

# Japan Geoscience Union Meeting 2011

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MIS029-01

Room:203

Time:May 23 16:30-16:45

## Distributions of low molecular weight dicarboxylic acids in Mt. Fuji aerosols and their stable carbon isotopic ratios

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Aerosols, suspended particles in the atmosphere, are thought to affect climate and weather condition via scattering solar radiation and acting as a cloud condensation nuclei (CCN), which can be a nuclei to form clouds. Among them, water-soluble organic aerosols, including low molecular weight dicarboxylic acids, are thought to have a large effect on a climate. Water-soluble organic aerosols are composed of not only primary emitted materials to the air, but also chemical degradation products of organic precursor compounds. Our laboratory has done many campaigns to reveal chemical compositions and distributions of organic aerosols at many locations.

This study aim to reveal molecular distributions, origins and transport pathway of organic aerosols over East-Asia and North-East Pacific region by collecting filter samples at the summit of Mt. Fuji. Here we will present the results of the 2009 and 2010 campaigns for the study of water-soluble organic aerosols including dicarboxylic acids. We will also show the analytical results of stable carbon isotopic composition of individual diacids.

Keywords: aerosols, dicarboxylic acids, stable carbon isotopic composition, Mt. Fuji

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MIS029-02

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## High levels of gaseous elemental mercury and particulate mercury observed at the summit of Mt. Fuji during summer observ

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The chemical cycling and spatiotemporal distribution of mercury in the troposphere is poorly understood. We measured gaseous elemental mercury (GEM) and particulate mercury(p-Hg) along with SO<sub>2</sub>, ozone, aerosols and meteorological variables at the summit of Mt. Fuji (3776m a.s.l.) from 23 August to 30 August. The mean mercury concentrations were 23ng/m<sup>3</sup> (GEM) and 4.7ng/m<sup>3</sup> (p-Hg). We observed this event of strongly enhanced atmospheric GEM levels with maximum concentration up to 25 ng/m<sup>3</sup>. High GEM and p-Hg levels were related to pollution events, particularly SO<sub>2</sub> transported from Asian Continent. As result of back trajectory analysis will show this phenomena

MIS029-03

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## Data analysis of meteorology and sulfur oxides observed at Mt. Fuji during summer seasons

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We have concerned sulfuric acid and the sulfate in the atmosphere, which are products of sulfur dioxide (SO<sub>2</sub>) oxidations, among pollutants from the continental sources, and have carried out the observational research by using Mt. Fuji (Igarashi et al. 2004; 2006; Igarashi et al., JAAST2008). The sulfate aerosol is mostly a minute liquid droplet scattering the solar radiation and working as cloud condensation nuclei, so it is deeply involved in the climate change. Also, sulfate has impacts on the ecosystem as acidic matter. Therefore, SO<sub>2</sub> is very important pre-cursor gas to be monitored, but many of the observations are done within the atmospheric boundary layer = surface of the earth. In order to obtain the vertical distribution information, aircraft or mountain observations have been carried out. However, the continuous observation of the SO<sub>2</sub> in the atmosphere over East Asia is still scarce. The long-term monitoring data at high mountains are valuable for the clarification of various processes in the atmosphere as well as for the model verification.

It was revealed by previous work (Igarashi et al., 2004; 2006) that the SO<sub>2</sub> concentration at the summit of Mt. Fuji didn't show a diurnal variability, being characterized by the long-range transport of pollution that arises from the change of the weather pattern of the cyclonic scale. Such transport events were found a lot in winter but not in summer. However, concerning the observed interesting phenomena in summer remains unclear; full analysis has not been given yet (Igarashi et al., JAAST2008). In order to achieve a further analysis of the temporal-spatial variation of the mountain air quality during summer, simulation of the atmospheric chemical fields along with meteorology in the Mt. Fuji surrounding area is given in the present study (association with a poster in the same session; Igarashi, Katata, and Kajino). Targets are diurnal variation of SO<sub>2</sub> at Nana-gou Hachi-shaku (7.8-gou; about 3,200masl) during early August 2007 and trans-boundary pollution events in late August 2007. A chemical transport model, WRF-Chem, which is able to express precise geographical features of/around Mt. Fuji was used to simulate the regional as well as local meteorological and chemical fields. Detailed analysis with the comparison between simulation and observation will be given in the present work.

