

Interactive comment on “Introducing the concept of Potential Aerosol Mass (PAM)” by E. Kang et al.

Anonymous Referee #4

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Understanding the contribution of secondary organic aerosol constituents to the ambient particle concentration is a very important topic to advance our understanding of particle related adverse effects on human health and climate. This manuscript introduces a new concept "Potential Aerosol Mass" and methodology to measure the potential aerosol mass that can be added to the ambient concentration through secondary reactions with oxidants in the atmosphere. The new methodology is desirable for several reasons including the possibility to do field measurements outdoors and to study the potential aerosol mass in emissions from single natural and anthropogenic sources.

The paper is well written and the author team seems to have a high level of understanding of the critical processes affecting the new concept. I would recommend publication as a full peer-review paper after the comments and suggestions described here are taken into account.

Interactive
Comment

The data-set is very rich and I think the reader would risk coming into difficulties to digest the whole data-set in a single research paper. Therefore I would suggest moving some material to a future publication before the final peer-review publication. Most suitable to remove from this first paper would be parts of the large set of different VOCs studied.

The paper nicely illustrates fair to good agreement between the SOA yield in the PAM chamber and the presently used large environmental chambers. It also illustrates some divergence between seemingly similar experiments in different large environmental chambers. Another important point of the paper is the direct measurement of atmospherically relevant oxidants generated in the chamber.

When it comes to the characterization of the PAM chamber the arguments about losses and conversion efficiency would have been sharper if some particle size dependent analysis would have been included (for example using mobility analysers) For example the occurrence of particle losses and potential non complete conversion efficiency is derived from a rather complicated procedure which involves calculating the amount of water present on the TEOM filter. Another type of control experiment would have been to compare the yield with and without a pre-existing non-acid seed aerosol.

An important finding is the strong dependence of the yield on the total particle mass concentration. Especially the fact that the yield is a factor of 2-3 lower at typical atmospheric concentrations of 10-30 $\mu\text{g}/\text{m}^3$ compared to more often used higher concentrations in the large experimental chambers. During PAM experiments at low total mass concentrations the particles are expected to be smaller. These smaller particles have a higher deposition probability due to brownian diffusion. Is it possible that size dependent losses contribute to the dependence of yield on the total mass concentration?

Robinson et al. (2007), recently suggested that a potentially large fraction of the SOA detected in the atmosphere comes from relatively low vapor pressure gas phase organics, which are oxidised only the first couple of generations. Trusting the reference,

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this could be a very important mechanism within and downstream urban environments. It would be interesting if the authors could elaborate whether the yield and speciation of such compounds could be expected to be similar in the PAM chamber and the atmosphere. Could any rough estimation be made of what time-scales in the atmosphere the conditions in the PAM chamber would translate to?

In future publications the chemical composition of the potential aerosol mass formed in large environmental chambers and the PAM chamber needs to be carefully compared, for example using aerosol mass spectrometry, filter analysis or indirect measurements such as hygroscopicity. Only then do we now for certain whether measurements with the PAM-chamber can be safely extrapolated to atmospheric conditions.

Specific questions and comments.

Throughout the introductory section secondary organic aerosol particles and secondary sulfate particles are described as being separate classes of particles. I would argue that the different classes of compounds are to a large extent internally mixed with other sources in many relevant environments.

Page 9927. Add "Quantifying the particle organic components from oxidation of precursor gasses..."

Page 9931: change from how much precursor gas is oxidized" to "the amount of precursor gas that becomes..."

Page 9933: Move "the Rupprecht and Patashnick" to just give the company name in parenthesis "(TEOM, Model X, R&P...)"

Page 9933: Doesn't delta Mfilter mean mass increment rather than mass

Page 9936: Add "from knowledge of solely the UV light intensity and the relative humidity".

Page 9938: In arriving at the "absolute uncertainty in conversion efficiency of 16%"

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assumptions are made of the water uptake on the TEOM filter and SO₂ and particle deposition on the chamber walls. Taking into account error propagation, are these 16% still a valid number? What uncertainties does this translate into when determining the SOA yields? Is the SO₂ losses to the walls dependent on RH?

Page 9940: Replace "containing in purified dry" air with "using purified dry air"

Page 9940: Add to "achieve maximum aerosol mass concentration..."

Page 9941-9942: For the temperature dependence in the PAM-TEOM system to reflect the physical reality in the PAM-chamber, there needs to be a particle/gas phase equilibrium in the PAM chamber which is not affected by the heating in the TEOM cell before reaching the filter. Then the particle phase material needs to stay on the filter at 30°C and gas-phase material needs to pass the filter. Is it likely that the system works in this ideal way so that for example temperature effects can be quantified and reflect the physical reality?

Page 9952: What is the likely reason for getting only 50% conversion efficiency? Is it due to only a single UV lamp used or is it due to some interaction with other trace gases in the complex sample in outdoor air?

Figure 4a: The term "Expected aerosol mass" is misleading in this graph since it refers to SO₂ measured in the gas phase. I would suggest something like "Sulphate equivalent SO₂ concentration"

Reference:

Robinson A.L., Donahue N.M., Shrivastava M.K. et al. (2007). *Science* 315, 1259-1262

Interactive comment on *Atmos. Chem. Phys. Discuss.*, 7, 9925, 2007.

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