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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol optical properties in the southeastern United States in summer – Part 2: Sensitivity of aerosol optical depth to relative humidity and aerosol parameters" *by* C. A. Brock et al.

C. A. Brock et al.

charles.a.brock@noaa.gov

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Response to Reviewer 2 Manuscript Number: ACP-2015-821 Manuscript Title: Aerosol optical properties in the southeastern United States in summer – Part 2: Sensitivity of Aerosol Optical Depth to Relative Humidity and Aerosol Parameters

The discussion below includes the complete text from the reviewer, along with our responses and corresponding changes made to the revised manuscript. The authors thank the reviewer for useful comments that have improved the manuscript.

Comment: The manuscript analyses the sensitivity of aerosol optical depth to relative humidity and to different aerosol parameters. The work uses the parameterization of hygroscopic growth developed in the companion paper (Aerosol optical properties in the southeastern United States in summer – Part 1: Hygroscopic growth). The paper is well written and the results are appropriately discussed. In this sense, the manuscript is suitable for publication in ACP provided that the companion paper is accepted and after minor revisions suggested bellow.

Along the manuscript, the authors present some numerical results with an excessive number of significant figures. See for example the comment on AOD at pager 31487 lines 1-2. This fact reflects the need of strengthen the discussion on the uncertainties of the derived variables, having in mind that the experimental measurements and the models developed present uncertainties that in some way affect the result of the study.

Response: We have evaluated the precision of the figures presented throughout the manuscript and stand by the values shown. In the example that concerns the reviewer, this is a model sensitivity test where the height of the well-mixed layer is allowed to vary over the observed range of heights. There are only slight differences in the AOD, which are due to changes in the humidity distribution. Certainly we could not measure AOD to this level of precision, but as a model sensitivity study, the small change (requiring three significant figures to show a difference) makes the point; the AOD is not sensitive to this parameter. Regarding how uncertainties affect the overall results, we feel the two manuscripts Brock et al. 2016a ("Part 1") and the current manuscript "Part 2" together robustly explore the uncertainties in the data and analysis, including two Monte Carlo simulations of propagated uncertainties and a numerical model of the response of the UHSAS optical particle counter. The current manuscript (Part 2) focuses on simulations by a simple model of the sensitivity of AOD to the range of observed variability of various parameters, and not to experimental uncertainties.

Comment: The description on determining ambient extinction must be improved (refer to page 31480 lines 2-6). Although the procedure for deriving f(RH) is described in

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the companion paper, the wording of these sentences on two of the higroscopic growth models considered must be improved. In its present form is a little bit confusing, please state first that you derive the model and then that you apply it to the ambient conditions during the experimental campaign.

Response: We have improved the description the three methods we used to calculate the ambient f(RH) value while still keeping the description succinct. This section now reads: "The value of f(RH) was calculated for each data point in three different ways. In the first method, κ-Köhler theory was applied to measurements of aerosol size distribution and composition to predict particle diameter as a function of RH. Mie theory was then used to predict the ambient extinction from the deliquesced particle size distribution. In the second method, the observed 3-point f(RH) values were used to fit a curve of the form ({Eqn 2}) and the extinction at ambient RH was calculated using the fitted coefficient. Finally, a new parameterization of the form ({Eqn 3) was fitted to the observed 3-point f(RH) values and the extinction at ambient RH calculated."

In addition to the changes noted above, in the Introduction we have added mention of two relevent papers, one of which recently appeared in ACPD.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 31471, 2015.

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