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Atmospheric Measurement Techniques Discussions

Interactive comment on "Broadband measurements of aerosol extinction in the ultraviolet spectral region" *by* R. A. Washenfelder et al.

Anonymous Referee #1

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Washenfelder et al. describe a novel, broadband optical extinction spectrometer based on the sensitivity enhancement resulting from the use of optical cavities. The broadband spectrometer comprises dual optical cavities using near-UV LEDs to monitor aerosol extinction from 360-420 nm. Extinction measurements of the long-wavelength channel are found to be in excellent agreement with an additional cavity ringdown channel at 407 nm. This result is an important validation of the broadband measurements because CRDS is now an established technique for measuring the extinction of aerosols. Additionally, the measurements of the two broadband channels agree closely in the spectral overlap region. The authors give a considered analysis of the various contributions to the measurement uncertainty; the combined uncertainty for the extinction measurements is very good for this type of spectrometer. The broadband channels are then used to retrieve the complex refractive index of several model particle systems. Two approaches are adopted to retrieve the complex refractive index of the sample depending on whether the index varies strongly or weakly with wavelength. The results in this work agree with the few near-UV measurements in the literature and provide high quality values for the refractive index of these aerosols.

The advance made by this work is the application of the broadband optical cavity technique to the study of aerosol optical properties across a continuous spectral region. The near-UV region is particularly significant as there are relatively few of measurements of aerosol extinction in this region, apart from 355 nm (the third harmonic of the Nd:YAG laser). Recent studies of aerosol properties have suggested that some aerosol types, most notably brown carbon, start to absorb strongly at short wavelengths. This effect may have a significant effect on the local actinic flux – as for example, around megacities.

This is a careful and thorough study and I recommend publication of this article.

A few comments are in order:

(1) Although the effect of multiply-charged particles in the DMA is addressed, the reader is not informed whether this is potentially a big effect or not. What proportion of particles would be multiply charged?

(2) The renaming of the technique as BAES is not helpful – the system is a two-channel broadband optical cavity spectrometer and no different in any substantive way than their earlier three channel LED system (Axson et al. ACP, 2011) or their single channel Xe arc lamp system (Washenfelder et al. 2008). The proliferation of different names for the same approach (IBBCEAS/BBCEAS/CE-DOAS) is unhelpful to the community and implies a methodological novelty that does not exist. This is not the first time that aerosols have been measured with broadband systems. Axson et al. should be included in the references.

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(3) High power LEDs are a superb light source for broadband cavity systems but are limited to wavelengths above 360 nm. Further work is needed to study the optical properties of particles at very short actinic wavelengths (> 300 nm), where particulate absorption affects J(O 1D). This work goes some way to studying such short wavelengths.

Minor corrections:

p.115, l.5: “Composition” is a chemical, not physical property.

Sect. 3.2: The wavelength dependence of the complex refractive index and its components should be made explicit in Eq. (4).

Fig. 11: Lines of the same colour on figure should be redrawn – it is not clear which line corresponds to which refractive index.

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Interactive Comment