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2009年10月の東シナ海上空におけるエアロゾル化学成分の航空機観測

2009 Aerial observation of aerosols transported from East Asia

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[Introduction] Anthropogenic emission in East Asia has been increasing due to the rapid economic growth in this area. Atmospheric pollutants emitted in this area are observed even in North America, and they affect northern hemispheric climate. Not only in the global aspects but in regional aspects, long-range transport of pollutants is very important. Transformation of pollutants during the long-range transport is an important problem from a point of view of regional air quality and acid rain. In order to evaluate the transport of atmospheric pollutants from the East Asia and to analyze the transformation processes during the transport an aerial observation experiment was carried out in October, 2009 over the East China Sea.

[Method] The aerial observation was carried out on October 14th, 15th and 17th, 2009 over the northern part of the East China Sea. The aircraft employed was Beechcraft Kingair 200T chartered from Diamond Air Service, Inc.(Japan). The flight area was between Fukue Island, Japan and about 220 km south of Jeju Island, Korea. Level flights were made at 500, 1000, 2000, 3000 m asl. Circulating flights at altitudes of 500, 1000, 2000, and 3000 m were also made above a point of south of Jeju Island (on 14th) and Fukue Island (on 15th and 17th) where ground-based observation site is in order to observe vertical distribution.

Gases observed on board were O_3, SO_2, NOy including gaseous HNO_3, and CO. Number density and mass concentration of aerosols were also monitored on board. Chemical analyses of aerosols were performed by use of filter sampling of aerosols with a hi-volume tape sampler and subsequent analyses with ion chromatography (cation: NH_4^+, Ca^{2+}, K^+, Na^+, Mg^{2+}, anion: SO_4^{2-}, NO_3^-, Cl^-) as well as ICP-MS (Li, Na, Mg, Al, K, Ca, V, Mn, Fe, Co, Cu, Zn, Ga, As, Se , Rb, Sr, Ag, Cd, In, Sb, Cs, Tl, Pb). Two times of twenty minutes sampling at a flow rate of ~400 L min^{-1} were done at each altitude during level flights. For circulation flights 15 minutes sampling was done at each altitude.

[Results and Discussion] On Oct. 14th, the air mass came from China. Ionic species and trace elements increased in boundary layer, but at 3000 m near Fukue Isl., anthropogenic compounds such as SO_4^{2-}, NH_4^+, Pb increased rapidly.

On Oct. 15th, the air mass came from China through Korean Peninsula. Fractions of SO_4^{2-} in anionic species and NH_4^+ in cationic species were the highest in 3 days observation. That means anthropogenic pollutants were the main components of the aerosols collected on board. In trace elements, also, anthropogenic elements such as Pb and Zn increased near Fukue Isl. (on east side of the observation area), whereas crustal elements like Fe increased on west side of the observation area. CFORS results supported this transport pattern.

On Oct. 17th, which was a hazy day with Asian dust, the air mass came from desert area through China. CFORS forecasted an incursion of Asian dust. Concentrations of ions and trace elements were the highest in 3 days observations. Maximum concentration of Al and Ca^{2+}were ~7 ug m^{-3}. On other days they were less than 1 ug $m^{-3}$and 0.7 ug m^{-3}, respectively. V/Mn ratio was very constant around 0.13. All of those data suggest that the main components were dust origin. Not only dust particles, however, anthropogenic species also showed high concentrations on this day. As already reported, the dust-containing air mass pushed out anthropogenic pollutants during the long-range transport.

キーワード:航空機観測,エアロゾル化学成分,金属元素,イオン成分,東シナ海

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