

## ***Interactive comment on “Elemental composition and oxidation of chamber organic aerosol” by P. S. Chhabra et al.***

**Anonymous Referee #2**

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This paper provides a comprehensive overview of laboratory measurements of secondary organic aerosol (SOA) chemical compositions for a number of VOC systems, spanning from terpenes to aromatic hydrocarbons to aldehydes, which are all potentially important contributors to the formation of oxidized organic aerosols (OOA) in the real atmosphere. The Authors managed to write a clear, well-conceived paper based on a complex database, and this manuscript is certainly another important review job on the current knowledge of the factors governing SOA composition and about the comparison of laboratory SOA with ambient OOA. My main concern is that several interesting observations were done for specific VOC systems but such complexity is not adequately acknowledged in the abstract and in the conclusions of the paper where the Authors tend to emphasize only common behaviours. For instance, a highlight was the fact that the fraction of organic acids (f44) tends to increase with ageing (Abstract, C3904

line 17 – 18), but this tendency is actually shown to very different extents by the specific SOA types: naphthalene > monoaromatic HCs ~ isoprene > alpha-pinene > carbonyls. For the latter, the migration of the functional group composition in the f44 vs. f43 space is very modest or absent. Therefore, stating that precursor structure determine the functionality only at the “starting point” on the triangle plot and that spectral uniqueness is lost with ageing (Conclusions, page 10322, lines 20 to 24) is not an appropriate summary of the observations. Indeed, Figure 9 highlights that the functional group and elemental compositions of SOA are dependent on the identity of the SOA precursors irrespectively of ageing. This is in a quite sharp contrast with the results reported in the paper by Lambe et al. (ACPD, 13617-13653, 2011), still in review, which show that under more oxidizing conditions the “migration” of the SOA composition across the f44 vs. f43 space occurs to a much larger extent than presented in this study. The Authors are encouraged to express their opinion on the actual importance of OH exposure of SOA particles in standard reaction chamber experiments on the observed formation of organic acids. This is an important point, because the Authors acknowledge that the conditions of chemical ageing reached in the chambers cannot fully reproduce the atmospheric processing, but at the same time they tend to convey the message that the organic oxidation states observed in a suite of laboratory experiments can be adequate to account for the variability in the real atmosphere provided that a sufficient number of gaseous precursors are considered. This can also be true although hard to believe in general. The Authors must support their conclusions by providing examples of environments where an appropriate mix of SOA from different precursors (the “extremes” of page 10323 line 2) can be found. I have another major comment: FTIR data, in the way they are presented here, are not of any use for the discussion and conclusions. FTIR functional group distributions can be very informative and directly compared to the AMS functionalities in the f44 vs. f43 space, whereas here the Authors have tried to squeeze the FTIR compositions into the Van Krevelen domain in spite of the large uncertainty on the H:C dimension. This is a pity because the functional group data provided by FTIR analyses could be exploited to extract information on the chemical

composition of SOA for the systems characterized by a poor degree of mass closure in chemical speciation measurements. To do that, the discussion of FTIR data must be significantly expanded, otherwise it adds no significant pieces of information to the discussion of the AMS datasets.

Minor comments: Fig. 9 is the most informative of the paper, but it is rather crowded and it is difficult to identify the data for specific VOC systems in the f44 vs. f43 space as well as in the Van Krevelen domain. The palette helps but it is not enough: I suggest to include tags with acronyms or numbers to help the identification of the specific types of experiments shown in the previous figures.

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