

Japan Geoscience Union Meeting 2011

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MIS029-P01

Room:Convention Hall

Time:May 23 14:00-16:30

Black particles falled in Kanagawa Prefecture on December 15, 2010

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Black particles falled in Kanagawa Prefecture on December 15, 2010. People thought that it may be the artificial material and worried about the hazardous property. Black particles are brought in to the Kanagawa environmental research center and analyzed. But neither the poisonous substance nor the radioactivity were contained in black particles. On the other hand, the blowing dust was observed on the southeast flank of Mt. Fuji and strong westerly of 40m/s was measured above Kawaguchiko-machi, 3000m in height, on December 15. These particles were thought to be the natural product, brought in to the Kanagawa prefectural museum and Kanagawa prefectural hot spring research, and analyzed. Black particles were dispersed east of Mt. Fuji. Dispersed area was sector which top was Mt. Fuji and its center was toward east. The Most distant dispersal point was Ichihara, Chiba prefecture, about 132km from summit of Mt. Fuji. Almost of particles were brown to black glass shards which were not weathered. Its size were about 0.1 to 0.01mm and became smaller toward east. The result of the chemical analysis using EPMA showed similarity to Fuji-Hoei tephra erupted 1707, especially high content of TiO₂ and K₂O. Black particles were thought to be reworked Fuji-Hoei tephra brought by strong westerly.

Keywords: Fuji-Hoei tephra, Black particles, reworked tephra, glass shard

Measurement of Cloud Condensation Nuclei at the Summit of Mt. Fuji

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1. Introduction

Aerosols serve as Cloud Condensation Nuclei (CCN) when cloud is formed and control the effect of cooling earth by cloud. Aerosol particles in the atmosphere have the various critical supersaturation by its solubility and size on dry condition. Generally, the higher supersaturation is, the more particles that can serve as CCN are because the smaller size that particles begin to grow as cloud droplets is. The relationship between CCN concentration and supersaturation is called supersaturation spectrum and this is used by some researchers when they take observations of CCN. The example of fixed point observations of CCN in Japan is a few. It is particularly a few in the mountain atmosphere, so we observed CCN at the summit of Mt. Fuji in summer.

2. Methods

This observation is done at the Mt. Fuji Weather Station from 17 July 2010 to 25 Aug. 2010. We used CCNC (Cloud Condensation Nuclei Counter ; DMT Inc.) as measuring instrument. This CCNC makes supersaturation inside, so we can experimentally make clouds. CCNC can count the number of CCNs grown according to the condition if CCN is contained in sample air. In this time, we set 6 stages of supersaturation between 0.1% and 0.44%.

In analysis, we used the backward trajectory (NOAA HYSPLIT) and drew supersaturation spectra by its origin.

3. Results and Discussion

There was a difference in the shape of supersaturation spectra between continental air and maritime air, and CCN concentration of continental air was higher than maritime air. When air had come from the sea and the land of Japan, supersaturation spectra lay between continental air and maritime air. This is suggested that the CCN concentration depends on how long the air has been on the land. Concerning its shape, this result correspond to the results that Uchida (1971) observed CCN at the Youth House and Tarobo at the bases of Mt. Fuji (650m and 1,300m levels) in spring. The years and seasons that Uchida observed there are different from this observation, so it is necessary to observe at the summit of Mt. Fuji and Tarobo at one time.

Also, the power of supersaturation spectra of the summit of Mt. Fuji was higher than other area's observations (Seinfeld and Pandis, 2006). The power depends on the size distribution and the chemical compound of particles then. We set the narrow range of supersaturation against other area's observations in terms of the size distribution, which some researchers set supersaturation between about 0.1% and 1%. So, we concerned that the size particles begin to grow as cloud droplets is large and the range of supersaturation made the difference of the power wide in comparison. Therefore it is necessary to be compared in the same range of supersaturation from now on. Then, we must consider whether the power is still high, and which of the effects is larger, by the size distribution or the chemical composition of particles.

References

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Seinfeld, J.H. and S.N. Pandis, Atmospheric Chemistry and Physics, From Air Pollution to Climate Change, Second Edition, Cambridge Press, p793, 2006

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Keywords: Cloud Condensation Nuclei, CCN, Mt. Fuji, supersaturation spectrum

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MIS029-P03

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Measurement of variation of total mass, composition, and optical property for aerosol particles at summit of Mt. Fuji

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It is well known that a particle in which diameter is less than 2.5 μm (PM2.5) influence health issue by air pollution and climate change by scattering and absorbing sun light. It is important to observe the chemical composition, optical property and mass concentration of PM2.5 to clear source, transportation of PM2.5. To investigate behavior of PM2.5 at the summit of Mt. Fuji, we measured total mass concentration and optical property of PM2.5 using SHARP monitor and nephelometer, respectively, and collected PM2.5 using high-volume air sampler in this study.

