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Reaction probability of sulfate and nitrate precursors onto East Asian dust particles

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We investigated the chemical evolution of dust particles and examined the reaction probability of sulfate and nitrate precursors (e.g., SO_2, N_2O_5, and HNO_3) onto dust particles in East Asia. For this investigation, two data sets from ACE-ASIA C130 Flights #6 and #8 and three data sets measured in Seoul were analyzed. During the selected dust storm periods, large amounts of CO_3^{2-} still remained in fine-mode dust particles (Dp$<\sim$1.3 mm). The average fractions of CO_3^{2-} (based on $[Ca^{2+}]$+$[Mg^{2+}]$ equivalences) for the two C130 flights were 87% and 39%, respectively, and the average CO_3^{2-} fractions for three data sets in Seoul ranged from 43.4% to 86.5%. Such high CO_3^{2-} fractions remaining in fine-mode dust particles were probably due to the small reaction probabilities (γ) of sulfate and nitrate precursors onto dust particles. More interestingly, in the studied cases the reaction probability was strongly correlated with relative humidity (RH), indicating the dependence of γ on RH or the existence of particulate water on dust. Moreover, we found that γ depends not only on RH, but also on the surface properties of dust. Furthermore, γ was very sensitive to RH when dust particles were hydrophilic (or largely wet), but less sensitive to RH when dust particles were hydrophobic (or largely dry). It is, therefore, recommended that further field and/or laboratory investigations should be conducted to examine the relationships among γ, RH and the dust surface properties.