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Vertical distribution of aerosols in the boundary layer during non-KOSA periods in spring at Ishikawa, Japan: Preliminary results of the observation using a tethered balloon

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Abstract

Asian dust (KOSA) is often transported along with pollutants from Asian continent to Japan by the westerlies. This phenomenon can cause regional environment changes in East Asia, which include radiative forcing, cloud process or primary productivity by marine phytoplancton, and also might have an influence on human health. To reveal these effects, many researches have investigated the transport mechanisms and the chemical/physical characteristics of those particulates through many observations conducted near the ground or in the free troposphere. Vertical distribution of aerosols is very important for understanding diffusion process of both particles come from Asian continent and local regions. However, there is no data on the information of aerosol mixture state and concentration in the boundary layer at the Japan Sea side of the archipelago.

This study focuses on providing aerosol mixture states in the boundary layer near coastal area of the Japan Sea. Aerosol measurements were conducted for three days on May 4, 6 and 8, 2006 at the Japan Sea side of the archipelago (Tsubata, Ishikawa prefecture), using a tethered balloon. To measure aerosol mixture states vertically, an aerosol sampler, Optical Particle Counter (OPC), thermometer, hygrometer and Global Positioning System (GPS) receiver were mounted on the tethered balloon. In this observation, we could measure atmospheric aerosols up to about 500 m from the ground. The elemental compositions of individual particles collected, particle diameter larger than 1.0 μm, were analyzed by Scanning Electron Microscope and Energy Dispersive X-ray spectrometer (SEM-EDX). In addition, the OPC was measured particle number concentration sized at diameters > 0.3, 0.5, 0.7, 1.0, 2.0, 3.0, and 5.0 μm.

During the balloon-borne observations, KOSA events were not observed, and meteorological data also showed that the aerosols we measured was seemed to be local origin. The mixing state of particles was significantly different from day to day. On May 4, most of

particles were consisted of sea-salt less modified by H_2SO_4 or HNO_3. Particles collected on May 6 were also mostly sea-salt particles, but more modified than on May 4. Chemical composition of particles collected on May 8 were much different comparing with the cases of May 4 and 6; mineral dust and heavy metal particles are often appeared in the sample. The OPC measurements showed that number concentrations of particles larger than 1.0 μm were decreased with increasing altitude in all cases. These decreases are probably due to the sea-salt particle, since the number fractions of sea-salt particles were decreased with increasing altitude. Mixture states of particles were almost same between near the ground and at several hundreds meters high. In this observation, we could not find critical layers separating the atmospheric character, and the atmosphere was well mixed from the ground to several 100 m high. In addition, we could measure vertical distribution of aerosols in the boundary layer without effects of aerosols transported from Asian continents. These data will be provided as a back ground condition of aerosol mixture state at the Japan Sea side of the archipelago.