulated by the BC mass fraction rather than by absolute loadings" and the counter-current trend of SSA with the BC mass fraction are not surprising. Is there really a need for discussion for this overall picture? There might be a need for discussion, however, for the data given in lines 25/26: if the particles consist of a BC core and a non-absorbing shell, their mass absorption efficiency can be much higher than if they consisted of BC only. In this case, a straightforward dependence of SSA on the BC mass fraction is not to be expected.

Figures 10 a and b, though color-coded, should be either deleted or their contents should be plotted differently.

p 25266, last paragraph + discussion next page: This issue is interesting, but the data don't seem to contain enough info to resolve it. Of course it is an interesting question, but it should be moved to the discussion section.

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 25243, 2010.