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YEARS OF COLLABORATION BETWEEN JAPAN AND **IGAC**

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IGAC was formed in 1990 to address growing international concern over rapid changes observed in Earth's atmosphere. IGAC operates under the umbrella of Future Earth and is jointly sponsored by the international Commission on Atmospheric Chemistry and Global Pollution (iCACGP). The IGAC International Project Office is hosted by the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado and is sponsored by the US National Science Foundation (NSF), National Oceanic and Atmospheric Association (NOAA), and National Aeronautics and Space Administration (NASA). Any opinions, findings, and conclusions or recommendations expressed in this newsletter are those of the individual author(s) and do not necessarily reflect the views of the responsible funding agencies.

Editor: Megan L. Melamed **Design:** Allison Gray

The Importance of Collaborations

hen most people think about IGAC and collaborations, they think about all the IGAC Activities getting scientists from across the atmospheric chemistry community to work together. However, many of these IGAC Activities are in collaboration with other organizations and the importance of collaborating with other organizations should not be underestimated.

I recently attended the quadrennial World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) Symposium 10-14 April 2017 in Geneva, Switzerland. I had the honor to sit on a panel on "Partnerships". Other organizations on the panel included the World Bank, United Nations Environment, International Bureau of Weights and Measures (BIPM), International Atomic Energy Agency (IAEA), World Health Organization (WHO), ICLEI -Local Governments for Sustainability, Global Experts on Scientific Aspects of Marine Environmental Protection (GESAMP), Convention on Long Range Transboundary Air Pollutants (LRTAP), and Stratosphere-troposphere Processes And their Role in Climate (SPARC).

What this panel demonstrated is these organizations are talking to one another, know what the other one is focusing on, and are often collaborating on a variety of activities. For example, WMO jointly sponsors the IGAC Activity Interdisciplinary Biomass Burning Initiative (IBBI) and IGAC and SPARC are sponsors of both the Chemistry-Climate Model Initiative (CCMI) and the Atmospheric Composition and the Asian Monsoon (ACAM) activity.

The importance of collaborations is two-fold. First, collaborating with other organizations prevents duplication of research efforts and advances scientific research. Second, collaborating with other organizations enhances the opportunity for scientific research to be applied outside of the scientific research community and have an impact on air quality policies for example.

As scientists, I think we all strive to enhance scientific research and want the results of our research to extend beyond the scientific community and have an impact. Nevertheless, there are few opportunities in which a group of organizations can sit down and have a conversation about what each one is focusing on and how to enhance collaborations. I am therefore grateful to the WMO for giving IGAC the opportunity to sit on the panel and foster collaborations with other organizations.

Happy reading!

Mg L. me



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Megan Melamed received her PhD in 2006 in Environmental Engineering from the University of Colorado. She then received the National Science Foundation International Research Fellowship to work at the Universidad Nacional Autónoma de México (UNAM) in Mexico City for two years. Upon completion of the NSF Fellowship, Megan became an American Association for the Advancement of Science (AAAS) Science & Technology Policy Fellow at the U.S. Environmental Protection Agency. She has been the IGAC Executive Officer since January 2011.



Save the Date

2018 joint 14th Quadrennial iCACGP Symposium/15th IGAC Science Conference

25-19 September 2018



Announcing the Scientific Program Committee for the 2018 joint 14th Quadrennial iCACGP Symposium/ 15th IGAC Science Conference

- Colette Heald (Co-Chair), IGAC SSC member, MIT, USA
- Melita Keywood (Co-Chair), iCACGP vice president, CSIRO, Australia
- Mary Barth, iCACGP member, NCAR, USA
- Paul Beukes, IGAC SSC member, North-West University, South Africa
- Greg Frost, IGAC SSC member, NOAA, USA
- Michael Gauss, iCACGP member, Met Norway, Norway
- Sachiko Hayashida, iCACGP member, Nara Women's University, Japan
- Manish Naja, IGAC SSC member, AIRES, India

Submit articles to the next IGAC News

IGAC is now accepting article submissions for the next IGACnews. Workshop Summaries, Science Features, Activity News, and Editorials are all acceptable and desired. Science Features should have an approximate length of 1500 words with 1-2 images. All other submissions should be approximately 500 words and have 1-2 images. Please provide high-resolution image files. The deadline for submissions for the Aug/Sep issue of the IGACnew is 15 August 2017. Send all submissions to **info@igacproject.org**.



