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Number size distribution of ambient aerosols at Cape Hedo, Okinawa and Fukue Island, Nagasaki

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[**Introduction**]

Recent drastic economical growth in the East Asian region has caused large emission of anthropogenic pollutants to the atmosphere. Some aerosols act as cloud condensation nuclei (CCN) and influence the global climate. There was a report that the higher ratio of inorganic aerosol to the sum of inorganic and organic aerosol and the larger particle size resulted in the higher ratio of CCN to condensation nuclei at the same water vapor supersaturation.

We have conducted field studies for chemical compositions of ambient aerosols at some locations in the East Asian region. In this work, measurement results of number size distribution of aerosols, which potentially influences cloud formation, are presented. Obtained data at two locations were analyzed for better understanding the spatial distribution of aerosol size in the region.

[**Observation**]

The number concentration was measured at Cape Hedo, Okinawa (lat 26.9^{o}N, long 128.3^{o}E) from 15 to 22 February 2012 and at Fukue Island, Nagasaki (lat 32.8^{o}N, long 128.7^{o}E) from 15 to 28 February 2013 using a Wide-Range Particle Spectrometer (WPS, MSP Corp.), which has a capability to measure a wide particle size range. The WPS consists of two main parts: a combination of a Differential Mobility Analyzer (DMA) and a Condensation Particle Counter (CPC) for particle measurement from 5 to 350 nm (or from 10 to 500 nm) and a Laser Particle Spectrometer (LPS) for measurement from 350 to 10000 nm.

Simultaneously, chemical compositions of ambient aerosols (ammonium, nitrate, sulfate, chloride and organics) were measured by a Quadrupole Aerosol Mass Spectrometers (Q-AMS, Aerodyne Research, Inc.) at Cape Hedo and an Aerosol Chemical Speciation Monitor (ACSM, Aerodyne Research, Inc.) at Fukue Island. At Fukue Island only, sulfur dioxide concentrations were also measured by an SO_2 analyzer (Model 43i, Nippon Thermo Co., Ltd.). Sulfur dioxide concentrations at Cape Hedo were monitored at Hedo Acid Deposition Monitoring Station (Ministry of the Environment).

[**Results and Discussion**]

The size distributions at Cape Hedo consistently had two peaks at 50 nm and 200 nm. On the other hand, those at Fukue Island varied. There were two peaks at 50 nm and 150 nm after 0:00 a.m. JST on 23 February 2013. Ambient aerosols at 150 nm were largest among the particles which were measured at Fukue Island. There was one peak at 15-25 nm after 12:00 p.m. JST on 24 February 2013 when the number concentration was over 100000 #/cm^3. The concentration was also high on 16 and 25 February 2013. The growth of nucleation mode particles was observed from noon to night of each day. We believed that these cases were new particle formation (NPF) events. Such a case was not observed at Cape Hedo.

The molar ratio of sulfur dioxide to the sum of sulfur dioxide and sulfate was studied at both monitoring sites during the observation period by a WPS. When NPF events occurred at Fukue Island, the ratio increased over 80%. On the other hand, the ratio at Cape Hedo was at most 60% even on 17 February 2012 when the transport time of air masses from China according to back trajectory analyses (NOAA HYSPLIT) was approximately one day. The transport time was as long as that to Fukue Island. It was inferred that enough gases such as sulfur dioxide to cause NPF were around Fukue Island and semi-volatile vapors which were newly generated by photochemical reactions condensed on pre-existing particles because the concentrations of gases were low and those of aerosols such as sulfate were high around Cape Hedo.

Keywords: Number size distribution, East Asia, Wide-range particle spectrometer (WPS), New particle formation