Atmospheric Chemistry and Physics
An Interactive Open Access Journal of the European Geosciences Union

Atmos. Chem. Phys., 8, 4595-4604, 2008
www.atmos-chem-phys.net/8/4595/2008/

Ternary solution of sodium chloride, succinic acid and water; surface tension and its influence on cloud droplet activation

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Abstract. Surface tension of ternary solution of sodium chloride, succinic acid and water was measured as a function of both composition and temperature by using the capillary rise technique. Both sodium chloride and succinic acid are found in atmospheric aerosols, the former being main constituent of marine aerosol. Succinic acid was found to decrease the surface tension of water already at very low concentrations. Sodium chloride increased the surface tension linearly as a function of the concentration. Surface tensions of both binary solutions agreed well with the previous measurements. Succinic acid was found to lower the surface tension even if sodium chloride is present, indicating that succinic acid, as a surface active compound, tends to concentrate to the surface. An equation based on thermodynamical relations was fitted to the data and extrapolated to the whole concentration range by using estimated surface tensions for pure compounds. As a result, we obtained an estimate of surface tensions beyond solubility limits in addition to a fit to the experimental data. The parameterization can safely be used at temperatures from 10 to 30°C. These kinds of parameterizations are important for example in atmospheric nucleation models. To investigate the influence of surface tension on cloud droplet activation, the surface tension parameterization was included in an adiabatic air parcel model. Usually in cloud models the surface tension of pure water is used. Simulations were done for characteristic marine aerosol size distributions consisting of the considered ternary mixture. We found that by using the surface tension of pure water, the amount of activated particles is underestimated up to 8% if particles contain succinic acid and overestimated it up to 8% if particles contain only sodium chloride. The surface tension effect was found to increase with increasing updraft velocity.

Final Revised Paper (PDF, 496 KB) Discussion Paper (ACPD)

Citation: Vanhanen, J., Hyvärinen, A.-P., Anttila, T., Raatikainen, T., Viisanen, Y., and Lihavainen, H.: Ternary solution of sodium chloride, succinic acid and water; surface tension and its influence on cloud droplet activation, Atmos. Chem. Phys., 8, 4595-4604, 2008. Bibtex EndNote Reference Manager