Chemistry-Climate Model Initiative (CCMI) Special Issue

Submissions are now being accepted for the joint ACP/AMT/ ESSG/GMD special issue entitled "Chemistry-Climate Model Initiative (CCMI)

Recent IGAC Fostered Publications



Sustainable Policy–Key Considerations for Air Quality and Climate Change.

(2016). M.L. Melamed, J. Schmale, and E. von Schneidemesser. *Curr. Opin. Environ. Sustain.* doi:10.1016/j. cosust.2016.12.003.

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IGAC is on LinkedIn, Twitter and Facebook in an effort to further advance international scientific cooperation and serve as a resource to the public, especially you. Please join us to stay apprised of the most current news on conferences, workshops and publications. Let us hear from you on how to improve the international conversation, **@IGACProject**.



12-13 NOVEMBER 2016 TSUKUBA, JAPAN

IGAC Endorsed

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HOST INSTITUTION AND SPONSOR



National Institute for Environmental Studies

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The Morino Foundation for Molecular Science

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BACKGROUND



This workshop was endorsed by IGAC as part of both the IGAC Japan National Committee and the IGAC China Working Group. The workshop is part of IGAC's effort to foster fundamental scientific research. 2nd International Workshop on Heterogeneous Kinetics Related to Atmospheric Aerosols



Workshop Participants

tmospheric aerosols play critical roles in air pollution and climate change. There are growing evidences that heterogeneous reactions on the surface of aerosol particles and the reactions in the liquid phase could have significant implications in the impacts of aerosols on air quality and climate change. However, the evidences about the heterogeneous kinetics related to atmospheric aerosols based on field observation, laboratory studies, and model simulation are not yet fully consistent. The objectives of this series of the workshops are to exchange the most recent findings in the areas of the heterogeneous kinetics related to atmospheric aerosols, to identify the gaps in the understanding of the roles of atmospheric aerosols on air pollution and climate change, and to discuss future research priorities and collaborations. The first workshop was held in August 9-10, 2015, Beijing, China, and this is the second of the series held in Tsukuba, Japan.

Atmospheric chemistry has long been developed in history based on gas phase kinetics and photochemistry, a branch of physical chemistry. In recent topics of atmospheric chemistry related to aerosols, however,



interlinkage between physical chemistry and atmospheric chemistry has not been enough, particularly in Asian countries including Japan and China. While the understanding of heterogeneous kinetics and multiphase chemistry necessitate the experimental approaches of physical chemistry and theoretical analysis of molecular science, heterogeneous atmospheric chemistry surely provides an unexplored and interesting target area of science for the future development of physical chemistry and molecular science. This workshop was financially sponsored by the Morino Foundation that was founded in 1985 by the legacy of Prof. Yonezo Morino, an outstanding molecular scientist in Japan, for promoting activities of molecular sciences. Several physical chemists who are interested in surface and interface chemistry were invited.

About 50 scientists from China, Taiwan, Singapore, Switzerland, Turkey, Japan, and the United States participated in the two-day workshop. Two speakers, Profs. Veronica Vaida (University of Colorado, Boulder) and Kevin Wilson (Lawrence Berkeley National Laboratory) were invited to give keynote speeches, which covered the topics of chemical processing at environmental water-air interfaces and the interfacial chemistry of organic aerosols and cloud droplets, respectively.

The workshop was opened by remarks by A. Morita who was the applicant for obtaining the support of the Morino Foundation. Talks on in-situ observation of surface melting of ice crystal by optical microscopy (G. Sazaki, Hokkaido Univ.), molecular structure of liquid interfaces probed by sum frequency generation spectroscopy (S. Yamaguchi, Saitama Univ.), in-situ observation of the phase transitions of single droplets levitated in air (S. Ishizaka, Hiroshima Univ.), and in-situ microscopic observation of deliquescence and crystallization of single levitated microdroplet (A. Harano, Gunma Univ.) were given by physical chemists. Two quantum chemistry studies were presented on microscopic structure and uptake kinetics at aqueous surfaces (A. Morita, Tohoku Univ.) and heterogeneous reaction mechanism of gaseous HNO3 with solid NaCl (Q. Zhang, Shandong Univ.).

