Geophysical Research Abstracts, Vol. 8, 07835, 2006
SRef-ID: 1607-7962/gra/EGU06-A-07835

Renucleation of dicarboxylic acids in aerosol chamber experiments - implications for the atmosphere?

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In aerosol chamber experiments we generate aerosols by spraying an aqueous solution into a pre-chamber and then leading the aerosol into the aerosol chamber which was beforehand conditioned to a relative humidity of 60-70 %. This process usually yields a monomodal particle size distribution with a maximum is at particle diameters around 200 nm.

During experiments involving dicarboxylic acids as aerosol components we observed that in some cases the initial particle distribution has an additional peak at around 10-20 nm, so in the size range usually assigned to nucleation. While the occurrence of this bimodal particle distribution was always observed for pure dicarboxylic acid aerosols, in mixed organic/inorganic aerosols there appears to be a dependence on the nature of the inorganic seed aerosol as well as on the organic acid.

We found evidence that the nucleation mode particles are formed by renucleation of dicarboxylic acid from the gas phase. Bringing the aerosol from the generator r.h. of 100% to the chamber r.h. of 60% causes evaporation of water and the semivolatile dicarboxylic acid. The resulting gas-phase concentration of dicarboxylic acid depends on the solubility of the acid and can easily exceed the saturation vapour pressure over the solid especially for the less soluble dicarboxylic acids like succinic acid.

The transport of an aerosol from a high relative humidity regime (droplets, 100%) to a lower relative humidity regime (aerosol chamber, 60has some resemblance to cloud evaporation. Thus, also this process might lead to the formation of particles by renucleation of organic compounds from a supersaturated gas phase.