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Water activity and activation diameters from hygroscopicity data - Part I: Theory and application to inorganic salts

S. M. Kreidenweis¹, K. Koehler¹, P. J. DeMott¹, A. J. Prenni¹, C. Carrico¹, and B. Ervens²

¹Department of Atmospheric Science, Colorado State University, Fort Collins, CO, 80523, USA

²NOAA, Boulder, CO, 80503, USA

Abstract. A method is described that uses particle hygroscopicity measurements, made with a humidified tandem differential mobility analyzer (HTDMA), to determine solution water activity as a function of composition. The use of derived water activity data in computations determining the ability of aerosols to serve as cloud condensation nuclei (CCN) is explored. Results for sodium chloride and ammonium sulfate are shown in Part I. The methodology yields solution water activities and critical dry diameters for ammonium sulfate and sodium chloride in good agreement with previously published data. The approach avoids the assumptions required for application of simplified and modified Köhler equations to predict CCN activity, most importantly, knowledge of the molecular weight and the degree of dissociation of the soluble species. Predictions of the dependence of water activity on the mass fraction of aerosol species are sensitive to the assumed dry density, but predicted critical dry diameters are not.

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