Laboratory studies of the cloud droplet activation properties and corresponding chemistry of saline playa dust

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Saline playas (dried lake beds) emit large quantities of dust that can facilitate the activation of cloud droplets. Despite the potential importance of playa dust for cloud formation, several models assume that dust is non-hygroscopic highlighting the need for measurements to clarify the role of dust from multiple sources in aerosol-cloud-climate interactions. Here we present water uptake measurements onto playa dust represented by the hygroscopicity parameter κ, which ranged from 0.002 ± 0.001 to 0.818 ± 0.094. Single-particle measurements made using an aircraft-aerosol time-of-flight mass spectrometer (A-ATOFMS) revealed the presence of halite, sodium sulfates, and sodium carbonates that were strongly correlated with κ underscoring the role that dust composition plays in water uptake. Predictions of κ made using bulk chemical techniques generally showed good agreement with measured values; however, several samples were poorly predicted using bulk particle composition. The lack of measurements/model agreement using this method and the strong correlations between κ and single-particle data are suggestive of chemical heterogeneities as a function of particle size and/or chemically distinct particle surfaces that dictate the water uptake properties of playa dust particles. Overall, our results highlight the ability of playa dust particles to act as cloud condensation nuclei that should be accounted for in models.