Multiphase Chemical Oxidation of Atmospheric Organic Aerosol

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Organic aerosol (OA) is ubiquitous in the atmosphere and can undergo chemical modification during transport. Multiphase chemical oxidation reactions between OA and oxidants can impact source apportionment, air quality, and the particles' potential to act as cloud condensation nuclei (CCN) and ice nuclei and thus climate. Temperature and humidity affect the phase state of the OA particles which in turn can impact the oxidation kinetics. The initial step in multiphase oxidation reactions involves the adsorption of the gas species on the particle surface. We will examine typical adsorption energies of gas species on different inorganic and organic substrates, the resulting desorption lifetimes, and how temperature impacts the residence time of an adsorbed gas species on the surface. Model-derived sensitivity studies that include the effect of temperature on desorption lifetime and particle phase will be presented for the case of reactive uptake of OH by biomass burning aerosol surrogate particles composed of abietic acid and levoglucosan. We will show experimental data that demonstrates the importance of particle phase state, modulated by temperature and humidity, for OH oxidation and resulting CCN activity and cloud droplet numbers. Preliminary reactive uptake experiments will be presented on the uptake of NO_3 and OH by organic substrates serving as surrogates for atmospheric OA for temperatures as low as -40 ºC.