



Formation and evaporation kinetics of monoterpene SOA from nitrate radical oxidation

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Formation and Evaporation of Secondary Organic Aerosol (SOA) was investigated at the Georgia Tech Environmental Chamber (GTEC) facility. Aerosol formation was initiated at low temperatures by separate, simultaneous and sequential oxidation of α -pinene and limonene with the nitrate radical (NO_3). Reaction products were analyzed in the gas and particle phase using a High-Resolution Time-of-Flight Chemical Ionization Mass Spectrometer (HR-ToF-CIMS) coupled with a Filter Inlet for Gases and AEROsols (FIGAERO). Through step-wise heating of the reaction chamber, particle evaporation was triggered with minimal interference; slow evaporation of oxidation products was monitored using FIGAERO-HR-ToF-CIMS and a Scanning Mobility Particle Sizer (SMPS).

Using a kinetic multi-layer model that describes chemistry and mass transport in the gas and particle phases, we infer elusive particle-phase reaction rates and assign volatility distributions of nitrated and non-nitrated reaction products. Gas-phase chemistry is represented by a semi-explicit chemical mechanism derived from the Master Chemical Mechanism (MCM). The novel kinetic model features an estimation scheme of particle-phase diffusion coefficients in SOA depending on local average product volatility and oligomerisation degree. We show that slow diffusion in organic aerosol particles can not only cause spatial heterogeneity of reaction products, but can also be exacerbated by evaporation of higher volatility compounds at the particle surface. This finding may have implications for the treatment of SOA in large-scale atmospheric models.