Most of the talks by atmospheric chemists followed on the topic of many aspects of heterogeneous reactions of organic and inorganic species at water and various aerosol surfaces. Specific topics on the formation of OH and other



Tsukuba city in Japan with Mt. Tsukuba for a background. A real-size model of HII rocket is seen in the Tsukuba Expo Center.

active oxygenated species by secondary organic aerosols in water (M. Shiraiwa, Univ. of California Irvine), and chemical reactions promoted by freezing were reported (N. Takenaka, Osaka Prefecture Univ.). A couple of presentations covered the topics of field observations and regional and global modeling including secondary organic aerosols.

At the end of the sessions, general discussion about future actions were made presided by M. Mochida (Nagoya Univ.). A project proposal in Japan entitled "multiphase organic chemistry in the atmosphere" was introduced, and future collaboration between Chinese and Japanese scientists in this field has been discussed. The workshop was concluded by the closing speech of H. Akimoto who discussed the historical development between atmospheric chemistry and physical chemistry since 1960s, and encouraged the collaboration between the scientists in these two fields.

The Third International Workshop on Heterogeneous Kinetics Related to Atmospheric Aerosols has been decided to be held in China in 2017. 660

science feature

Atmospheric Chemistry Research in Japan: Twenty five-year History with IGAC

AUTHOR

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BACKGROUND

IGAC Japan National Committee is a national committee under the Science Council of Japan. It oversees IGAC-related scientific activities in Japan and works closely with IGAC to contribute to the mission of IGAC.

This article was originally published in Japanese in the journal *Chikyu Kankyo*, which means "Global Environment" The citation for the article is Tanimoto, H. et al., **Review: Present and Future of Global Atmospheric Chemistry Research in Japan**, in the Special Issue of "The 25-yr summary of IGBP-Japan activities", Chikyu Kankyo, 20, 151–162, 2015.

Abstract

Research on atmospheric chemistry in Japan began at the time of the inauguration of the International Global Atmospheric Chemistry (IGAC) Project in 1989, and has been, since then, continuously developing. Global atmospheric chemistry research proposed or carried out by Japanese researchers encompasses a variety of research themes including regional air pollution in East Asia, precise observation of greenhouse gases, and laboratory experiments on ozone photolysis. Parallel with the scientific development, researchers in atmospheric chemistry in Japan began organizing themselves, and currently approximately 260 researchers form a research community, called the Japan Society of Atmospheric Chemistry (JpSAC). A quarter of a century has passed since the beginning of the atmospheric chemistry research in Japan, and now integrated research combining field observations, satellite observations and three-dimensional chemistry transport models is ongoing. Also, links to the broader Earth system sciences and social sciences have gained attention in recent years. Future projects include environmental monitoring of the atmospheric composition from space, and research on heterogeneous chemical kinetics of organic aerosols. The Japanese research community is willing to commit a leading role in the global atmospheric chemistry research for the coming decades.

1. Beginning of Atmospheric Chemistry Research in Japan

1.1. Inauguration of IGAC

It is not an exaggeration to say that atmospheric chemistry research in Japan started at the time of the inauguration of the IGAC (International Global Atmospheric Chemistry) Project. IGAC was established by CACGP (now iCACGP, International Commission on Atmospheric Chemistry and Global Pollution), which is a part of IAMAS (International Association of Meteorology and Atmospheric Sciences), under the umbrella of ICSU (formerly International Council of Scientific Unions, currently International Council for Science). The first CACGP Assembly Meeting for the planning of IGAC was held already in 1986 in Stockholm, but the concrete establishment of IGAC took place in Dookie, Australia in 1988, after recommendation of the Working Group at the 6th CACGP Symposium in Peterborough, Canada in 1987. From Japan, Toshihiro Ogawa, (then affiliated with the University of Tokyo), and Hajime Akimoto, (then affiliated with National Institute for Environmental Studies) participated in that meeting. Upon approval by CACGP, IGAC was officially inaugurated in 1989. This first IGAC research programme has been summarized in Galbally (ed.) (1989).