Mass concentrations of PM2.5 in the daytime were higher than that in the night time. It is suggested that top of Mt. Fuji is strongly influenced by valley breeze. Using two high-volume air samplers we collected PM2.5 on the quartz filter which was exchanged every week or 3 days. We controlled sampling time for high-volume air sampler to classify daytime (10:00-19:00) and nighttime (0:00-5:00) PM2.5. We analyzed the chemical composition such as water soluble compounds (sulfate, nitrate, and ammonium etc.), metals and organic and elemental carbon of PM2.5 on the filter we collected. From the observed results and metrological data we investigated the cause of variety of aerosol concentration and mass closure.

Keywords: Mt. Fuji, optical property, chemical composition, mass closure

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MIS029-P04

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Temporal and spatial trends of acidic substances in the ambient air at the top and foot of Mt. Fuji (1)

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It was clarified that long-range transport of acidic substances and the subsequent deposition caused forest decline in Europe and North America in the 1960s. Various air pollutants, emitted in East Asia by recent economic and industrial development, are inevitably transported to Japan by the westerlies because Japan is located at the east end of Asian continent. Chemical transport model like CMAQ revealed that the long-range transport of ozone and the precursors from China causes the increase of advisory for photochemical smog in widespread area from the northern part of Kyusyu to Kanto region in Japan.

Mt. Fuji, which is the highest mountain in Japan (3776 m a.s.l.), is an isolated peak and therefore could be regarded as the tower to observe the long-range transportation from East Asia such as China and Korea to Japan, the mixing processes from the boundary layer to the free troposphere, and the nucleation/precipitation scavenging processes of various atmospheric pollutants.

Simultaneous sampling of acidic gases (SO₂, HNO₂, HNO₃, HCl) and aerosols were performed with a four-stage filter pack sampler at daytime (6:00 ? 18:00) and at nighttime (18:00 ? 6:00) at the top and foot of Mt. Fuji during summer observational campaign. After sampling, chemical analysis was performed by commonly used method after extraction with ultra pure water or hydrogen peroxide solution (0.05 %) and filtration samples through 0.45 μ m. Cloud water was also collected by a passive sampler (Usui Kogyo, FWP-500).

We here report the spatial and temporal trends of acidic substances in the ambient air and discuss the influence of long-range transportation on the background concentration of acidic substances in the ambient air at the top of Mt. Fuji during the summer observational campaign in 2009 and 2010.

Keywords: background concentration, free troposphere, Long-range Transportation, East Asia, backtrajectory analysis

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MIS029-P05

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Study on cloud water chemistry and its controlling factors using Mt. Fuji as an observational tower (2)

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It was clarified that long-range transport of acidic substances and the subsequent deposition caused forest decline in Europe and North America in the 1960s. Various air pollutants, emitted in East Asia by recent economic and industrial development, are inevitably transported to Japan by the westerlies because Japan is located at the east end of Chinese continent. Chemical transport model like CMAQ revealed that the long-range transport of ozone and the precursors from China causes the increase of advisory for photochemical smog in widespread area from the northern part of Kyusyu to Kanto region in Japan.

Mt. Fuji, which is the highest mountain in Japan (3776 m a.s.l.), is an isolated peak and therefore could be regarded as the tower to observe the long-range transportation from East Asia such as China and Korea to Japan, the mixing processes from the boundary layer to the free troposphere, and the nucleation/precipitation scavenging processes of various atmospheric pollutants. Simultaneous sampling of cloud water has been performed at the summit and in the foot (1300 m a.s.l.) of Mt. Fuji during the summer from 2006. We here mainly report the summer observational campaign in 2010.

