Atmos. Chem. Phys. Discuss., 4, S3752–S3755, 2004
www.atmos-chem-phys.org/acpd/4/S3752/
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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Organic aerosol and global climate modelling: a review" *by* M. Kanakidou et al.

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Received and published: 1 March 2005

We thank Dr. A. Gelencsér who took the time to read the manuscript and comment on it. His comments helped us improve the educational structure of the paper.

To avoid any misunderstanding the definition of SOA is now added in page 5858, line 13. "Carbonaceous species that exist in the aerosol phase tend to be identified according to the manner in which they entered the particulate phase. Organic compounds that are emitted directly in particulate form are referred to as Primary Organic Aerosol (POA). Note that the particulate matter in which these organic compounds reside may contain non-organic compounds as well. Many gas-phase organic compounds undergo oxidation in the gas phase to yield products, generally oxygenated, that have sufficiently low vapor pressures that they will partition themselves between the gas

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and aerosol phases. Such compounds are often referred to as semi- or non- volatile, and when residing in the aerosol phase, as Secondary Organic Aerosol (SOA). Thus, in its common usage, SOA refers to that organic component of particulate matter that transfers to the aerosol phase from the gas phase as products of gas-phase oxidation of parent organic species. Other classes of aerosol organic compounds exist that do not fit neatly into these two categories. One class is organic compounds emitted into the atmosphere in vapor form, which subsequently condense into the aerosol phase without undergoing gas-phase chemistry. Since these compounds can be identified with a particular source, it seems most appropriate that they fall into the POA category. Another class of compounds are gas-phase organic species that are absorbed into cloud droplets and subsequently end up in the aerosol phase when the cloud droplets evaporate and leave residual aerosol. Again, the distinction can be drawn as to whether the compound was emitted directly by a source or resulted from chemical processing in the atmosphere, in terms of its categorization as POA or SOA,respectively.”

The sentence in line 16 (page 5858) has been also modified to

”This applies also to the free troposphere where low temperatures favour condensation of semi-volatile compounds that have been chemically produced locally or elsewhere.”

We agree with the reviewer that the determination of SOA using atmospheric observations is an important task. However, there are no direct analysis methods available for SOA. Measurements of the concentrations of the few known SOA components explain a very small fraction of the measured organic PM. One then has to rely on a number of indirect techniques, each one of them having significant weaknesses. However, a detailed discussion of these issues would probably lead to another review paper. We have added a new section (Estimation of SOA from observations) to address this issue and we have removed the paragraph “A difficult task Ě Zhang et al., 2002)” at the end of section 13.1.

“Estimation of SOA from field observations Estimating the SOA concentration from field observations remains a challenging task. Unfortunately there is no direct method for measuring SOA. Field measurements of OC provide just an upper bound that is the maximum possible concentration of SOA in the corresponding area.

Since primary OC and EC are mostly emitted from the same sources, EC can be used as a tracer for primary combustion-generated OC (Gray et al., 1986; Turpin and Huntzicker, 1995; Strader et al., 1999). The formation of SOA increases the ambient concentration of OC and the ambient OC/EC ratio. OC/EC ratios exceeding the expected primary emission ratio are an indication of SOA formation. Primary ratios of OC and EC vary from source to source and show temporal and diurnal patterns, but since EC is only emitted from combustion sources, gaseous tracers of combustion (CO, NO, NOx) can be used to determine periods dominated by primary aerosol emissions (Cabada et al., 2004). Ozone is an indicator of photochemical activity, and it also can be used as a tracer for periods where secondary organic aerosol production is expected. In this case, increases in the OC/EC ratio correlated to ozone episodes are indicative of SOA production. The major weakness of the method is its reliance on the assumption of a constant primary OC/EC during the analysis period. Variations of sources strengths, meteorology, etc. are expected to change the primary OC/EC. This assumption can be relaxed if there are high temporal resolution data by grouping the data by period of day, month, etc. In any case, this variability introduces significant uncertainties in the estimated SOA concentration. Even if such an almost constant ratio exists, its determination is non-trivial. The primary OC/EC ratio is primarily determined either from measurements during periods where the primary sources dominate the ambient OC or from emission inventories (Gray, 1986; Cabada et al., 2002). Once more the existence of measurements every 2-4 hr reduces significantly the uncertainty of the estimated SOA concentration (Cabada et al., 2004). An upper limit of the SOA concentration can also be estimated based on the unexplained OC during the use of the CMB approach and organic speciation measurements (Zheng et al., 2002).

Measurements of the SOA product concentrations could be helpful in estimating the

SOA concentrations using observations. However, one needs to be careful because a lot of these species continue reacting in the atmosphere and therefore are not conserved as SOA tracers.

References Gray, H. A.: Control of atmospheric fine primary carbon particle concentrations, EQL Report No. 23, Environmental Quality Laboratory, California Institute of Technology, CA, 1986.

Gray, H. A., Cass, G.R., Huntzicker, J.J., Heyerdahl,E.K., and Rau J.A.: Characteristics of atmospheric organic and elemental carbon concentrations in Los Angeles, Environ. Sci. Tech., 20, 580-589, 1986.

Strader, R., Lurmann,F., and Pandis,S. N.: Evaluation of secondary organic aerosol formation in winter, Atmos. Environ., 33, 4849-4863, 1999.

Turpin, B. J. and Huntzicker, J.J.: Identification of secondary organic aerosol episodes and quantification of primary and secondary organic aerosol concentration during SCAQS, Atmos. Environ., 29, 3527-3544,1995.

Interactive comment on Atmos. Chem. Phys. Discuss., 4, 5855, 2004.