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Modelling the Effects of Atmospheric Alkylamines on the Properties of Sea Salt Aerosols using the Extended Aerosols and Inorganics Model (E-AIM)

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Sea salt aerosols contribute significantly to the mass loading of ambient aerosol, which may serve as cloud condensation nuclei and can contribute to light scattering in the atmosphere. Two major chemical components commonly found in sea salts are ammonium sulfate (AS) and sodium chloride (NaCl). It has been shown that alkylamines, derivatives of ammonia, can react with ammonium salts in the particle-phase to displace ammonia and likely change the particle properties.

This study investigated the effects of atmospheric alkylamines on the composition and properties of sea salt aerosols using a chemical system of methylamine (MA, as a proxy of alkylamines), AS and NaCl (as a proxy of sea salt aerosol). The concentrations of ammonia and MA in aqueous/gas phases at the thermodynamic equilibrium were determined using the Extended Aerosols and Inorganics Model (E-AIM) under varying initial inputs, along with the deliquescence relative humidity (DRH) and the corresponding particle water content. Our findings indicated a notable negative relationship between MA concentration and the DRH for both AS and NaCl while the effect of MA on NaCl is smaller than that on AS. The salt of MA in the particle phase may absorb water vapor and may lead to the displacement reaction between AS and NaCl due to the low solubility of sodium sulfate. The acidity in the particle phase also played a significant role in affecting the DRH of sea salt aerosols. Since both sea salt aerosol and alkylamines are emitted into the atmosphere from the ocean in large quantities, our study suggested the potential impact of alkylamines on the environment and the climate via the modification of sea salt aerosol properties.