COMPARISON OF MEASURED AND MODELLED DIMETHYLAMINE-SULFURIC ACID NANOPARTICLE HYGROSCOPICITY

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Aerosol related processes, such as cloud formation and light scattering, have currently one of the highest uncertainties in a global climate modelling perspective [1]. These uncertainties hinder our ability to accurately predict the extent of the climate change. To be able to capture the effect which aerosols have on climate in large scale simulations requires detailed knowledge which can only be attained by studying aerosol properties in a smaller scale.

Here we have studied the hygroscopicity, i.e. the water uptake of nanoscale aerosol particles and compared the measured values to those predicted by the state-of-the-art thermodynamic equilibrium model [2]. Our study focuses on how well the hygroscopicity of sub-30 nm dimethylamine (DMA)-sulfuric acid (SA) particles is presented in the model. Both of the studied compounds are known constituents of atmospheric aerosols [3][4]. We performed the comparison between the measurements and the model with particles having various DMA:SA molar ratios ranging from 0.8:1 to 2:1 and with relative humidities from ca. 0% to 80%. The thermodynamic model has been tested for particle sizes where the curvature of the particles does not significantly affect the partitioning of water between gas and particle phase [5].

Our analysis shows that the hygroscopicity of DMA-SA nanoparticles is underestimated by the model in all studied conditions. However, the relative difference between the measurements and the model predictions are not higher than 15%. This difference showed increase as the relative humidity increased and a slight decrease with increasing particle size and increasing acidity, though in the latter case the differences between different compositions were only of few percent.

Our findings indicate that the water uptake might have uncertainty when the modelled system contains dimethylamine and the particle size is within the nanoparticle range. The uncertainty in water uptake reflects to predicted particle size and also possibly to the partitioning of other compounds between gas and particle phase and particle phase and particle phase chemical reactions. The extent of the effect of this uncertainty to e.g. the growth of small particles to sizes where they can act as cloud condensation nuclei remains to be studied.

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