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# Role of acids and bases in nanoparticle growth

Taina Yli-Juuti (1), Kelley Barsanti (2), Bryan Bzdek (3), Lea Hildebrandt Ruiz (4), Tuija Jokinen (1), Antti-Jussi Kieloaho (1), Ulla Makkonen (5), Tuukka Petäjä (1), Taina Ruuskanen (1), Murray Johnston (3), Markku Kulmala (1), and Ilona Riipinen (6)

(1) Department of Physics, University of Helsinki, Helsinki, Finland (taina.yli-juuti@helsinki.fi), (2) Department of Civil and Environmental Engineering, Portland State University, Portland, USA, (3) Department of Chemistry and Biochemistry, University of Delaware, Newark, USA, (4) Atmospheric Chemistry Division, National Center for Atmospheric Research, Boulder, USA, (5) Finnish Meteorological Institute, Helsinki, Finland, (6) Department of Applied Environmental Science and Bert Bolin Centre for Climate Research, Stockholm University, Stockholm, Sweden

Secondary aerosol particles that are formed in atmosphere by gas-to-particle conversion during new particle formation events have potential to affect climate significantly due to their typically high number concentrations. This, however, requires that the freshly formed nanoparticles of about 1 nm in diameter grow tens of nanometers and reach climatically relevant sizes, i.e. sizes where they can act as cloud condensation nuclei. During the growth towards larger sizes the nanoparticles are subject to coagulational losses, and the rate at which the nanoparticles grow by condensation of vapors is a key factor affecting their probability to survive to climatically relevant sizes. Vapors that condense on the nanoparticles can be produced in the atmosphere from volatile compounds through gas phase chemical reactions, and their volatility can also be further lowered by particle phase processes. Therefore, particle composition and particle phase processes may influence nanoparticle growth.

We study the growth of atmospheric nanoparticles and especially the role of particle phase salt formation in the nanoparticle growth using MABNAG model (Model for Acid-Base chemistry in NAnoparticle Growth) and by comparing to atmospheric measurements. MABNAG is a condensation growth model for aqueous solution particles. In MABNAG the dynamics of gas phase mass transport of vapors to particle are coupled with thermodynamics of particle phase acid-base chemistry, and both the composition and size dependence of equilibrium vapor pressures are accounted for. The model is applied especially for boreal forest environment. Here nanoparticle growth is modeled with a system of water, two acids (sulfuric acid and an organic acid) and two bases (ammonia and an amine) as condensing vapors. Focus is on the neutralization of acids by the bases and the related effects on the particle growth.

According to the model predictions the enhancement of condensation of organic acid due to salt formation is dependent on the base concentrations and significant only at high-base conditions. However, for the sulfuric acid and the two bases acid-base chemistry is important. The growth rate of the particles is predicted to increase with increasing relative humidity, partly due to the increase in water mass but also partly due to the increase in condensation of the amine and the subsequent enhancement of condensation of the organic acid.