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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Evaluation of the atmospheric significance of multiphase reactions in atmospheric secondary organic aerosol formation" *by* A. Gelencsér and Z. Varga

Anonymous Referee #1

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Evaluation of the atmospheric significance of multiphase reactions in atmospheric secondary organic aerosol formation

A. Gelencser and Z. Varga

General Comments

This manuscript uses a conceptual model to assess the significance of a multi-phase reaction pathway to SOA formation in the atmosphere. Results show that gas-phase precursors with Henry's law constant greater than 103 M atm-1 have the potential to

form SOA by in-cloud oxidation pathways. For candidate precursor species meeting this criteria, the authors suggest more detailed laboratory studies are needed to assess aqueous phase reaction rates, product yields and product vapour pressures. The manuscript shows nicely the sensitivity of the multi-phase SOA mechanism on the precursor Henry's law constant, as well as prescribed gas-phase and aqueous phase oxidation rates. Overall, the study argues a convincing case for the potential importance of multi-phase SOA formation and I recommend it for publication with minor revision. As a recommendation, I suggest the authors show the sensitivity of the SOA yields to the assumed vapor pressures of the precursor and product species. For a reaction system, the vapor pressures of the products can vary over many order of magnitude and representing the vapor pressures of all the possible products with one surrogate vapor pressure is a simplification. I agree that representing a complex reaction system is not necessary for evaluating the potential of this new SOA pathway; however, a few sensitivity tests with varying vapor pressures (decreased by a factor of 10 or increased by a factor of 10) would help elucidate the potential for this SOA pathway over a range of conditions.

Specific Comments

Section 2. I recommend expanding the details of the conceptual model. For example, as I read the manuscript, I found it necessary to create my own diagram describing the physical and chemical processes included in the model (gas-aerosol-liquid equilibia, gas-phase reaction rates, aqueous-phase reaction rates, prescribed concentrations, rate coefficients, Henry's law constant, vapor pressures, and LWC). I also recommend the authors include the equations used to described the gas-aerosol equilibria and gas-liquid equilibria. It was also not clear whether the model simultaneously solves gas-aerosol and gas-liquid equilibria or whether the model was split up into modules describing gas-aerosol and gas-liquid equilibria and then run separately for cloud and non-cloud periods. The numerical methods used to solve the system of equations should also be outlined. Finally, some of the parameters needed for solving the gas-

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aerosol partitioning were not included in the manuscript such as the average molecular weight of the absorbing organic phase and the aerosol mass fraction of the absorbing organic phase.

Technical Corrections

Page 4409. Line 3. I would recommend restructuring the sentence as follows to remove the "been perfected" word choice, "The concept of atmospheric organic tracers has been widely used for source apportionment of size-resolved aerosol in urban or metropolitan areas, especially Los Angelos."

Page 4409. Line 7. I would recommend replacing "vague" with "uncertain".

Page 4414. Line 11 and Line 14. Please replace "than" with "then".

Page 4416. Line 11. I would recommend re-phrasing this sentence as the meaning is unclear, "The mass concentrations of all species are expressed on a carbon basis, therefore no mass increase is assumed for the first and second generation products."

Page 4417. Line 13. I would recommend removing "already". I would also suggest changing "all species reside in the droplets and being oxidized there." to "all species reside and are oxidized in the droplets."

Please check spelling of "logarithm" throughout text and figures.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 4407, 2005.