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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Secondary aerosol formation from photochemical aging of aircraft exhaust in a smog chamber" *by* M. A. Miracolo et al.

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GENERAL REMARKS

The discussion paper by Miracolo et al. reports results from a smog chamber study on the formation of secondary organic aerosol from the emissions of an aircraft engine. The aircraft engine was operated at the ICAO LTO cycle loads of 4%, 7%, 30% and 85%, using standard JP-8 fuel with a fuel sulfur content of 608 ppm by mass. The aircraft engine exhaust was collected in a Teflon bag and exposed to UV light. Among others, measured aerosol particle properties include particle number concentration, particle number size distribution, black carbon, elemental carbon, organic carbon, and

non-refractory particulate mass. Based on this data, the authors report significant SOA production during photo-oxidation which exceeds primary emissions by far. A model based on traditional SOA precursors cannot reproduce the strong formation of SOA.

The set-up of the study and the conduction of the experiments are scientifically sound and contribute to an important area of research. The presentation of the material is straightforward. However, few more steps in the data analysis may add further important information on SOA particle number emission and mixing state. It appears worthwhile to invest additional work in order to provide this additional relevant information.

SPECIFIC COMMENTS

1/ During the experiments, mass concentration, chemical composition and particle size distributions were measured for both primary and secondary aerosol. Results are presented in Figure 4 in terms of emitted mass per kg of fuel. It might be worthwhile to summarise the data for 3h ageing in one table because it is difficult to extract explicit numbers from the figures. Although the characteristics of primary emissions will be published in a companion paper, key properties such as the emission factors for particle number, particle mass, elemental carbon and organic carbon may be added to this proposed table.

2/ From the set of data the authors should be in a position to report also the increase in particle number emissions. Besides SOA mass, information on SOA number is of interest as well.

3/ The size distributions shown in Figure 3 suggest that the aerosol in the chamber starts as a mono-modal size distribution at t = 0 and develops into a bi-modal size distribution after photochemically induced formation of nucleation mode particles. The modal diameter of the primary particle mode shifts from approx. 50 nm at t =0h to 70-80 nm at t = 0.17h, and finally to > 100 nm after 3h of ageing. The amplitude of the mode also increases from t = 0h to t = 3h which suggests that an externally mixed

mode of super-100 nm sized SOA particles has developed. The authors may also discuss the changes in microphysical properties of SOA particles which would add an important piece of information to this work.

4/ Figure 2 suggests a very good agreement between SMPS volume and SOA mass after lights were switched on. Is this true for all conditions? And what about the agreement of SMPS volume and primary particle mass taken e.g. from the SUNSET data? Combining size information and mass information should enable the authors to investigate the mixing state of the aerosol after 3h of photochemical ageing. This would add another important aspect to the presented work.

5/ Figure 6 suggests that for 85% load more single-ring aromatics are emitted compared to total SOA. This fact should be inlcuded in the discussion of Figure 6 on page 27906, lines 24ff.

TYPOGRAFIC ERRORS:

Page 27895, line 7: correct citation to Petzold and Schröder, 1998. Page 27897, line 16: correct to "... initial particle mass concentrations ..."; line 23: correct to "... increased on average by 4.4°C ... ".

Page 27900, line 2: delete "measurements".

Page 27903, line 19: correct citation to (Seinfeld et al., 2006).

Page 27911, line 3: correct to "Aircraft engines emit ...".

Reference Grieshop et al. 2009b is missing; correct the numbering of references.

Figure 7: Figure caption: correct "... Only undenuded (no TD) ...".

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 27893, 2010.