

***Interactive comment on “Laboratory studies of the chemical composition and cloud condensation nuclei (CCN) activity of secondary organic aerosol (SOA) and oxidized primary organic aerosol (OPOA)” by A. T. Lambe et al.***

**Anonymous Referee #2**

Received and published: 28 June 2011

The authors show that a potential aerosol mass flow reactor can be used to generate oxidized organic aerosol representative of measurements found in the ambient. The organic aerosol are believed to contain carboxylic acids. Results suggest that the formation and fragmentation model of carbon to carbon bonds aptly describes the formation of OOA. Cloud Condensation nuclei are modeled with a single hygroscopicity parameter,  $\kappa$ , that is found to follow an empirical relationship based on mass spectra O/C values.

The subject matter is relevant and of interest to the larger scientific community. How-

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ever, the authors are dealing with very dense and complicated data sets. Important details (e.g., instrument calibration, set-up, changes in SOA-precursor concentrations) are vaguely mentioned or excluded from the discussion. The following reviewer's concerns, once addressed will help improve the clarity of the paper.

## MAJOR CONCERNS

P13621. Can more details be provided for the experimental setup? For example what type DMA and CPC are used? Is it the same DMA on P13623. L8? What type of SMPS (TSI 3080?) What is the sheath to aerosol flow? For which data points were the C-ToF-AMS used? Under what conditions (flow rate, supersaturation) was the CCNC operated? Was the CCNC calibrated? If so, how? Or in other words, how do the authors know the supersaturation in the instrument? This value is critical for kappa calculations in Equation 1. Are the kappa values presented an average of activation experiments? If so how many? The authors mention "the CCN activity of particles was measured with a previous described technique P13624. L1". However this statement is very vague, as the papers cited mainly describe instrumentation parameters and several techniques exist for CCN activity measurement. The addition of experimental details will help future readers reproduce the work.

P13622. L4. How significant are 30% fluctuations in RH to OH production?

Figures 2 and 3. How are the dashed lines for oxalic acid determined? How do the authors know the slope of the dashed line as  $f_{43}$  increases? This is not explicitly stated in the text but is critical to the interpretation of the results and the discussion. Perhaps one of the most interesting graphs is Figure 4 where the authors explore the mixture of naphthalene and  $\alpha$ -pinene. Figure 4 suggests that the mixture is not simply the additive contribution from both species. " $f_{44}$  of the mixture was always lower than  $f_{44}$  of naphthalene SOA and  $\alpha$ -pinene SOA. ...results suggest that a more quantitative understanding (P13627 L19)" is required. This is somewhat contradictory to the statement in the summary (P13634, L2): "...ambient OOA contains organics from multiple

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precursors; the corresponding f44-f43 composition may provide information about contributions from specific pre-cursors". Do the authors have a similar Figure 5 for the mixture of  $\alpha$ -pinene and naphthalene? Can the contributions of a mixed SOA species be characterized with PMF?

Little discussion is provided for isoprene SOA. Isoprene is an important biogenic precursor and has been the discussion of several papers. The reviewer is unaware of previously published work that has been able to produce isoprene SOA at low precursor levels (less than 330ppb) without the use of NO<sub>x</sub>. A table with the pre-cursor conditions would be valuable. If PAM is the first technique to do this, it should also be highlighted. Furthermore, the isoprene SOA appears to "misbehave" in several figures (2,6,7). Have the authors given consideration as to why isoprene is not consistent with the empirical models? These details could add to the importance of the paper.

Figure 6. If the data fall outside of the associated uncertainty with the H/C and O/C parameterization, does not this suggest that the model is even less robust than assumed? Figure a has a concave (almost opposite trend) and Figures b and c have several points that lie outside of the shaded area. What percentage of points, actually fall within the described uncertainty levels, and for what conditions?

Fig 7. Why is glyoxal not shown? What is the meaning of the dashed lines?

Fig 7. For comparison, perhaps it would be more effective to show the parametrization of Chang et al. 2010 and Jimenez et al 2009 on the figure as well?

Fig 7. Can you provide a list of compounds that do not follow the trend at low O/C? It is difficult to read all the symbols that are grouped together.

The reviewer is thoroughly confused by the results presented in Figure 8. Why is glyoxal mixture data the only one shown? Why not also show data for a mixture of organic with O/C = 0.3 with sulfate?  $\kappa$  assumes the aerosol is completely soluble and the volume contributions of each species are additive; hence the contributions of

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each component to the kappa total should be a function of the volume fraction. But Why is figure 8 not a linear line with a slope of 1? Does the data deviate from simple single parameter kappa theory? Furthermore, the authors fit the glyoxal/sulfate data points with the parametrization based on  $O/C=1.0$  but the text states that “For these data,  $O/C$  ratio increased from 1.06 to 1.50” (P13633 L7). How do the authors use a lower  $O/C$  ratio to fit the data? Perhaps the authors could elucidate and explain in detail the calculations for this figure.

MINOR CONCERNS P13626 L2. What is meant by similar? What are the exact values observed in Lee et al., 2011?

P13627 L5. Insert “as observed in Fig. S3”

Fig. 1. Is a DMA part of the particle-sizing (SMPS) system?

Fig 2. And Fig. 3. The font on the graphs is very small and difficult to read.

Fig. 6. Why not include oxalic acid dashed lines? (also addresses the previous question about the oxalic acid parameters)

Fig 8. What is the meaning of the dashed line?

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Interactive comment on Atmos. Chem. Phys. Discuss., 11, 13617, 2011.

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