1.2. Beginning of IGAC-Japan Activities

In Japan, the IGAC-Japan National Committee was established in 1987 under the Science Council of Japan. At the same time, an IGBP-Japan National Committee was established in 1989 under the Science Council of Japan, and the IGAC-Japan's research was included in the Research Plan of IGBP-Japan as part of Research Area 1: "Transformation of

atmospheric trace gases and their exchange with the biosphere". Table 1 lists research themes of IGAC-Japan adopted in the "Research Plan of the IGBP-Japan".

Table 1. Research themes of IGAC-Japan (Japan NationalCommittee for IGBP, 1995)

Theme 1	Atmospheric Photochemistry and Ozone Budget
Theme 2	Emission and Distribution of Greenhouse Gases
Theme 3	Long-range Transport and Transformation of Aerosols
Theme 4	Cycles and Biogenic Processes of Sulfur
Theme 5	Biogeochemical Cycles of Trace Metals in the Atmosphere and Ocean
Theme 6	Polar Atmospheric Chemistry

2. Scientific Achievements of IGAC-Japan

The APARE (East Asian/North Pacific Regional Experiment) and RICE (Rice Cultivation and Trace Gas Exchange) projects were the projects that Japanese researchers took leadership at the beginning of IGAC. Other activities that Japanese researchers actively participated in included the PASC (Polar Atmospheric and Snow Chemistry) project, as a part of which Showa Station in Antarctica was promoted.

2.1. APARE

At the Dookie meeting the APARE project was proposed by the Japanese participants within the "Marine" Focus Area, in consultation with the Chinese participants. This APARE project gained international attention together with the "North Atlantic Regional Experiment" (NARE), which was within the same focus area (Molina, 1992).

The APARE tasks included compiling emission inventories in East Asia, conducting ground-based and aircraft observations, and establishing a ground-based monitoring network. However, due to the lack of research capacity and funding in the Asian region at that time, it was impossible to plan and conduct any large-scale, internationally collaborative, atmospheric chemistry observation with the leadership of Asian countries. Hence, Japan, China, Taiwan, Hong Kong, and Korea started from their own yearly rotating APARE meetings in order to build a research network. Soon later, U.S. NASA decided to make the aircraft observation campaign, PEM-West (Pacific Exploration Mission) Phase A in the Northwest Pacific and conduct it as part of the APARE project. This brought a considerable change to this situation in East Asia. As a part of the PEM-West A project, airborne observations with a DC-8 aircraft were carried out, based at Yokota Base in Japan, Hong Kong and Guam in September 1991 (Hoell et al., 1996). Yutaka Kondo (Nagoya University at that time) participated in the DC-8 research flights, and made airborne observations of nitrogen monoxide (NO) and total reactive oxidized nitrogen (NOy). Furthermore, as part of ground-based observations under the PEM-West A, continuous observations of ozone (O₃) and carbon monoxide (CO) at Oki Island, Okinawa, and Kenting were jointly made by H. Akimoto (National Institute for Environmental Studies at that time) and C-M. Liu from National Taiwan University.

In summary, the PEM-West A campaign made the first simultaneous observations of nitrogen oxide (NO_x), O₃, CO, non-methane hydrocarbons, and sulfur compounds in the free troposphere in the Pacific region, and the photochemical O3 budget and the oxidation process of dimethyl sulfide (DMS) in the free troposphere in this region were revealed for the first time. Also, the PEM-West A ground-based observations were the first efforts to quantify the long-range transport of O₃ in the East Asian region. After these studies the PEM-West Phase B project was launched in 1994 also within APARE (Hoell et al., 1997). Boosted by these two campaigns, an emission inventory of sulfur dioxide (SO₂) and nitrogen oxide (NO_x) in the Asian region was compiled for the first time (Kato and Akimoto, 1992) also as part of APARE, and was provided to the Global Emission Inventory Activity (GEIA) project within the IGAC "Global" Focus area. All of these experiences encouraged Japanese scientists to plan and conduct their aircraft campaigns (BIBLE and PEACE) in the late 1990s, in close coordination with IGAC (Figure 1).