Keywords: Free Troposphere, Background Concentration, Long-range Transportation, Aerosol-Gas-Cloud Interaction

MIS029-P06

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Numerical simulation of mountain air quality around Mt. Fuji during summer season

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Introduction

The atmospheric model research relating to the chemical observation at mountains in Japan is a few (e.g. Inomata et al., 2010; Osada et al., 2009). We have concerned atmospheric sulfate, which is a product of sulfur dioxide (SO₂) oxidations, among pollutants from the Asian continent, and have carried out the observational research by using Mt. Fuji (Igarashi et al. 2004; 2006; Igarashi et al., JAAST2008). It was confirmed, by the data analysis with a synoptic-scale transport model, that 1) the gaseous species observation at the summit of Mt. Fuji captures the free tropospheric nature through a year, 2) the summit is the best point to detect the Asian outflow of the pollution, and 3) the reproduction by the chemical transport model is effective and beneficial (Inomata et al., 2010). However, the conclusion obtained by simple meteorological analyses exhibited limitation for the observation results in Mt. Fuji during summer. The non-hydrostatic chemical transport model (WRF-chem) was applied to deepen the understanding of the interesting SO₂ variations observed at Mt. Fuji during summer (association with an oral presentation in the same session; Igarashi et al.), and the reproduction of the event was carried out in the present study.

Target events

There were two interesting phenomena in the summer of 2007. The first one is a diurnal variability of SO₂ in 7.8-gou (about 3200m asl). After August 5, 2007, the highest SO₂ concentration reached 1 ppbv for the period until the tenth August, and a remarkable diurnal variability was observed. The second one is SO₂ observation data at the summit of Mt. Fuji. The maximum concentration reached 5 ppbv during the end of August, 2007, and the recorded concentration level was comparable with those in winter that was brought by trans-boundary pollution event. It was found that the air parcel which reached the vicinity of the summit originated from the Asian continent by the backward trajectory analysis. There were other evidences that the air parcel responsible for the event was from the Asian continent. The high aerosols number concentration (Kobayashi et al., 2010) and high radon concentrations (Nagano, Kojima, KEK Proc. 2009-8) were observed at the same time, synchronizing with an early southward shift of the autumnal rain (Shurin) front in summer.

Reproduction and analysis by WRF-Chem model

In order to explain transportation and the variation of SO_x concentration level around Mt. Fuji during summer, which are influenced by mountain and valley winds that were not clarified by simple data analysis so far, the reproduction of the above-mentioned phenomenon was performed by using chemical transport model coupled online with the non-hydrostatic meteorological model (WRF-Chem). Taking the transport event from the Asian continent into considerations, the most outside domain was set to cover the East Asian area, and the inner area with Mt. Fuji as the central point was set by nesting procedure in the calculation. JCAP II emission inventory (Chatani et al., 2011) were used for a detailed domestic inventory. The REAS inventory data (Ohara et al., 2007; Kurokawa et al., 2009) were used for the Asian inventory. The model performance for the mountain air quality was examined by comparing the numerical results with the SO₂ concentration, etc. observed during the summer of 2007.

Keywords: Mountain air qual, Non-hydrostatic model, WRF-chem, Mt. Fuji

MIS029-P07

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Long-range transport of mercury in Mt. Fuji during summer observation campaign, 2008

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An intensive field campaign for the measurement of elemental gaseous mercury (Hg(0)) and Particulate mercury Hg(p) concentrations in ambient air was conducted in summit of Mt. Fuji from 11 August to 17 August in 2008 using an developed measurement technology, which was the first time Hg(0) and Hg(p) were monitored at a remote area in Mt. Fuji. The overall average Hg(0) covering the sampling periods was 2.61 1.24ng/m³, which is only a little elevated comparing to global background of approximately 1.5-2.0ng/m³.

Elemental gaseous mercury concentrations range from 1.45ng/m³ to 5.42ng/m³ in ambient air. Although there is not significant difference in concentration between daytime and night time, distinct daily variability of Hg(0) observed during survey periods. The phenomenon is caused by the direction of airmass. The back trajectory analysis were shown in Fig. 2. From this result, when airmass come from East Asian continent, elemental gaseous mercury concentrations were larger when that come from the Pacific Ocean.

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MIS029-P08

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Dynamic analysis of particulate matter at Mt. Fuji during summer seasons using inorganic constituents

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Unlike other pollutants, airborne particulate matter (PM) is a complex mixture of particles that are very different in size, chemical composition, physical state and morphology. Moreover, PM has a variety of emission sources, which range from natural to anthropogenic and stationary to mobile. It also has a variety of physical and chemical properties. Therefore, not only the size distribution of particles but also information related to their chemical composition will play an important role in solution of the behavior and major emission source of PM and their effect on human health and the ecosystem. Test analysis samples of size-resolved PM were collected using a 3-stage NLAS impactor (Tokyo Dylec Co., Ltd., particle cut-size of stage is 10 micron, 2.5 micron and

1.0 micron for a flow rate of 3 L/min) with a one-day sampling interval on the a polycarbonate filter and back-up filter. Sampling of the PM was conducted at the summit of Mt. Fuji, from 11 to 18 August, 2008 using by the developed active sampler system which can operate anywhere with dry batteries and/or car batteries. Elemental compositions of sample were determined by ICP-MS, and ionic species were analyzed by IC. For ICP-MS analysis, a part of filter and half of a back-up filter were directly treated with 10mL of nitric acid for 10 min using an ultrasonic apparatus, and 100uL of 1% Triton solution was added. For IC analysis, treatment was conducted with 8 mL of ultra pure water for 10 min of ultrasonication. A blank filter and a blank back-up filter were analyzed with all the procedures. The determination limits and concentration range of ICP-MS and IC were investigated from the reproducibility of calibration standard solutions and linearity of calibration curves.

