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Uptake of HNO_3 to deliquescent sea-salt particles: a study using the short-lived radioactive isotope tracer ^{13}N

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Abstract. The uptake of HNO_3 to deliquescent airborne sea-salt particles (RH = 55%, P = 760 torr, T = 300 K) at concentrations from 2 to 575 ppbv is measured in an aerosol flow tube using ^{13}N as a tracer. Small particles (<approx> 70 nm diameter) are used in order to minimize the effect of diffusion in the gas phase on the mass transfer. Below 100 ppbv, an uptake coefficient (γ_{upt}) of 0.50 ± 0.20 is derived. At higher concentrations, the uptake coefficient decreases along with the consumption of aerosol chloride. Data interpretation is further supported by using the North American Aerosol Inorganics Model (AIM), which predicts the aqueous phase activities of ions and the gas-phase partial pressures of H_2O, HNO_3, and HCl at equilibrium for the $NaCl/HNO_3/H_2O$ system. These simulations show that the low concentration data are obtained far from equilibrium, which implies that the uptake coefficient derived is equal to the mass accommodation coefficient under these conditions. The observed uptake coefficient can serve as input to modeling studies of atmospheric sea-salt aerosol chemistry. The main sea-salt aerosol burden in the marine atmosphere is represented by coarse mode particles (> 1 µm diameter). This implies that diffusion in the gas-phase is the limiting step to HNO_3 uptake until the sea-salt has been completely processed.

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