Geophysical Research Abstracts
Vol. 12, EGU2010-2580, 2010
EGU General Assembly 2010

Sea salt, sulfate, nitrate, chloride in Asian dust particles observed in Japan: results of individual particle analysis

Daizhou Zhang (1), Maromu Yamada (1), Yutaka Tobo (2), Hiroko Ogata (1), Kazutaka Hara (1), Tetsuji Nagatani (1), Atsushi Matsuki (2), Yasunobu Iwasaka (2), and Kirsten Lieke (3)

(1) Prefectural University of Kumamoto, Kumamoto, Japan (dzzhang@pu-kumamoto.ac.jp), (2) Kanazawa University, Kanazawa, Japan, (3) Institute of Applied Geosciences, Technische Universität Darmstadt, Darmstadt, Germany

Atmospheric particles were collected in Japan during Asian dust storm events from 2000 to 2007. Dust particles were analyzed by using electron microscopes and the mixture state of individual dust particles with sea salt, sulfate, nitrate and chloride were investigated. About 60∼85% of dust particles were internally mixed with sea salt, 91% or more dust particles contained sulfate, and 27% or less contained nitrate. Besides the coagulation of sea-salt and dust particles, chlorine could deposit onto dust particles through the absorption of chlorine-containing gases when the particles passed through the marine atmosphere between China and Japan. The quantitative estimation revealed that the chlorine deposition on many particles was not negligible compared to sulfur deposition. The preferential formation of chloride in Ca-rich dust particles in cases when the particles contain little or no sulfate was found. Most of the particles were in an amorphous state and nearly spherical even under high vacuum, implying the potential enhancement of dust hygroscopicity. Comparisons of the relative weight ratios of sodium, sulfur and chlorine in mixture particles and in sea salt particles showed that mineral materials could enhance particulate sulfate and nitrate formation and restrain chlorine depletion from the sea salt components in mixture particles.

Size distributions of the particles segregated by the mixture degrees of mineral and sea salt in different dust storm events were similar and all distributions showed a diameter range of 1∼8 μm with maximum mode around 3 μm. Out of 1∼8 μm, dust particles were rarely detected. It is confirmed that the size increase of dust particles had a strong correlation with their sea salt content but was independent from their non-sea-salt sulfur content, suggesting that the growth of dust particles in size during their dispersion in the marine atmosphere was dominated by the combination with sea salt rather than by other processes such as surface uptake of sulfate. Estimates of size shift of dust particles due to sea salt adhering indicated that mixing with sea salt had caused their size distributions to shift to larger ranges approximately by $0.4 \sim 0.8$ μm during the particles passed the marine atmosphere between China and Japan. Since size and density of a particle are two key parameters in determining its settling velocity, it is expected that the combination of dust particles with sea salt might largely change the settling velocity of dust particles to the surface and consequently the sedimental flux of mineral dust to sea surface in the marine atmosphere. Estimates with the observational data from six dust events revealed that, due to sea salt adhering, the gravitational settling flux of mineral dust increased approximately $14 \sim 17\%$ in well-mixed events and $4 \sim 6\%$ in less-mixed events, indicating the importance of considering this effect in the schemata of particle gravitational settling when mapping dust flux to the ocean.

This presentation provides the data of Asian dust to the presentation (by K. Lieke et al.) about the comparison of African dust and Asian dust observed at islands close to the continents where they were originated.