2.2. RICE

One further contribution of Japanese researchers to the early IGAC activities was RICE. Katsuyuki Minami and Kazuyuki Yagi (National Institute for Agro-Environmental Sciences) measured methane emissions from rice paddy fields in Japan and Thailand, and indicated that the observed flux was much lower than the previous estimates

science feature



Figure 1. (Left) Location of ground sites and flight paths during PEM-West A (1991) and B (1994) (both were coordinated with APARE), BIBLE (1998-2000), and PEACE (2002) campaigns. (Right) Current ground-based stations in Japan and East Asia, contributed by Japanese organizations.

for sub-tropical regions used in the IPCC report (Yagi et al., 1994), resulting in a major revision of the IPCC estimates of global methane emissions from rice paddy fields.

2.3. PASC

Yoko Yokouchi, participated in the observations of the Polar Sunrise Chemistry-1992 experiment as a part of the PASC project, and found that when surface O₃ decreased because of bromine atoms, trichloroethylene correlated positively and bromoform correlated negatively with O₃ (Yokouchi et al., 1994).



2.4. Global Biogeochemical Cycles of Greenhouse Gases

In 1970s, a group of Tohoku University led by Takakiyo Nakazawa started long-term monitoring of GHGs. Soon later, the Japan Meteorological Agency (JMA) and National Institute for Environmental Studies (NIES) started continuous observations at a number of sites in Japan, and at the same time, Tohoku University and National Institute of Polar Research (NIPR) made considerable efforts to expand the observation areas to the Arctic regions, Antarctica, Siberia, China and Canada. In addition to ground-based observations, aircraft observations using commercial and chartered aircrafts, ship-based observations using cargo ships, and stratospheric observations using balloons, have been made. Through these observations, Japan has provided invaluable data to the international research community for a deeper understanding of GHG variations (Sawa et al., 2012).

2.5. Laboratory Experiments on Ozone Photolysis

Excited oxygen atom (O(¹D) produced by the photochemical reaction of O_3 in the UV region is an important chemical species that controls the production rate of hydroxyl radicals (HO_x) in the troposphere and HO_x and NO_x in the stratosphere. Data on O₃ photochemical reactions are compiled in the Chemical Kinetics and Photochemical Data for Use in Atmospheric Studies Database developed by NASA Jet Propulsion Laboratory (JPL) and the International Union of Pure and Applied Chemistry (IUPAC), and had been recognized already before the 1990s. However, until the mid-1990s there was a large uncertainty in the recommendation values of the quantum yield of O(¹D) produced by photochemical reactions of O₃.

Matsumi and Takahashi made precise measurements of the quantum yield of O(1D), and showed that the recommended O(1D) quantum yield used in atmospheric models until the mid-1990s were erroneous, and when corrections were made for those errors with their new data, the production rate of tropospheric HO_x was as high as twice the earlier estimates. This led to an international project on O(1D) quantum yield by the UV photochemical reactions of O3 started, reviewing the laboratory data from the earliest measurement to the latest reports, and recommending the new values for the use in atmospheric models, as a joint IGAC-SPARC Task for 1999-2002, with the members comprising of researchers of both laboratory experiments and field observations, including A.R. Ravishankara (Aeronomy Laboratory of NOAA, National Oceanic and Atmospheric Administration) and Yutaka Matsumi (Matsumi et al., 2002).

2.6. Air Pollution of Megacities

The "Megacities: Asia" project was proposed by Yutaka Kondo as an IGAC Task to study the role of megacities in East Asia as emission sources of aerosols and O_3 on a local and regional scale. In Japan, a research project called Integrated Measurement Program for Aerosol and oxidant Chemistry in Tokyo (IMPACT) was carried out during 2003-2004 with the objectives to clarify the processes of how the primary emissions from Asian megacities form secondary products. Major research highlights of this project include the physical and chemical properties of aerosols, the dynamics of OH and HO₂ radicals, speciated chemical composition of ultrafine aerosols, and the relationship between coating of black carbon aerosols and their cloud condensation properties (Kondo et al., 2010). Furthermore, the Japanese research groups participated in the megacity campaigns conducted in 2006 at two locations in China (Guangzhou and Beijing), as part of an international collaboration, together with research groups from Germany, Korea and Taiwan.

