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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Slower CCN growth kinetics of anthropogenic aerosol compared to biogenic aerosol observed at a rural site" *by* N. C. Shantz et al.

Anonymous Referee #2

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The authors measure and simulate droplet growth rates of aerosol of anthropogenic and biogenic orgin. Organics affect two parameters necessary to model droplet growth, the accommodation coefficient, alpha_c, and the hygroscopicity parameter, kappa. Below 20% organic aerosol mass fractions, droplet growth behaves like pure ammonium sulfate. Lowering alpha_c for constant liquid water content, increases cloud droplet numbers. Alpha_c increases when the liquid water on the droplets increases. These findings can have significant consequences for the aerosol-indirect-effect.

The subject matter is relevant and of interest to the greater scientific community. However sometimes insufficient details and or a lack of references do not appear to support

conclusions. Subtle changes in syntax and organization will improve the clarity of the paper and are suggested by the reviewer below.

MAJOR CONCERNS:

One finding suggests that oxygenated compounds may not correlate to a more soluble and or higher droplet growth uptake. Can you show evidence of this? How was the oxygenated state determined? No figures and current analysis in the text indicate this. Furthermore, nowhere in Slowik et al 2009 is droplet growth shown and the droplet growth work of Shantz et al, 2008 applies to a different study.

The relationship between alpha_c and kappa is unclear. Is it linear? How strong is the correlation? Is it consistent? There appears to be an infinite number of simulations of the combination of the two parameters that could fit the experimental data. The paper would be of greater relevance to others if the authors could expound on the correlation and or provide a sensitivity study of the two parameters for this data set.

The authors should emphasize that a soluble sulfate and insoluble organic model, kappa =0 and alpha_c =0.044 can be used to describe droplet growth. This finding is consistent with previous works (e.g, Fountoukis et al., 2007). Alpha_c = 0.044 is very close to previously reported optimal values, alpha_c=0.042 (e.g, Fountoukis and Nenes, 2005). Please cite relevant works.

How will incorporating nitrate salts affect the models? Nitrates contribute to the regional aerosol population (Fig 3.) and can increase particle hygroscopicity. How sensitive are the models if nitrates are incorporated?

Fig 5a and 6a. For alpha_c=1 and kappa =0, Figure 5 shows that 3.5 volts are measured at 3 seconds and Fig 6 shows that 1.5 volts are measured at 5 seconds. Also the simulations for pure sulfate are not the same on a daily basis. Why are the simulations between the two figures different? The observed voltage sulfate droplets are not the same (Figs 3. And 4). What has changed between experiments? What alpha_c and kappa values reproduce the ammonium sulfate growth observed in these figures?

P13783 L16. How do the authors infer the organic molecular weight? Is there any evidence that suggests molecular weight is higher?

Fig 3. What sizes do the voltages correspond to? Can you provide the conversion? Droplet sizes are more relevant to readers with different optical sizing techniques and would be of greater use and reference to future works.

Fig. 4. Why do the droplets grow again after 9 seconds? The text suggests that droplet measurements are impacted by gravitational settling and diminish in size after 5 seconds (P13781 L18). So again, what is happening at 9 seconds? Is this droplet coalescence in the instrument? Does this effect occur before 5 seconds? Unfortunately, the authors may have opened "a new can of worms." with this figure. Why is data shown up to 10 seconds? The authors suggest only the first 5 seconds are relevant for analysis but some unexplained measurement behavior is shown for larger times.

MINOR COMMENTS

P13781 L15. Replace "of the particles" with "of the dry particles" P13781 L21. Are there references for the particle densities? PS. Cross et al measure 1.27 g as an average organic particle density close to 1.3.

P13783 L17. HOA is not defined in text. How much looks like HOA? Is this data from Slowik et al, 2009?

P13786, L25. "... the oxidation of forest emissions are soluble". References Please. (like those already cited e.g., Engelhart et al, 2008; Hartz et al 2005)

Fig 3. 4. 5. 6. Captions. Average particle densities are calculated from organic and sulfate AMS composition assumptions. This is mentioned in the text but not the figures. Please clarify. Suggestion: replace "assuming a particle density of" with "assuming an organic and sulfate composition particle density..."

Fig 3. Does 0.1 um refer to the dry particle size? Please clarify in caption.

References:

Cross, E.S., J.G. Slowik, P. Davidovits, J.D. Allan, D.R. Worsnop, J.T. Jayne, D.K. Lewis, M. Canagaratna, and T.B. Onasch, Laboratory and Ambient Particle Density Determinations Using Light Scattering in Conjunction with Aerosol Mass Spectrometry, Aerosol Science and Technology, 41:343–359, 2007. DOI: 10.1080/02786820701199736.

Fountoukis, C. and A. Nenes, (2005) Continued Development of a Cloud Droplet Formation Parameterization for Global Climate Models, J.Geoph.Res.,110,D11212, doi:10.1029/2004JD005591

Fountoukis, C., Nenes, A., Meskhidze, N., Bahreini, R., Brechtel, F., Conant, W. C., Jonsson, H., Murphy, S., Sorooshian, A., Varutbangkul, V., R. C. Flagan, and J. H. Seinfeld (2007) Aerosol–cloud drop concentration closure for clouds sampled during ICARTT, J.Geoph.Res., 112, D10S30, doi:10.1029/2006JD007272

Interactive comment on Atmos. Chem. Phys. Discuss., 9, 13775, 2009.