

## ***Interactive comment on “Reducing uncertainties associated with filter-based optical measurements of soot aerosol particles with chemical information” by J. E. Engström and C. Leck***

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### Overview

The study that is presented here is focused on improving interpretation of filter-based light absorption measurements. The approach that is taken is somewhat unique in that the corrections that are derived to account for the light scattering "artifact" are based on the link between the chemical composition and the optical properties of the particles on the filter. Whereas I believe that this approach is worth exploring, it is an approach that is fraught with potential uncertainties that may not improve the accuracy of the absorption measurement, but may actually decrease the accuracy. I don't think that

C309

the authors have adequately identified these uncertainties in their analysis and until they are taken into account, I would not recommend this approach to others that wish to apply it to their measurements. As a general statement, given the dozens of studies that have been published on instrument comparisons and developments of algorithms to correct for the intrinsic limitations of filter-based techniques, it seems to me that we are approaching asymptotically the limit to which we can continue trying to extract information from these techniques.

### Specific Comments

Page 1202: Second Sentence. Is there a single diffuser plate for each detector. How well characterized are these plates and detectors so that reference is true reference, i.e. what is the background response of the two detectors and diffuser plates in the absence of a filter? What is the filter to filter deviation and when looking at a "clean" portion of a filter, how does the light transmission through this filter change across its surface? How are the diodes calibrated?

Page 1203: Line 15. A photodiode or two photodiodes?

Page 1203: Line 22. I don't understand these two components, 40;1 and 40;2. Figure needs to be revised. two photodiodes? Collection angles? How well characterized? Are the components one with a clean filter and one with the sample?

Page 1204: Line 9. Don't call it single scattering albedo. Call it something else or it is misleading, even with the explanation that it is not an absolute value. The community knows what SSA is and in this paper it is nothing even close. Not only is only a tiny fraction of the scattering measured but the absorption has not even been yet corrected.

Page 1205: Line 1. Even this value for the MAC is highly suspect and uncertain. An uncertainty of +/- 20% would be generous and at the least needs to be propagated into the final results.

Page 1206: Line 12. Define "synthetic soot". This process of fitting the coefficients

C310

needs a better description, e.g. is there a unique combination of these three coefficients and don't these values need constraints? I suspect a best fit is possible with quite a few different combinations of these three  $k$  values.

Page 1206: Line 24. Why is only the inorganic mass used? Clearly there is a major contribution of OC to the soot and just as clearly OC has a very strong scattering signal that if not taken into account will lead to corrections that are even larger than those that are being derived with only the inorganics. My guess if the OC correction was added, the resulting, corrected values would end up close to zero or negative. Herein lies the basic problem with this technique. First of all, the value of  $3.8\text{m}^2\text{g}^{-1}$  has a large uncertainty and depends on specific mixtures of salts AND OC, as well as the uniformity and depth of the loading. Secondly, why is the chemical correction always larger than the optical correction and what will happen if further correction is applied for the OC contribution? Basic question: is it worse to under-correct or over-correct. What is the authors' opinion? Are they correcting too much or too little?

Page 1211: Line 7. "The benefits in using the chemical quantification of the non-absorbing matter collected on the PCMB filters was that a Cionmass could be quantified for each of the two groups separately (Sect. 2.3.2)". However, ignoring the scattering properties of OC and BC could introduce major uncertainties.

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