Evaporation of organic and inorganic/organic particles

A.A. Zardini¹, I. Riipinen², I.K. Koponen³, M. Kulmala² and M. Bilde¹

¹Department of Chemistry, University of Copenhagen, DK-2100, Denmark
²Department of Physical Science, University of Helsinki, 00014, Finland
³National Research Centre for the Working Environment, DK-2100, Copenhagen, Denmark

Keywords: Evaporation, Aerosol thermodynamics, SOA, Vapour pressure

Biogenic sources as well as human activities contribute large amounts of volatile organic compounds to the atmosphere. Upon oxidation, polyfunctional molecules such as dicarboxylic acids are formed. These molecules generally have lower vapor pressures than the parent molecules and are able to condense on existing particles or maybe even participate in formation of new particles in the atmosphere. Current knowledge about the thermodynamic properties governing this partitioning as well as the influence of the organic molecules on properties of aqueous solution droplets is poor.

We have therefore developed a method based on the HTDMA technique (Hygroscopicity Tandem Differential Mobility Analyzer, see Fig.1) for determining the sub-cooled liquid state vapor pressure as well as other thermodynamic properties of secondary organic aerosol components.

The temporal evolution of the particles chemical composition is monitored by an Aerosol Mass Spectrometer operating in parallel with the HTDMA. The integrated results of evaporation and chemical composition changes are then compared to predictions from thermodynamic equilibrium models.

This work is supported by EUCAARI (European Integrated project on Aerosol Cloud Climate and Air Quality interactions) No 036833-2 and by the Danish Natural Science Research Council through the Copenhagen Center for Atmospheric Research (CCAR).


Figure 1. Our TDMA setup consists of three interconnected components: a particle generation system where a narrow size range of particles is selected in the first DMA; a laminar flow reactor where particles are allowed to evaporate at constant relative humidity and temperature; and a second DMA with a particle counter (SMPS) to measure the size of the particles at the sampling ports (1 to 4).

We have already measured evaporation rates of droplets containing one dicarboxylic acid (C3- to C5) and water (Koponen et al., 2007; Riipinen et al., 2006; Zardini et al., 2006). In this work we investigate more complex, multicomponent aqueous solution aerosol particles made of evaporating and non evaporating organic components together with inorganic salts.