2.065 Urban particle phase state and its link with chemical composition,mixing state, and liquid water content.

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Abstract:

Particle phase state can be liquid, semi-solid and solid, and it has significantly influences on particle chemical and physical processes. In the present study, particle rebounding fraction, mixing sate, chemical composition, and hygroscopicity were investigated in the urban atmosphere of China. The particle phase state and its link with particle chemical composition and aerosol liquid water content (ALWC) were studied. The particle phase state was sensitive to ambient relative humidity (RH). The particles changed from rebounding to adhering when RH increased above 60%, suggesting a transition from semi-solid to liquid state. This transition RH was below the deliquescence RH of both (NH4)2SO4 and NH4NO3. Sub-micrometer particles were in the liquid state during heavy haze episodes. This might be because the elevated RH and inorganic fraction in particles resulted in the enrichment of aerosol liquid water content. The transition to a liquid phase state, marking the beginning of the haze episode, might kick off a positive feedback loop. The liquid particles might readily uptake pollutants that then react to form inorganics, thereby further increasing water uptake. We propose that the liquid phase state facilitates the mass transfer and multiphase reactions of the particles, thereby accelerating secondary particle growth in haze over the North China Plain. We argue that the atmospheric particle phase state may deeply influenced by the increasing global burden of nitrate aerosol in the century, and particles in liquid phase state may facilitate the formation of secondary inorganic salts and the VOCs transformed into SOA by aqueous reactions.