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Secondary organic aerosol (SOA) formation from reaction of isoprene with nitrate radicals (NO_3)

N. L. Ng[1], A. J. Kwan[2], J. D. Surratt[1], A. W. H. Chan[1], P. S. Chhabra[1], A. Sorooshian[1], H. O. T. Pye[1], J. D. Crounse[1], P. O. Wennberg[2,3], R. C. Flagan[1,2], and J. H. Seinfeld[1,2]

[1]Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, CA 91125, USA

[2]Division of Engineering and Applied Science, California Institute of Technology, Pasadena, CA 91125, USA

[3]Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, CA 91125, USA

Abstract. Secondary organic aerosol (SOA) formation from the reaction of isoprene with nitrate radicals (NO_3) is investigated in the Caltech indoor chambers. Experiments are performed in the dark and under dry conditions (RH<10%) using N_2O_5 as a source of NO_3 radicals. For an initial isoprene concentration of 18.4 to 101.6 ppb, the SOA yield (defined as the ratio of the mass of organic aerosol formed to the mass of parent hydrocarbon reacted) ranges from 4.3% to 23.8%. By examining the time evolutions of gas-phase intermediate products and aerosol volume in real time, we are able to constrain the chemistry that leads to the formation of low-volatility products. Although the formation of ROOR from the reaction of two peroxy radicals (RO_2) has generally been considered as a minor channel, based on the gas-phase and aerosol-phase data it appears that RO_2+RO_2 reaction (self reaction or cross-reaction) in the gas phase yielding ROOR products is a dominant SOA formation pathway. A wide array of organic nitrates and peroxides are identified in the aerosol formed and mechanisms for SOA formation are proposed. Using a uniform SOA yield of 10% (corresponding to $M_0 \cong 10$ μg m^{-3}), it is estimated that ~2 to 3 Tg yr^{-1} of SOA results from isoprene+NO_3. The extent to which the results from this study can be applied to conditions in the atmosphere depends on the fate of peroxy radicals in the nighttime troposphere.

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