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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Global modelling of secondary organic aerosol in the troposphere: A sensitivity analysis" *by* K.Tsigaridis and M. Kanakidou

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We would like to thank the reviewer for his/her suggestions that helped improving the paper and particularly the presentation of our results. When reducing the number of figures as suggested by ref #2, we keep information on the vertical distribution of SOA and how sensitive this is the most critical parameters for SOA budget.

- The statement that benzene is not able to form particles has been removed in the revised version.

- Activity coefficient: Text has been added in the revised version explaining that our results are not sensitive to Lamda values when considering the expected range representative for atmospheric conditions. The overall range of 0.2-1 is given by Bowman and Karamalegos (2002) for highly dissimilar to identical in nature POA and semi-volatile

compounds and values from 0.7 to 1 for dissimilar to similar with SOA compounds expected to be representative for atmospheric conditions.

"No activity coefficient dependence" has been rephrased to "when we neglect the variation of the activity coefficient with the aerosol chemical composition" and "Strong dependence" has been modified to "assume a stronger influence of the activity coefficient (all Lamda values equal to 0.7, reflecting semi-volatile organic compounds less similar to the aerosol components; case S1.5)"

- ageing of primary hydrophobic aerosol. The comment on the validity of the approach of hydrophobic to hydrophilic conversion of POA in section 2.4 has been modified to clearly note that "The validity of this hypothesis for the entire primary carbonaceous aerosol though is questionable since BaP is probably not the most adequate compound to represent the primary carbonaceous aerosol and thus requires to be experimentally checked. Since the whole paper aims in a sensitivity analysis of SOA budget, we added cases S1.7 (with constant conversion rate of hydrophobic to hydrophilic aerosols) and S1.8 (without conversion of hydrophobic to hydrophilic aerosols). These are presented in the new section 3.3 added to investigate the importance of the hydrophobic to hydrophilic conversion addressing also the relevant comment of ref #2. Discussion has been added in section 4: "Since the hydrophilic aerosols are faster removed from the troposphere by dry and wet deposition than the hydrophobic ones, the burden of carbonaceous aerosols in case S1.8 is higher than in case S1. This appears to be a critical factor of uncertainty, since the chemical production of SOA is almost doubled in case S1.8 and the corresponding burden increases by about 80%. In addition, the variable conversion rate approach (S1) compared to the constant turnover time (S1.7) is overestimating the SOA production above tropical areas with strong primary carbonaceous aerosol sources by about 10%, whereas it makes only a 6% overestimate to the chemical production of biogenic SOA (Table 6)." and in section 6: "Indeed, neglecting the hydrophobic to hydrophilic conversion of primary organic particles the removal of the aerosols from the atmosphere is reduced and the corresponding comparison between

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calculated and observed organic aerosol data is improved (case S1.8)."

- Discussion structure The discussion has been restructured clearly stating the ranking of uncertainties as derived from our simulations. The sections have the following flow gram: Description of simulations, budget analysis, SOA distributions and finally comparison of model results to observations. The abstract and the conclusion have been modified accordingly.

Interactive comment on Atmos. Chem. Phys. Discuss., 3, 2879, 2003.