

## ***Interactive comment on “Airborne measurements of trace gases and aerosols over the London metropolitan region” by G. R. McMeeking et al.***

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This manuscript is a general summary of mostly airborne measurements with some ground based data to complement them. The data are thoroughly described with one exception noted below. The overall paper is well organized and easy to follow. In several places, also noted below, a bit more clarification would be helpful, at least for this reviewer. As I note below, I think one of the primary results, the lack of difference between urban and regional aerosol properties, other than the SSA, is not emphasized enough. That there is so little difference in the aerosols, whereas there is a large difference in trace gases, should somehow receive more discussion, unless this is to be discussed in greater detail in a complementary paper. The conclusion that "Our observations indicated that regional aerosol appeared to dominate urban sources" doesn't

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seem to be well enough supported, or at least I didn't link the similarity in mass concentrations and composition to a dominance of regional sources over urban. Please be sure to clarify this in the conclusions.

Additional comments

In the instrument description I didn't see if the aerosols were dried before entering the PSAP and I would also like Table II to include uncertainty estimates as well as ranges.

Figure 3, no PM10

Figure 6 - Please clarify what is shown in these figures, e.g. how are ratios from aircraft being compared to those on the ground? I was unable to understand the various panels in Figure 6, i.e. are ratios being compared to ratios? How are these data points being selected. This was to me the most confusing section.

Page 18, Line 24, "The growth factor differed from  $\sim 2/3$  of the ammonium sulphate-dominated aerosol sampled over the Pacific, showing the importance of treating the aerosol as an internal rather than external mixture." Please clarify. How does this show the importance of treating aerosol as internal rather than external?

Page 19, Line 6, Might mention that Baumgardner et al. (2007) derived values of 5 m<sup>2</sup>/g from the SP2 and PSAP in Mexico City but we were very near the sources of rBC.

Page 20, Line 11, "One important distinction between our results and those reported by Moteki et al. (2007) and Subramanian et al. (2010) ... was that we considered the entire rBC population but the previous studies restricted their analyses to rBC particles with a specific mass/size range." Clarify. I thought that Subu derived rBC with lognormal fit that should cover the whole range.

Page 22, Line 16, "...only represented a small contribution to sub-micron aerosol mass." Yes but as previously noted, decreased the SSA from 0.91 to 0.86. Is this consistent with the derived mass scattering and absorption coefficients, i.e. can you

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get a 5% decrease in SSA with the observed changes in rBC from plume to regional?

Page 27, Line 11, "The lidar results also showed a relatively homogenous aerosol concentrations along the loop around London...". Figure 13 seems to contradict this statement since there seems to be distinctive difference from East to West. Also, Figure 13d is mislabeled as June 16.

Page 28, Line 6, "This was more than could be reasonable (reasonably) explained by the contribution of the absorption coefficient, which could not be measured ...". But from the previously derived mass absorption coefficient, the SP2 rBC could be converted to an absorption coefficient. Were the scattering coefficients converted to the wavelength of the lidar, i.e. 550 to 355? If not, this explains part of the discrepancy.

Page 28, line 11, "The most likely reasons for the higher lidar results stem from the need to bring aerosol into the aircraft for measurement.". The inlet losses and drying are obvious sources of the uncertainty, but the uncertainty in converting backscattering to extinction is also large and should be mentioned.

Page 28, Line 27, "There was little change in total aerosol mass concentrations between the urban plume and the regional, background aerosol,...". It seems to me that this conclusion is one of the most notable and perhaps should be given more than a single sentence in the conclusions. I understand that the paper is an overview of the data, but perhaps in the summary the key results should be listed as bullets to underscore their importance.

The elements that I found missing were size histograms or any information about how the aerosols were number or mass distributed. The PCASP, CAS and AMS all give size resolved information that I think should be presented, if nothing more than averages in the plume, outside the plume and regional, to show if there are obvious shifts in the sizes due to diffusional growth. This is only the addition of one figure.

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