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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol optical properties in the southeastern United States in summer – Part 1: Hygroscopic growth" *by* C. A. Brock et al.

Anonymous Referee #1

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Scientific significance:

Good – Hygroscopicity of aerosol is still highly uncertain, despite being an important factor in determining aerosol direct radiative forcing. The data on OA K_chem are therefore of high scientific importance, especially since they fall on the low end of the expected range and are supported by a robust analysis. The new fit parameter to describe hygroscopic growth, Kext, is a moderate improvement over the most commonly-used fit parameter, gamma, and is of sufficient value to merit publication.

Scientific quality: Excellent – This paper combines careful measurements, quantifica-

tion of uncertainties where this is possible and acknowledgement where it is not, and a robust, comprehensive and clear analysis.

Presentation quality: Excellent – The paper is very well-written and organized. The analysis presented supports the conclusions. I wish all papers I reviewed were this well-written.

This paper should be accepted for publication once the following minor points are addressed:

1. The Abstract and Conclusions state that the new Kext parameter formulation does a better job of describing the observed aerosol hygroscopic growth than does the traditionally-used gamma fit parameter/formulation. This is true, but the improvement over the gamma fit is only, on average, 20% for the RH (70%) where the bias in the gamma fit is greatest; at other RHs the gamma fit is better. By not quantifying the improvement in the Abstract/Conclusions, the reader gets the sense that improvement by using the new Kext over the gamma fit is perhaps greater than it is. Please quantify the improvement in the Abstract and Conclusions.

2. As noted in the comment by Anne Jefferson, the goodness of the gamma fit/formulation will depend in part on what is used for RH_o in Eqn. 1, and this should at a minimum be acknowledged in the paper.

3. pg 25705 lines 5-12: "The parameter Kchem may be calculated from the volume-weighted contribution due to species i, Ki, which are determined. . ." Please be explicit here: contribution to what? contribution to hygroscopicity? to mass?

4. pg 25707, line 21: Sub-micron sea salt was assumed to be zero. Is there any evidence to support that sub-micron sea salt was negligible? Given its high f(RH), even a small mass contribution might significantly affect extinction at higher RH.

5. pg 25709, lines 24-27 & Figure 2 & Figure 4: Figures 2 and 4 only show/include data (and regression) for a section of one flight.

a) Why only fit data from 11:10-11:45 from that flight?

b) What is the fit/regression for the full data set?

c) How is the comparison of the Kext and gamma fit affected by inclusion of more of the field data?

d) Fig. 2b. There seems to be two groups of data: <50 Mm-1 there is excellent agreement; >50 Mm-1 the calculated extinction is higher than the measured extinction. This is clearly the case for another high-extinction period $\sim$12:10-12:20 shown in Fig. 2a, but not included in Fig. 2b. Again, this makes me question why only data from 11:10-11:45 are include in the comparison, as well as whether the fit is not as robust at high extinction.

e) (small point: "over the time period from 11:10 and 11:45 LT" should be reworded to, e.g. "over the time period 11:10-11:45 LT")

6. pg 25711, lines 26-27: "This $\sim$20 % effect on f (RH) due to refractive index change for RH $\leq$ 90 % (Hegg et al., 1993) can be ignored to first order." Here it is asserted that a 20% effect "can be ignored to first order" – yet the average 20% bias caused by using the gamma fit was earlier presented as a significant enough error to be worth exploring an entirely different fit formulation. This seems to be an inconsistency.

7. pg 25715, line 20: I think there is a typo (misplaced "r"?) toward the end of the line: "K_{chem}r".

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 25695, 2015.