3. Atmospheric Chemistry Community in Japan and Links to IGAC

3.1. International Conferences

The first epoch of the Japanese atmospheric chemistry activities in the early 1990s began with the organizing of the "Joint Meeting on Global Atmospheric Chemistry (8th CACGP Symposium / 2nd IGAC Scientific Conference)" in Fuji Yoshida in September 1994. Toshihiro Ogawa, Hajime Akimoto, Kimitaka Kawamura and Mitsuo Uematsu became the core members of the Local Organizing Committee (LOC). In the Fuji Yoshida conference a total of 260 people (170 international and 90 Japanese) from 27 countries participated. This was a very successful conference, which marked a great momentum in the history of the Japanese atmospheric chemistry research.

In 1997 the "International Symposium on Atmospheric Chemistry and Future Global Environment", was held in Nagoya, with the LOC chair being Yasunobu Iwasaka. This regional conference was attended by a total of 180 participants (90 international and 90 Japanese), including eminent scientists as the 1995 Nobel Laureate in Chemistry Paul Crutzen, the first IGAC SSC Chair Ronald G. Prinn, and the second chair Guy Brasseur, and provided an excellent opportunity for international dissemination of the results of Japanese atmospheric chemistry research.

In 2018, the joint 14th iCACGP Symposium/15th IGAC Science Conference will be again held in Japan, with the host city of Takamatsu, Kagawa, chaired by Hiroshi Tanimoto.

3.2. Growth of the Japanese Research Community

Since its inauguration, the Japanese atmospheric scientists began to culitvate the community. Right after the inauguration of IGAC, the first "Atmospheric Chemistry Symposium" was held in 1990, and since then it has been organized every year by Nagoya University. Also, after the IGAC conference, which took place in Fuji-Yoshida in 1994, an "Atmospheric Chemistry Discussion Forum" opened for the first time in 1995. These two platforms of presenting the results of atmospheric chemistry research, exchanging information and exploring cooperation opportunities, were united later, and the Japan Society of Atmospheric Chemistry (JpSAC) was officially established on January 7, 1999, which has greatly contributed to the development of the community. In order to strengthen the cooperation between Atmospheric Chemistry and broader Geosciences, JpSAC started collaboration with Japan Geoscience Union (JpGU), and JpSAC organizes the Atmospheric Chemistry Session at the JpGU annual meetings since 2007.

Today JpSAC has approximately 260 members, including 40 student members. Most of the members are also members of IGAC, but what makes JpSAC a unique organization in the world is that it provides a forum for researchers also from SPARC (Stratosphere Processes and their Role in Climate), SOLAS (Surface Ocean-Lower Atmosphere Study) and iLEAPS (Integrated Land Ecosystem-Atmosphere Processes Study) to conduct mutual discussions on the interactions among the troposphere, stratosphere, terrestrial ecosystems, and surface ocean. In addition to two meetings per year it also provides a mailing list, publishes a journal/newsletter twice a year, and offers Young Scientist Awards.

3.3. Links to IGAC

In 2010, IGAC established Working Groups (WG) in order to develop national or regional atmospheric chemistry research communities in regions with no or only very weak research network, with the aim of promoting international exchange among researchers in different regions through the IGAC activities. Up till now China WG (2011) and the Americas WG (2012) have been set up. Since there was already an IGAC-Japan National Committee in Japan, in order to further strengthen the relationship between the Japanese atmospheric chemistry research community and IGAC, and to strengthen visibility of activities in Japan, the IGAC-Japan National Committee started close collaboration with IGAC, just like other IGAC WGs.

Japan has relatively strong ties with Southeast Asia from the past, and has good experience in field research in Southeast Asia. With support from the members of IGAC SSC in Northeast Asia, efforts are now being undertaken to establish a unified research community in atmospheric chemistry in the monsoon Asian and Oceania region. It has been approved with the name of IGAC-MANGO (IGAC-Monsoon Asia and Oceania Networking Group) (Tanimoto et al., 2015).

