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# Source Apportionment of Primary and Secondary Organic Aerosols in Southern California during the 2005 Study of Organic Aerosols in Riverside (SOAR-1)

K.D. Docherty (1), J.L. Jimenez (1), E.A. Stone (2), I.M. Ulbrich (1), P.F. DeCarlo (1), J.J. Schauer (2), B. Williams (3), A.H. Goldstein (3), R. Peltier (4), R. Weber (4), and the SOAR-1 Team

(1) University of Colorado at Boulder, Department of Chemistry & Biochemistry and CIRES, Boulder, Colorado, United States (jose.jimenez@colorado.edu, +1-303-492-3557), (2) Environmental Chemistry and Technology Program, University of Wisconsin, Madison, Wisconsin, (3) Department of Environmental Science, Policy, and Management, University of California-Berkeley, Berkeley, CA, (4) School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, Georgia

Ambient sampling was conducted in Riverside, California during the 2005 Study of Organic Aerosols in Riverside (SOAR-1) to characterize the composition and sources of organic aerosol using a variety of state-of-the-art instrumentation and source apportionment techniques. The secondary organic aerosol (SOA) mass is estimated by elemental carbon and carbon monoxide tracer methods, water soluble organic carbon content, chemical mass balance of organic molecular markers, and positive matrix factorization of high-resolution aerosol mass spectrometer data. Estimates obtained from each of these methods indicate that the organic fraction in ambient aerosol is overwhelmingly secondary in nature during a period of several weeks with moderate ozone concentrations and that SOA is the single largest component of $PM_1$ aerosol in Riverside. Average SOA/OA contributions of 70-90% were observed during mid-day periods while minimum SOA/OA contributions of 45% were observed during peak morning traffic periods. These results are contrary to previous estimates of SOA throughout the Los Angeles Basin which reported that, other than during severe photochemical smog episodes, SOA was lower than primary OA. Possible reasons for these differences include: (a) for studies that used the EC-tracer method, a large systematic underestimation of SOA can occur when primary OC/EC ratios are derived from ambient measurements during periods "dominated by POA" since there is almost always a large SOA background present (Zhang et al., ACP, 2005); and (b) for model-based studies a large underestimation of SOA is observed for this area, consistent with previous studies (e.g. Volkamer et al., GRL, 2006).

The results of the PMF analysis of high-resolution AMS spectra will also be summarized, and tracers from 1-hr data from the thermal-aerosol-GCMS instrument (TAG, Williams et al., JGR 2007) are used to help the interpretation of the AMS components. PMF is applied both to ambient-only and ambient plus thermally-denuded data, the latter of which is shown to enhance the separation of AMS components and which also provides information on their volatilities. We identify six OA components. Three of these components are likely primary and are characterized by a wide range of volatilities. These include a reduced hydrocarbon-like OA (HOA) which correlates with combustion emission tracers and two minor (3% of the OA mass each) components, one of which is strongly associated with amines. The majority ( 80%) of the OA is composed of oxidized components (OOA) which are of likely secondary origin. These include a highly oxidized, low volatility regional background OOA-1 component and a less oxidized, high volatility nitrate-associated OOA-3 component, each of which have been reported from previous AMS PMF analyses. We also report for the first time the presence of a secondary OA component which is intermediate in both extent of oxidation and volatility (OOA-2). Biomass burning makes a negligible impact to OA during SOAR-1, a result that is consistent across all the apportionment methods as well as ATOFMS data.