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

Anonymous Referee #1

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General Comments

This manuscript describes a new approach for combining measurements of the extinction, scattering, and absorption by ambient aerosols with interpolation and extrapolation to span a spectral range of 300 nm to 650 nm. It also outlines a method for retrieving the effective complex index of refraction of the aerosols based on comparison of these measurements with Mie theory calculations. The utility of the approach lies in its ability to generate climate relevant optical properties across the UV-visible spectrum from measurements of polydisperse aerosol size populations at ambient concentrations. As such, it avoids complications and limitations associated with size selecting particles and opens up possibilities for monitoring spectral optical properties in real time and correlating them with observed chemical and physical changes. Overall, this is a well-written manuscript describing an advance in how aerosol optical properties are measured and will be of interest to many in the field. It is recommended for publication in Aerosol Measurement and Techniques after the specific comments, below, are addressed.

Specific Comments

1. What are the detection limits for the photoacoustic spectrometer and the cavity ring down spectrometer?

2. There probably is not a lot of difference between using an exponential function and using a power law function to extrapolate absorption, scattering, and extinction (the authors can correct me if I am wrong). However, the power law function is more commonly, almost exclusively, used for all three measurements. Can the authors elaborate some on why they choose to employ combinations of both functions?

3. Related to point #2, assuming either an exponential or a power law function holds over the entire spectral range could introduce errors. For example, Massabo et al. [1] recently found that ambient aerosol absorption is better fit to a two- or three-power law function. Given that the current work extrapolates absorption from a single wavelength (404 nm), the choice of extrapolation function could have a sizable impact on the fitting and refractive index retrieval. It is worth noting that such an impact would not be obvious in the PPFA and SRFA samples since they have negligible black carbon components. Consequently, the error could impact the ambient measurements, though there are no independent measurements that could identify or constrain this potential error.

4. Figures 4 (schematic of sample flows) and 11 (SMPS plots) are not necessary and could be moved to supplemental information.

5. Figure 8 shows good agreement between calculated measured SSA at 404 nm, but both values use the measured extinction. A more direct and convincing demonstration of the agreement would be to compare calculated (alpha_ext(404) – alpha_sca(404))

and measured (alpha_abs(404)) absorption at 404 nm.

6. The manuscript would be strengthened significantly by including plots of the extinction/absorption Angstrom exponents, which could be calculated from the derived spectral values of extinction and absorption.

7. In the captions for Figures 9 and 10 it would be helpful to remind the reader that these ambient measurements are for the dry aerosol (i.e. do not include the water component which would alter substantially the optical properties). Also, the sampling location should be included in the captions.

8. To highlight the good agreement between the measured and calculated values, it would be interesting and illustrative to plot curves of the measured extinction (maybe one wavelength for each CES cell), scattering (457 nm, 525 nm, and 637 nm), absorption (404 nm), and SSA (404 nm) in Figures 9a, 9b, 9c, and 9d, respectively.

9. In the Conclusions it is confusing that the authors claim that such a large error on alpha_abs (404 nm) of 60% leads to only negligible errors in total column radiative transfer calculations. And, as the authors point out, the error is expected to be even larger at longer wavelengths where absorption is smaller. It seems like such large errors have to be important given that the absorption extrapolated from 404 nm is used to determine optimum agreement between the calculated and measured scattering values.

Technical Corrections

Page 1, line 1: “VU-Vis” should read “UV-Vis”

Page 1, lines 23 and 27: “EFR” should read “ERF” for consistency with other abbreviation (“ERFari”)

Page 2, line 13: “white-type” should read “White-type”

Page 2, line 15: the detection limit for the White-type cells should be larger than that of

CES, not lower, since they have shorter effective path lengths

Page 3, line 30: it would seem that the colored glass filters

Page 4, line 28: “flown” should read “flowed”

Page 7, line 3: “Fig. 2b” should read “Fig. 2a”

References

(1) Massabò, D.; Caponi, L.; Bernardoni, V.; Bove, M. C.; Brotto, P.; Calzolai, G.; Cassola, F.; Chiari, M.; Fedi, M. E.; Fermo, P.; et al. Multi-Wavelength Optical Determination of Black and Brown Carbon in Atmospheric Aerosols. Atmos. Environ. 2015, 108, 1–12.

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