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Atmospheric Measurement Techniques
Discussions

Interactive comment on "A new approach for measuring the UV-Vis optical properties of ambient aerosols" *by* Nir Bluvshtein et al.

Anonymous Referee #3

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The manuscript describes the benefits of bringing together a number of complementary tools to measure the optical properties of ambient aerosol, with direct retrievals of the scattering, absorption and extinction coefficients, the single scattering albedo (SSA) and the complex refractive index. Measurements are made using two broadband cavity enhanced spectrometers operating over different wavelength ranges, a photoacoustic spectrometer with cavity ringdown, and a nephelometer. This combined approach could lead to significant improvements in measurements of the wavelength resolved scattering and absorption properties of ambient aerosol. The authors provide a substantial amount of data to benchmark the approach, comparing it with previous measurements. The paper is largely well-written and the Figures are clear. The authors should consider the following comments.

(1) The fitting procedure to get the absorption coefficient, the SSA and the imaginary

part of the RI depends on one direct absorption measurement, the PAS measurement at 405 nm which has a large error (stated to be typically 60 %). So, to get the values for these properties over the full wavelength range, the authors must assume a variety of power laws or exponential relationships with wavelength to relate the extinction, scattering and absorption measurements. This is very briefly described in section 2.3.1. This is a key part of the retrieval and I think more discussion and consideration of errors needs to be included here, a figure needs to be shown including the trial power laws etc. and the variation in the fitting error. This extra detail would be helpful to the reader.

(2) Although their retrievals broadly match their expectations for the trends (e.g. in figures 6 and 7), the impact of the errors on the SSA, single wavelength absorption measurements, extinction and scattering measurements on the retrievals need to be more fully discussed. For example, on these two figures, I would expect to see error envelopes on the lines shown in each of these plots, following from the cumulative effect of the uncertainties in the individual measurements. Even with the errors reported in section 3.1 from the simulations (of order 5, 10 and 60 %), I would expect the error envelopes to become large when outside the range of the measurements, for example in the retrieved value of the absorption coefficient below 400 nm in Figs. 6 and 7, particularly when the uncertainties in the nephelometer and PAS measurements are considered. These error envelopes should then be included in plots such as Figure 7(b) for the imaginary part of the refractive index. In this plot, error bars are shown in the real part but not the imaginary part, is there a reason for this? In Fig 7 there is a systematic error in the agreement between the retrieval of the extinction coefficient and the measured value around 400 nm with the BBCES data crossing the retrieved line – does this have consequences for the fit? To reduce errors, ideally there should be more overlap in wavelength between the measurements of scattering coefficient and extinction coefficient, what prospect is there for doing this? Depending on the errors on the imaginary part in Figs 6 and 7, can the authors now definitely state that their new measurements of the optical constants should be preferred over the previous measurements.

(3) I think the authors should stress in the abstract that continuous measurements of extinction coefficients are made between 315 and 345 nm and 390 to 420 nm, but other measurements are pointwise (404, 457, 525, 637 nm). The authors suggest that their approach gives optical coefficients and SSA over the full range 300 – 650 nm but this is not the measurement range. There does seem to be some confusion in the text over the upper wavelength range for the BBCES measurements: the upper range stated in 2.1 (360 to 390 nm) does not match with the range in 2.2.1 (390 to 420 nm). Also line 9 of page 11 says 360 to 390 nm.

(4) Line 7, page 7: for clarity, specify what the "individual wavelengths" are.

(5) Line 27, page 7: The real part of refractive index ranges from 1.692 at 300 nm (presumably this is the wavelength?) and 1.856 at 650 nm. These are much larger values that those expected for SOA, why have such large values been chosen? Why are values for imaginary parts of refractive index quoted to nearest 10-6 in magnitude – presumably the measurement is not this sensitive?

(6) Line 3, page 8: An additional error with normal distribution of +/- 2% standard deviation was added to simulated data set. Why this level of error?

(7) On page 10 line 20, the authors state "the retrieval of the effective complex RI is strongly dependent on accurate representation of the size distribution and aerosol particle number concentration." As a consequence they have only used data taken during the night when variations in number concentration are less severe. For the instrument to be robust in the field, is there a solution to this?

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