Atmos. Chem. Phys. Discuss., 7, S2980–S2982, 2007
www.atmos-chem-phys-discuss.net/7/S2980/2007/

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Modeling secondary organic aerosol formation through cloud processing of organic compounds" *by* J. Chen et al.

Anonymous Referee #1

Received and published: 9 July 2007

The paper presents a modeling study that addresses secondary organic aerosol (SOA) formation through chemical aqueous phase processes in cloud droplets using a recent multiphase chemical mechanism. The topic of this study represents an important contribution to the current understanding of SOA formation since many recent modeling studies have revealed that the processes that convert organic gas phase precursors into low-volatility particulate mass are poorly quantified. Even though the current understanding of SOA formation in clouds is far from being complete, the present study should be regarded as an important starting point that uses an explorative approach to give a first idea of the importance of aqueous phase processes in the bigger picture of aerosol models (increase of SOA mass by up to 43%). The study motivates future

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

modeling and laboratory studies that will lead to a more comprehensive and complete representation of organic aqueous phase chemistry in SOA models.

The paper is certainly highly appropriate for publication in ACP. I have a few comments that should be included that mainly address the current limitation of the understanding of aqueous phase processes and the citation of prior studies.

p. 8953, l. 25: You should refer here to the modeling studies that applied the same multiphase mechanism as you did and could explain successfully oxalate concentrations [Sorooshian et al., 2006; Sorooshian et al., 2007]

p. 8954, l. 15: The studies you cite for oligomerization reactions refer to reactions in concentrated particles, thus, not (necessarily) in dilute aqueous drops. You should either make this clear in this context that processes can occur in liquid particles or remove these citations here.

p. 8956, l. 11: (2) the assumption that aldehydes are converted fully to their corresponding acids is not true as it has been shown in lab studies [Carlton et al., 2006 and references therein]. You should state that your assumption may represent an overestimate of yields. p. 8957, l. 10: Does the vapor pressure (partitioning behavior) of the lumped compound groups represent an average value for the individual species or how were their physicochemical properties derived?

p. 8959, l. 5 ff: The assumption of constant RH, T, LWC etc certainly represents a rough simplification to the system but allows an efficient model simulation. Can you elaborate a bit on the trends you might expect if these values vary?

p. 8961, l. 27: You state that SOA formation in clouds is less important for aromatics than for monoterpenes. In general, e.g. the OH concentration in more polluted scenarios is smaller. Could this fact explain this trend or is it more related to the reactivity of aromatics vs. monoterpenes?

p. 8965, l. 28: It should be made clear here that the presented multiphase mechanism

ACPD

7, S2980–S2982, 2007

predicts water-soluble organics that can be further oxidized in cloud droplets. Previous SOA studies on deliquescent particles (with a relatively small volume compared to drops) predict the formation of other products that form particulate mass due to their low-volatility. Thus, SOA formation on deliquescent particles and in cloud droplets is caused by different organics that are formed in different chemical reactions.

Table 4: Is 'Scenario 1' and 'Scenario 2' used for the same scenarios that are called 'urban' and 'rural' in Table 5? (If so, use consistent terms)

References

Carlton, A. G., B. J. Turpin, H. Lim, K. E. Altieri, and S. Seitzinger (2006), Link between isoprene and secondary organic aerosol (SOA): Pyruvic acid oxidation yields low volatility organic acid in clouds, Geophys. Res. Lett., 33, doi: 10.1029/2005GL025374.

Sorooshian, A., F. J. Brechtel, B. Ervens, G. Feingold, V. Varutbangkul, R. Bahreini, S. Murphy, J. S. Holloway, E. L. Atlas, K. Anlauf, G. Buzorius, H. Jonsson, R. C. Flagan, and J. H. Seinfeld (2006), Oxalic acid in clear and cloudy atmospheres: Analysis of data from International Consortium for Atmospheric Research on Transport and Transformation 2004, J. Geophys. Res., 111, doi: 10.1029/2005JD006880.

Sorooshian, A., M.-L. Lu, F. J. Brechtel, H. Jonsson, G. Feingold, R. C. Flagan, and J. H. Seinfeld (2007), On the source of organic acid aerosol layers above clouds, Environ. Sci Technol., 41, 4647-4654.

Interactive comment on Atmos. Chem. Phys. Discuss., 7, 8951, 2007.