4. Current Initiatives

In recent years, integrated research combining field observations, three-dimensional chemical transport models and satellite observations of the troposphere has been conducted. Studies on Earth and social systems such as the impacts of atmospheric composition on the climate and on human health, have drawn a great deal of attention. Research capabilities in Japan or more broadly in East Asia have been greatly strengthened in quality and quantity (Figure 1). Table 2 lists research proposals currently supported by IGAC-Japan National Committee, and below are examples of the current initiatives.

Table 2. Research proposals supported by the IGAC-Japan National Committee

Detection of air pollution hotspots by UV/VIS imaging spectroscopy: uvSCOPE (as part of the ISS Earth Observatory Initiative)

Climate and earth system science by advanced aircraft observations: Plans for a new aircraft program of Japan

New Earth and planetary science using a flying boat

Long-range transport of Short-Lived Climate Pollutants from Asia to the Arctic (contribution to PACES)

Multi-phase chemistry of organics in the atmosphere (contribution to Fundamentals of Atmospheric Chemistry)

Collaboration with the EMeRGe field campaign in 2018

4.1. Observation of the Atmospheric Composition from Space

The community has put great effort for the satellite missions, in close collaboration with German partners. The GMAP-Asia (Geostationary Mission for Meteorology and Atmospheric Pollution in Asia) was proposed earlier, and later the APOLLO (Air Pollution Observation)/Anu-ISS and uvSCOPE missions were proposed as part of the ISS (International Space Station) Earth Observatory Initiative. The both APOLLO/Anu-ISS and uvSCOPE missions target comprehensive observations of SLCPs (Short-Lived Climate Pollutants) with high spatial resolution, hoping to contribute to the improvement of the emissions inventories (Japan Society of Atmospheric Chemistry, 2012).

4.2. Multi-phase Chemistry of Organic Aerosols

Air pollution with PM2.5 has been widely considered as a societal problem, and the underestimates of organic aerosols in the state-of-science models are not yet resolved. One of the reasons may be that multiphase reactions (heterogeneous reactions) have not been studied well so far. Nevertheless, the mechanisms and rates of multiphase reactions are fundamental in atmospheric chemistry. Therefore, a new project was about to launch, jointly teamed by atmospheric chemists, molecular scientists (e.g., theoretical chemists, computational chemists), and analytical chemists. Other efforts include two workshops on "Heterogeneous Kinetics Related to Atmospheric Aerosols" jointly organized by Japan National Committee and China Working Group in 2015 and 2016, as part of the IGAC-endorsed activity in the framework of Fundamentals of Atmospheric Chemistry.

Summary

Atmospheric chemistry research has successively matured into a solid academic discipline during more than 25 years of existence since its beginning. In Japan, the students of the first pioneers called "the fathers of atmospheric chemistry", have stepped into the forefront of research. They will further strengthen international collaboration, and commit to play a leading role in global atmospheric chemistry research for the next 25 years.

Acknowledgements

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28 FEBRUARY TO 2 MARCH, 2017 GENEVA, SWITZERLAND

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World Meteorological Organization (WMO) Workshop on Measurement-Model Fusion for Global Total Atmospheric Deposition

xperts on atmospheric measurements and modeling, data assimilation, and ecosystem and human health effects met at the World Meteorological Organization's (WMO) headquarters to review the state-of-the-science and establish a Global Atmosphere Watch project on Measurement-model Fusion for Global Total Atmospheric Deposition for the purpose of generating global maps of total atmospheric deposition as well as of ambient gases and particle species.

WMO's Global Atmosphere Watch (GAW) Programme coordinates high-quality observations of atmospheric composition across the global to local scales with the aim to drive high-quality and impact science while co-producing a new generation of products and services. The workshop on Measurement-Model Fusion for Global Total Atmospheric Deposition was an



WMO Headquarters in Geneva, Switzerland

initiative of GAW's Scientific Advisory Group for Total Atmospheric Deposition (SAG-TAD), whose mandate is to produce global maps of total atmospheric deposition for important atmospheric chemicals. The intended use of the maps is to enable research and assessment of biogeochemical cycles and ecosystem and human health effects.

