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Physical properties and photochemical stability of laboratory-generated SOA in an electrodynamic balance

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Laboratory studies of secondary organic aerosol (SOA) often have experimental timescales which are much shorter than the lifetime of atmospheric aerosols, leading to difficulty in the characterization of aerosol properties. The same limitations apply to repetitive measurements on hygroscopic growth and the kinetics of water uptake. Here we use an electrodynamic balance (EDB) capable of trapping and maintaining single particles for many days, extending the timescale over which laboratory generated SOA can be characterized. We investigate the properties of α-pinene SOA generated by reaction with OH radical in a continuous flow reactor. The SOA was characterized in situ by an Aerodyne Aerosol Mass Spectrometer (AMS) at the time of collection on a filter, and SOA was subsequently extracted for injection in the EDB. The AMS analysis which was concurrent with sample collection provides a priori knowledge of sample chemical functionality.

The EDB apparatus is particularly well suited to investigating the response of the particle to changes in relative humidity, temperature, or exposure to light. Two samples with differing O:C ratio are examined, and the hygroscopicity, kinetic response, volatility, stability under light, and propensity for phase separation are reported. The uptake of water to dry particles upon humidification and evaporation of water upon drying are kinetically limited, suggesting formation of a kinetically hindered (glassy) material at low relative humidity and temperatures around 0 °C and below. A sample with O:C = 0.53 showed greatly enhanced volatility under irradiation by blue light, indicative of photochemical processing. The results of this study will be compared to mechanical bounce and hygroscopicity tandem differential mobility analyzer (HTDMA) studies.