Keywords: Mountain meteorology, Mt. Fuji, Meteorological observation, Sulfur oxides, Summer season, WRF-chem

MIS029-04

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## Observation of aerosol particles at the summit and a base of Mt. Fuji

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Sulfur and organic species originated from ocean make new particles to increase the number of cloud condensation nuclei and change properties of cloud (Charlson et al., 1987). However, in the planetary boundary layer, there are many sea-salt particles that provide surfaces for heterogeneous chemical reactions with sulfur or organic gases. There are a few papers of new particle formation observed in the boundary layer under a high-pressure system (ex. Covert et al., 1996). It suggests that particles are produced in the free atmosphere. As the summit of Mt. Fuji, Japan is usually positioned in the free troposphere, we can measure the variation of aerosol in the free troposphere. Our purpose is studying the new particle formation and particle growing process.

Size distributions from 4.4 nm to 5000 nm in diameter were measured with a scanning mobility particle sizer (SMPS, TSI 3936N25 or 3936L22) and an optical particle counter (OPC, RION KR12 or KC01C), at the summit (3776m, 35.36N, 138.73E) and the base Tarobo (1300 m) in July and August 2006 to 2010. Sample air was dried to lower than 20% with a diffusion dryer.

One topic of the results is a peak measured with SMPS at the summit. This peak of 10 nm appeared at about 11 o'clock on 9th and 10th August 2006 and increased their size during daytime. Volume distributions kept almost constant value during increasing their size. This suggests that this size increasing was due to coagulation and these phenomena happened in the wide area. Moreover, these events did not synchronized at Tarobo. This suggests that these peaks may be the new particle formation by gas to particle conversion in the free troposphere around the summit. The event on 9th was occurred after a passing of a typhoon. It is expected that sulphur and organic species winded up by the typhoon produce new particles in the free troposphere.

The burst of the particles smaller than 20nm in diameter continuing longer than 3 hrs was observed 81 times during four summer seasons (134 days). These events were more observed in the daytime (25) than at night (56). Most of these events did not synchronize at Tarobo.

Origins of air mass of 13 times events in 2010 was estimated with a weather map, a prediction of chemical weather map by CFORS, surface weather elements, and surface gas concentrations. The results showed that the continental and maritime origin were estimated 2 and 5 times, respectively. It is found that the concentration just before the maritime event showed lower than those just before the other events.

### Acknowledgments

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Covert et al., J. Geophys. Res., 101, 6919, 1996.

Keywords: background aerosol, new particle formation, size distribution, radon, ion, cloud condensation nuclei

MIS029-05

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## Size distribution measurement of air ions at the summit of Mt. Fuji

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Atmospheric aerosols regulate the climate either by interfering with solar and terrestrial radiation, or indirectly by acting as cloud condensation nuclei upon which water vapor condense onto. The term new particle formation literally refers to an event by which new particles are formed in the atmosphere through condensation of precursor gases. Such gases are often adsorbed on preexisting particles (e.g. in polluted environments) and there will be no net change in the number of particles. On the other hand, explosive blooms of tiny particles have been observed in rather clean environments. The condition or mechanism that triggers the new particle formation is still not very well constrained, but attracted much attention as an important pathway for increasing the number of cloud condensation nuclei.

Elevated concentrations of ultrafine particles have been observed during ground-based measurements in the Asian high mountain ranges (Nishita et al., 2008; Venzac et al., 2008). These events were commonly associated with characteristic daytime upslope valley winds, consistent with reports from other parts of the world. If any, new particle formation in Mt. Fuji may be unique in its way since the mountain consists of a steep single peak. Our focus is to monitor the variation of air ion clusters and intermediate ions at the summit of Mt. Fuji, in order to conduct an in-depth identification of the types of nucleation events taking place over the unique topography.

