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Discussions

Interactive comment on "Aerosol optical hygroscopicity measurements during the 2010 CARES Campaign" *by* D. B. Atkinson et al.

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The authors would like to thank Dr. Jefferson for her speedy response to the posting of our discussion paper and we hope to address some of the important issues that she has raised. The stated uncertainties in the derived kappa values result from a number of measurement-model comparison-related sources, including the uncertainties in the measurements of scattering and extinction and the resultant uncertainty in the derived values of gamma. It would be useful to include an estimate of the uncertainty of the derived gammas in the final version of the paper and we provide that here to facilitate the discussion. The uncertainties in the measurements of scattering by each nephelometer are generally quoted as +/-5% (10 sec) – since all data used for this paper were

averaged to 10 minutes (Section 3.2.1 and 3.2.2) the resulting uncertainty in each scattering measurement is 0.6% and the combined uncertainty of the ratio (f(RH)scat) is 0.9%, assuming independence of the two scattering measurements. The ratio is then converted to a gamma as shown in Eqn 1. using high and low RH measurements with individual uncertainties of +/-2%, resulting in a uncertainty in gamma of 3%, most of which comes from uncertainty in the RH measurements. The nephelometer's internal RH and Temperature sensors (a standard design manufactured by Vaisala, Inc.) were used during CARES and their performance was verified pre-campaign by comparison with an external sensor (EE08 by E + E Elektronik Ges.m.b.H). As noted in Section 4.1, although the data existed to allow a non-linear 3 RH calculation of gamma for both T0 and T1, the decision was made to use only high and low RH measurements of scattering and extinction to comprise the experimental measurement of f(RH) and gamma, to standardize the measurements and simplify the modeling. There were small differences in the derived values of gamma from different pair-wise combinations of the high, medium, and low RH extinction and scattering measurements and the non-linear 3 RH treatment, but the temporal variation was similar for all.

Dr. Jefferson asks about the range of values encountered during the campaign, which was part of the rationale for including Figures 1 and 3 and SI Fig. S4. We felt that showing the range and temporal variability of the base measurements (extinction, scattering, and RH) and the derived quantities (f(RH), gamma) was more meaningful than providing summary statistics for the campaign.

One of the most salient issues that Dr. Jefferson raises is the truncation error correction that is sometimes applied to nephelometer-based scattering measurements. In this case, the one-wavelength Aurora nephelometers were used in the construction of the humidigraph, meaning that the Angstrom coefficient was not measured and thus could not be used to formulate an in situ correction. The absence of a correction to the scattering for larger particles could result in a low bias on the overall scattering measurements and perhaps more importantly in the higher RH measurements (where the particle size is larger) which would result in a low bias in gamma. Fortunately the contribution of larger particles was smaller at T1 where the humidigraph was deployed during the time period that the modeling-measurement considered, especially the last few days of the campaign to which the derivation of the OOA kappa is most sensitive. Interestingly the kappa obtained for the larger particles (which would be most sensitive to the truncation error) was similar between the two sites. Another interesting and possibly related issue with the large particle behavior that Dr. Jefferson raises is that the low RH for both sites is typically ~30%, lower than the efflorescence RH for pure NaCl (~45%). Since the model presumes that the particles are "dry" at the low RH, it isn't clear how this would affect the results that we present.

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