Atmospheric Science Research Division,
Research Institute for Science and Technology,
Tokyo University of Science

Certified non-profit organization
Mount Fuji Research Station

Special Seminar

Date: **Friday, October 26, 2018**

Venue: **Room221, Tokyo University of Science**
Kagurazaka 1-3, Shinjuku-ku
http://www.tus.ac.jp/info/campus/kagurazaka.html

Program:

15:00-15:05 Opening Remark
Kazuhiko Miura (Prof., Tokyo University of Science)

Chair: Yoko Iwamoto

15:05-15:30 Trace gas observation at the summit of Mt. Fuji during summer
Shungo Kato (Assoc. Prof., Tokyo Metropolitan University)

15:30-15:55 Change of carbon cycle in the Asian region from the analysis of CO_2 data at Mt. Fuji
Shohei Nomura (PD, National Institute for Environmental Studies)

15:55-16:20 Coffee Break

Chair: Hiroshi Okochi

16:20-17:20 The Air We Breathe: It is not what it used to be
Russ C Schnell （Deputy Director, NOAA Global Monitoring Division)

17:20-17:40 Discussion

18:00-20:00 Reception

Hosted by: Atmospheric Science Research Division, Research Institute for Science and Technology, Tokyo University of Science

Co-hosted by: Certified non-profit organization Mount Fuji Research Station

Trace gas observation at the summit of Mt. Fuji during summer

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The top of Mount Fuji (N35.4, E138.7, 3776 a.s.l.) is located in free troposphere and it is an unique observation location to observed long range transport of polluted air into the center of Japan, Kanto area. We have conducted observation of atmospheric trace gases during summer at Mount Fuji Research Station (MFRS) from 2008. CO is emitted from various combustion process. Since lifetime of CO in the atmosphere is about 1-2 months, it can work as a good indicator of polluted air. O_3 is harmful to human and plants, and also is important as a greenhouse gas. O_3 is produced by photochemical reactions of polluted air. SO_2 is emitted from fossil fuel burning, and also emitted from volcanic activities.

CO, O_3, and SO_2 were measured by IR absorption, UV absorption, and UV fluorescence, respectively (Kato et al., 2016). The observed data were uploaded to web site in real time (SO_2) or within a day (CO and O_3).

CO and O_3 showed considerable concentration variation even at the remote place (top of Mt. Fuji). Using the backward trajectories, the observed concentration variation can be explained in most cases. Backward trajectory was categorized to Pacific Ocean (P), South East Asia (SE), North (N), North West (NW), China (C), and China-Korea (CK). High CO and O_3 were from CK, C, NW, and N direction. Low CO and O_3 were from P and SE direction.

When plotting O_3 against CO, most data were along high CO, O_3 and low CO, O_3 line. This is reasonable by the explanation of polluted and clean air exchange. But in some cases, high O_3 but low CO data were observed. During such exceptional air, water content were lower. This indicate the influence of high altitude air (stratospheric air). Air from high altitude lose water by low temperature and stratospheric air contain high O_3 and low CO (Kato et al., 2016).

SO_2 was almost less than detection limit most of the time during summer. But high SO_2 peaks were observed occasionally. Using the backward trajectory calculation, the sources of high SO_2 evens were identified as volcanic activities from mountains in Japan.

Acknowledgements

This work was supported by the MFRS (Certified Nonprofit Organization Mount Fuji Research Station) and many researchers related to the MFRS.

References: Kato, S., Shiobara, Y., Uchiyama, K., Miura, K., Okochi, H., Kobayashi, H., Hatakeyama, S. (2016) Aerosol and Air Quality Research, 16, 2368-2377.

Change of carbon cycle in the Asian region from the analysis of CO_2 data at Mt. Fuji

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We installed a battery-powered carbon dioxide (CO_2) measurement system for monitoring atmospheric CO_2 concentration at the weather station on the top of Mt. Fuji (35.21° N, 138.43° E, 3776 m), Japan in July 2009. The system used 100 batteries to operate the measurement device during 10-months (Sep. to Jun.) because the station was not provided the commercial power during these months. The batteries were charged for 3 weeks during summer season (Jul. to Aug.) when the power was available at the station. The measurement system was set to operate for only about 3.5 hour per day because of the limited power supply. The measurements were never interrupted by a lack of battery power.

Atmospheric CO_2 concentration at the top of Mt. Fuji indicated clear seasonal variation. The concentration at Mt. Fuji showed CO_2 uptake by the vegetation of Siberia and China and by CO_2 addition from anthropogenic emissions over the Asian continent. From the comparison of CO_2 data of Mt. Fuji, Mauna Loa Observatory (MLO) and aircraft measurement by CONTRAIL project which measured atmospheric CO_2 concentration near Mt. Fuji, we concluded that the top of Mt. Fuji can be considered a suitable location for sampling free tropospheric air over the Eastern Asian region throughout the year and our dataset was showing regionally representative CO_2 concentration (Please refer to Nomura et al., 2017 for more information).

During 2009-2014, the difference CO_2 concentration between Mt. Fuji and MLO increased but the difference concentration had been stagnating at the recent, which indicated that the CO_2 data of Mt. Fuji detected the change of CO_2 emission from Asian region including China.

Acknowledgements
This work was partly supported by funds from the Ministry of the Environment, Japan. Also, we were supported about the maintenance of station by the MFRS (Certified Nonprofit Organization Mount Fuji Research Station). We thank Global Monitoring Division (GMD) of National Ocean and Atmosphere Administration (NOAA) and CONTRAIL project team for providing CO_2 data of Mauna Loa Observatory and near Mt. Fuji.

References: Nomura, S., Mukai, H., Terao, Y., Machida, T., and Nojiri, Y. (2017) Atmospheric Measurement Techniques., **10**, 667-680, doi: 10.5194/amt-10-667-2017.

The Air We Breathe: It Is Not What It Used To Be

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The composition of the atmosphere is changing due to burning of fossil fuels, manufacturing processes and agricultural practices. Some of these changes are warming the atmosphere, some are destroying the stratospheric ozone layer and others are producing tropospheric ozone. The NOAA Global Monitoring Division monitors various aspects of the atmosphere from 100s of locations around the Earth. At some, only one parameter is measured, at others up to 250 are monitored.

The greenhouse gas CO_2 passed the 400 ppm level at Mauna Loa Observatory, Hawaii, in May 2013 and in spring 2018 it was 413 ppm. This is a 133 ppm increase since pre-industrial times. Methane, the second most important greenhouse gas, after a decade of no growth, began increasing again in 2007. The likely causes are increased emissions from tropical wetlands and possibly emissions from gas and oil fields.

Chlorofluorocarbons (CFCs) are the main gases that cause ozone destruction in the stratosphere known as the "Antarctic Ozone Hole". The concentrations of the four CFCs controlled under the Montreal Protocol have decreased greatly in the past 20 years and ozone was expected expected to return to pre Ozone Hole concentrations between 2040 and 2050.

But, in a paper published by Montzka et al., *Nature,* **557**,413-417, (2018), a rapid CFC-11 emission increase of ~25% since 2012 has been documented. This surprising increase in emissions comes when the production of CFC-11 has supposedly been phased out. Data from Mauna Loa Observatory, Hawaii, points to the new production of the Montreal Protocol banned CFC-11 as occurring in southeast China.