

Influence of nitrogen oxides and ammonia on optical properties of secondary organic aerosols

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Secondary organic aerosols (SOA) contribute to a significant portion of submicron aerosol mass; yet their optical properties are understudied. We report on results from environmental chamber photooxidation experiments of α -pinene, longifolene, and 1-methylnaphthalene by hydroxyl radicals in the presence of variable concentrations of nitric oxide and ammonia. Refractive index (RI), mass absorption coefficient (MAC), and single scattering albedo (SSA) of SOA at $\lambda=375$ nm are determined and relationships between the optical properties and SOA composition tracers, as measured by an aerosol mass spectrometer, are explored.

In the absence of ammonia, RI and SSA values of the α -pinene and longifolene systems showed minimal absorption, regardless of nitrogen oxide conditions while SOA from 1-methylnaphthalene oxidation resulted in SSA values ≈ 0.7 - 0.95 , with 1-methylnaphthalene oxidation using HONO as the oxidant source forming the most absorbing SOA. Real component of RI in these experiments was in the range of 1.4-1.55 while the imaginary component was minimal for the biogenic SOA (< 0.004) and up to ≈ 0.02 for 1-methylnaphthalene SOA. SOA mass spectral analysis showed lower $\text{NO}^+/\text{NO}_2^+$ ratio in experiments with H_2O_2 compared to HONO as the OH source, suggesting higher contribution of organonitrates to SOA under high NO_x conditions. The contribution of organonitrates was highest at the beginning of the SOA growth and decreased as oxidation proceeded. On the other hand, MAC of the SOA increased monotonously (up to $\approx 0.1 \text{ m}^2/\text{g}$ for biogenic and $\approx 0.7 \text{ m}^2/\text{g}$ for 1-methylnaphthalene SOA) with oxidation, suggesting chromophores other than organonitrates were being formed that contributed to the increase in the relative absorption of SOA. Influence of ammonia on the optical and chemical properties of SOA will also be presented.