C-1 Studies on the Behavior of Acidic and Oxidative Component in East Asia (Final Report)

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To clarify the transboundary air pollution from the Asian continent to Japan, we conducted ground-based, aircraft and ship-board observations. To quantify the transboundary air pollution, the long range transport model which include transport, diffusion, chemical transformation and dry/wet removal processes was established. In addition, the chemical reactions which contribute significantly to this model were studied.

Stable isotope ratios of S and Pb were determined. The determination of Pb stable isotope ratios are valid for to assess the transboundary air pollution. As for S stable isotope ratios, those of snow were five times more bigger than those of rain, indicating the difference of origin of rain and snow. From the measurement of air pollutants throughout the year, annual dry deposition amount was estimated in rural area and SO_2 and HNO_3 were the dominant contributor compared to particulate sulfate and nitrate. PAN and PPN were detected in most of over 500 samples at remote sites and by aircraft. Mean concentrations of PAN and PPN in the islands and in lower troposphere over Yellow Sea to Japan Sea are 100-400 ppt(v/v) and 10-25 ppt, respectively. Good correlation between PAN and PPN at the each point was observed and PPN was found to be 5-9 % of PAN.

Spatial distribution of atmospheric pollutants related to acid deposition was measured in the maritime air around Japan during the PEACAMPOT Aircraft Observation Campaign. The aircraft observation campaigns were made three times. Based on the observations covering the Sea of Japan, the Yellow Sea, and the East China Sea between the Asian continent and Japan, it became clear that the impact of Korea is the largest for SO_2 gas. China has the largest impact for nss-sulfate. Using a ship-board Mie lidar and radio-sondes, we observed the marine atmospheric boundary layer. In observation at Oki island in December, however, clear convective plumes were observed by lidar, and clouds were developed up-to 1.5-2.6km.

To understand the observed characteristics of long-range transport of pollutants in East Asia, a 3-D atmospheric transport model which includes chemical reactions, the STEM (Sulfate Transport Eulerian Model), was applied. By the simulation it was found that wind pattern variations associated with a synoptic scale pressure system are extremely important for the transport of pollutants. The MRI Long-range Transport Model was combined to gain high spatial resolution over focused area and to capture the interaction process between cloud and pollutants. After the evaluations of the nesting model, the simulation of transport of sulfur oxides in the East Asian region is performed on whole year of 1985, and results are compared with the results by outer model only.

Photochemical oxidation of sulfite to sulfate in cloud droplets were experimentally investigated. Photoirradiation to sulfite in iron(III) solution of several molar concentration evidently accelerated the oxidation to a great extent. The photocatalytic oxidation in iron(III) solution obeyed a rate law of $[S(IV)]^{0.5}\ [Fe(III)]^{0.7}\ [H^+]^{0.2}$. The mechanisms was clarified for the reactions of ozone with natural hydrocarbons such as isoprene or mono terpenes. High concentration of ozone was observed in Mt. Maeshirane in Oku-nikko, where forest damage is very serious.