Almost complete detachment of the collected samples from the polycarbonate filter and back-up filter sample was achieved by 1% nitric acid and/or ultra pure water with 10 min of ultrasonication. Characteristic inorganic composition data were obtained for each PM size, and it is believed to be possible to elucidate the behavior and major emission sources of PM by analyzing these data. Therefore, obtaining highly accurate analysis data in a short time by combining collection of PM using the polycarbonate filter with the simple method and the developed active sampler system will lead new development in PM research.

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Development of a passive sampler for gaseous mercury in the atmosphere- Application to different altitudes of Mt. Fuji

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UNEP initiated Global Mercury Partnership to protect human health and global environment from the release of mercury and long-range transport issue, especially from anthropogenic mercury such as coal combustion.

To elucidate the vertical distribution of mercury concentration the different altitudes of Mt. Fuji, we have developed a passive sampler to measure the gaseous mercury concentration in the atmosphere.

A passive sampler does not require electric power supply and is suitable for multi points sampling. The body was made of fluorocarbon to prevent mercury from deposition on it. As an adsorbent of mercury in the sampler, a quartz fiber filter coated with gold was prepared in order to make it possible to measure the mercury by the heating atomic absorption spectrophotometry method.

The developed passive sampler was applied to measure the vertical distribution of gaseous mercury concentration in the atmosphere of Mt. Fuji. The sampling was carried out on July and August, 2010.

The passive sampler for the atmospheric mercury was successfully developed to measure the vertical distribution of mercury concentration each altitude of Mt. Fuji.

Acknowledgment: This research was partially supported by Mitui&Co.,Ltd. Environment Fund, the Environment Research and Technology Development Fund(B-1008)of the Ministry of the Environment, Japan, the Watanabe Memorial Foundation for the Advancement of Technology, and the financial support of Japan Post Service Co.,Ltd. In 2009. This work was performed during the period in which the NPO Valid Utilization of Mt. Fuji Weather Station maintained the facilities.

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MIS029-P10

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Observation of VOCs in the ambient air and in cloud water at the top and foot of Mt. Fuji during the summer

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Hydrophobic organic compounds such as PAHs, PCBs, and VOCs are harmful to humans and have adverse effects on ecosystems, so it is important to elucidate the fate of HOCs. In recent years the presence of HOCs, which is considerably larger than expected from the surrounding gas-phase concentration and Henry's law constants, has been reported in fog water and rainwater. There are several hypotheses to explain the discrepancy between the observed and the estimated concentration, for example the effect of dissolved and colloidal organic materials in atmospheric droplets and the effect of the large specific air-water interfacial area available for adsorption of hydrophobic organics. However, the wet scavenging mechanism of those toxic organic compounds as well as the dry deposition mechanism has been poorly understood.

Simultaneous sampling of cloud water along with atmospheric VOCs was performed at the top and foot of Mt. Fuji during summer observational campaign. We here report the concentration of VOCs in cloud water as well as that in the ambient air. Chlorinated hydrocarbons (CHs) and monocyclic aromatic hydrocarbons (MAHs) in cloud were determined by Head Space-Solid Phase Micro Extraction (HSSPME) / GCMS. The concentration of MAHs was higher than that of CHs both in cloud water and in the ambient air and toluene was the most abundant among VOCs. Cloud water contained higher amounts of VOCs than would have been expected from the gas-phase concentrations and Henry's law constants. We will also discuss the enhanced dissolution of atmospheric VOCs into atmospheric droplets.

Keywords: Free Troposphere, Background Concentration, Henry's law

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Atmospheric electric field measurement on Mt. Fuji

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In the view of global electrical circuit, variations of fair-weather atmospheric electric field simultaneously show similar signatures all over world. Meanwhile, the mountain-top observation of atmospheric observation field shows local-time dependent variation. Our concurrent observation of atmospheric electric field and photo camera shows that this variation is caused by cloud-sea electrical charges.