We have measured the size distribution of ion clusters (0.4nm<sup>2</sup>–2nm) and charged nanoparticles or intermediate air ions (2nm–10nm) for the first time at the summit of Mt. Fuji (3776m, 35.36N, 138.73E) using Air Ion Spectrometer (AIS, Airel Ltd.). AIS was installed in a corner of former building of Mt. Fuji weather station of JMA (Japan Meteorological Agency) during the 2009 summer measurement campaign (14 Jul–23 Aug). In 2010 (18 Jul–24 Aug), AIS was replaced by NAIS (Neutral cluster & Air Ion Spectrometer) which is capable of measuring uncharged clusters in addition to naturally charged air ions.

Unlike in Himalayas (Venzac et al., 2008), only one daytime event was observed (5 Aug 2010) through the 10 weeks worth of measurement, that accompanied typical banana-shaped continuous growth pattern with high concentration of intermediate ions covering the entire measuring range of AIS. This example strongly suggests that the new particle formation indeed took place at the site.

To our surprise, the elevated concentrations of ultrafine particles ( $D > 10\text{nm}$ ) were regularly found instead during the night hours (21:00–04:00LST). The positively charged particles were more pronounced during these events. Since there was no intermediate ion growth connecting ion clusters and the ultrafine particles, this gap suggests that the particles possibly nucleated at some distance from the measurement site (e.g. in the free troposphere), or via mechanisms other than ion-induced nucleation. We plan to compare these findings with the meteorological parameters, trace gases and aerosol concentrations to analyze the condition of such events in more detail.

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Keywords: atmospheric aerosols, new particle formation

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## Energetic radiation associated with thunderstorm activity on Mt. Fuji.

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Gradual energetic radiations probably caused by a summer thunderstorm have been observed at the top of Mt. Fuji, Japan. The largest of such variation was gradual and lasted for about 20 minutes, and was found to be high-energy gamma rays having a continuous energy spectrum up to 10 MeV or more. As for the feature of these variations, such variation might be caused by the bremsstrahlung photons generated by the energetic electrons produced continuously with an intense electric field in the thundercloud rather than originated in the process of lightning discharge.

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MIS029-07

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## Radiation Measurements at the Summit of Mount Fuji to Improve the Reliability of Cosmic Radiation Exposure Management

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The intensity of cosmic radiation in the atmosphere increases with altitude; the dose level at the cruising altitude of a civilian aircraft are nearly 100 times higher than that on ground. Accordingly, the exposure accompanying to the operation of jet aircraft is considered to be occupational exposure and, in some countries such as European countries and Japan, the management of cosmic radiation exposure for aircraft crew is performed. Its main task is the evaluation of crew doses by calculation. To obtain reliable estimations, it is desirable to monitor actually the cosmic radiation exposure at high altitude in addition to improvement of calculation models. For this purpose, we have started to utilize the former Mount Fuji Weather Station located at the summit of Mount Fuji, the highest place in Japan (3,776m asl) and measured cosmic radiation using several radiation instruments in the facility during the summer of 2008, 2009 and 2010. From September 2010, unattended continuous measurement was carried out using an energy-extended neutron monitor coupled with rechargeable batteries and a wireless LAN system. It was observed that the measured radiation dose levels were stable during those periods, as expected from the quiet condition of solar activity. Some variation which did not agree to both atmospheric pressure and the pattern of solar activity was observed, which suggests the uncertain effects of atmospheric condition. Spatial variation of shielding condition in the facility was also confirmed by neutron measurements. The unattended measurement operation continued for 4 months up to early January 2011. We like to establish a whole-year measurement in near future by solving the problems such as the fast falling of battery voltage.

Keywords: cosmic, radiation, Fuji, neutron, exposure, aircraft