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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Using Spectral Methods to Obtain Particle Size Information from Optical Data: Applications to Measurements from CARES 2010" *by* Dean B. Atkinson et al.

Anonymous Referee #3

Received and published: 21 November 2017

This manuscript describes a spectral deconvolution and fine mode curvature method that can retrieve particle size and determine relative contribution of the fine mode particles to the total particle extinction from Multi wavelength aerosol extinction, absorption and scattering measurements. Typically this method is used in remote sensing applications but authors extended the application of this method to in-situ measurements to retrieve particle size. The authors used extinction data from cavity ring down measurements, scattering data from nephelometer and absorption data from particle soot absorption photometer measurements. Overall, the manuscript is clearly written, some suggested clarifications are listed below. I understand this is more of a technique based manuscript but little bit more discussion about the science would be useful. I recom-

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Discussion paper

mend this paper for publication. However, prior to acceptance, the authors should address the following questions/ suggestions and modify the manuscript accordingly.

My main concern here is about the error analysis in the retrieved size and contribution of the fine mode particles to the total particle extinction. What are the errors on the estimates? A range of relative uncertainties are stated towards the end of the manuscript but it is not clear to me if the authors consider propagation of errors from the measurements.

In the abstract the authors should briefly mention the major limitations of the technique instead of just stating "..some limitations are also identified". Some of the limitations are mentioned in the text at different places but I suggest providing a list of all the limitations in details at the end so that it would be easier for readers to follow.

Line 177: please provide detail about the polynomial fit that yields a wavelength invariant version.

Line 220: I think authors should expand the discussion regarding the uncertainty in refractive index. How the estimated size will affect if some of the plumes contain more absorbing particles such as soot? Authors used an average value of real part from previous study. Here authors can propagate the error.

Line 249: Authors mention here about the truncation angel error but it is not clear to me if they incorporated the corrections to the nephelometer data.

Line 253: This part somehow misleading to me "Cavity ring down measurements do not (in principle) need to be calibrated"

Line 254: "have very small truncation errors"- please provide a number here.

Line 310: Authors mentioned about low relative humidly during measurements used here. Was it low also at T1 site? Scattering measurements can be substantially impacted at high RH.

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Line 333: “The absorption coefficients were adjusted to the nephelomete wavelengths using an inverse wavelength dependence”- please elaborate.

Error bars should be provided in all the figs.

Line 409: “are very similar in absolute magnitude”-please provide the numbers

Fig.3- FMF-CRD shows higher fine mode fraction during 06/19 to 06/20. Is it because of the no size cut for the CRD measurements?

Please consider to change the scale of the y-axis in Fig. 4. Shorter range would help to visualize the variations.

Fig. 5. Once authors do the error propagation, error bars should be included in the figure. Is it 1 hr average for the retrieved radius? What would be the minimum integration time for the optically derived radius to achieve a reasonable estimate? In other words, if there is a spike in the data for shorter time, can it be captured?

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