“Morphology and Optical Properties of Mixed Aerosol Particles”

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Experiments and modeling studies have shown that deliquesced aerosols can exist not only as one-phase system containing organics, inorganic salts and water, but often as two-phase systems consisting of a predominantly organic and a predominantly inorganic aqueous phase (1,2). Recent laboratory studies conducted with model mixtures representing tropospheric aerosols (1,2,3), secondary organic aerosol (SOA) from smog chamber experiments (4), and field measurements (5) suggest that liquid-liquid phase separations (LLPS) is indeed a common phenomenon in mixed organic/ inorganic particles.

During LLPS, particles may adopt different morphologies mainly core-shell and partially engulfed. A core-shell configuration will have consequences for heterogeneous chemistry and hygroscopicity and as a result will alter the optical properties of the particles in particular for organic phases containing absorbing molecules, e.g. brown carbon.

The primary objective of this project is to establish a method for investigating the morphology of mixed inorganic and absorbing organic compounds of atmospheric relevance and study their radiative properties before, during, and after phase transitions mainly during LLPS. This will be the first study looking into the radiative effect of LLPS in detail.

Our ternary model system consist of ammonium sulfate (AS)/ Polyethylene Glycol (PEG)/ and water (H_2O). Carminic acid (CA) was added as a proxy for an absorbing organic compound to the system.The behavior of single droplets of above ternary mixture was monitored during relative humidity (RH) cycles using optical microscopy. The same ternary mixture particle was levitated in an electrodynamic balance (EDB) and the change in its absorption properties was measured at varying RH.

In addition, Mie-code modeling is used to predict the absorption efficiency of the same ternary system and the result will be compared with the data obtained from EDB experiment.We also intend to determine the occurrence of LLPS in accumulation-sized particles and the change in their absorption using a cavity ring down aerosol spectrometer. If LLPS alters the absorptive properties of the suggested model aerosols significantly, absorption measurements of accumulation mode particles of the same composition would allow proving that LLPS indeed occurs in particles of accumulation mode size. Up to now LLPS has not been studied for particles in this size range.

References:

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