Measurement-model fusion for total atmospheric deposition is an emerging technique that requires measurements of atmospheric trace gases, particles, precipitation composition and precipitation depth, as well as predictions of the same from global/regional chemical transport models. The fusion of measurement and model results requires data assimilation and mapping techniques. Projects are currently being carried





Workshop Participants

out in Sweden, the United Kingdom, the United States and Canada, however, the methodology employed by each country is different and not necessarily applicable on a global scale. The objective of the workshop was to explore measurement-model fusion approaches and available global-scale data and models that may be used to produce global maps of selected reactive gases, aerosol species, and wet and dry deposition.

The three-day workshop commenced with keynote presentations on major international science and policy drivers behind the production of global deposition maps for total deposition, aerosols and gases from an ecosystem services and human health perspective. Subsequent sessions, designed to review the state-of-the-science, consisted of overview presentations and panel discussions on ongoing measurement-model fusion projects for total atmospheric deposition in the United States, Canada, Sweden and the United Kingdom; existing and planned ground-based and satellite-based measurements of precipitation, aerosols, reactive gases, wet, dry and total deposition of important atmospheric chemicals; and recent global, hemispheric and regional chemical transport and deposition modeling activities. The feasibility of and approaches to producing, on a routine retrospective basis, global maps of atmospheric total deposition and gas and aerosol concentrations was the focus of a plenary session and two parallel breakout discussions, one on measurements and the other on modeling. The threeday workshop ended with a final plenary and collective drafting of a detailed multiple-phase "road map" for a future GAW project on measurement-model fusion for global total deposition, aerosol species and reactive gases.

A workshop report summarizing the state-of-the-science, key conclusions and recommendations will be made available in the spring of 2017 on http://www.wmo. int/pages/prog/arep/gaw/gaw-reports.html. For more information about this project, including how to get involved as a project contributor and/or user of these global maps, please contact Mr Robert Vet, Environment and Climate Change Canada (Robert.vet@canada.ca) or Dr Ariel Stein, Chair of the Scientific Advisory Group for Total Atmospheric Deposition (Ariel.Stein@noaa.gov).



16-17 SEPTEMBER 2016 MARBLE MOUNTAIN LODGE, WILMINGTON, NY, USA

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Whiteface Mountain Cloud Chemistry Workshop



Participants enjoying the view from Whiteface Mountain Summit Observatory

pproximately 40 researchers attended the Whiteface Mountain Cloud Chemistry Workshop on 16-17 September 2016 at the Marble Mountain Lodge near Wilmington, New York to design a coordinated investigation of the effect of clouds on tropospheric composition.

Clouds cover 60% of the Earth's surface at a given time and are the primary means by which constituents from the polluted boundary layer are lofted to the free troposphere. Clouds play an important role by altering photolysis rates and as aqueous-phase chemical reactors, scavenging soluble gas-phase precursors and supporting oxidation reactions that yield lower volatility products that contribute to aerosol mass when the cloud drops evaporate. However, atmospheric chemistry observations (field campaigns and satellite retrievals) typically avoid clouds hindering knowledge of cloud impacts on tropospheric composition.

The workshop reviewed past mountaintop cloud chemistry studies, including Whiteface Mountain activities, the Great Dun Fell experiments in northern England, and the Mt. Schmücke experiments in Germany, to learn about successful operations and needed improvements with





Whiteface Mountain Summit Observatory

mountaintop cloud chemistry studies. With the idea that a future field campaign would be held at the Whiteface Mountain Observatory, results from regional and 0-dimensional box model studies were discussed to learn what might be expected in terms of atmospheric composition and cloud chemistry effects on that composition. The workshop highlighted the importance of the following science objectives for future field campaigns.

- 1. Quantify the impacts of clear-sky sampling bias in chemical characterization of the troposphere.
- 2. Identify key oxidants driving aqueous phase chemistry, through radiometric and chemical analysis, especially for organic compounds.
- 3. Quantify how aerosol characteristics and gas-phase composition change as a result of cloud processing.
- 4. Identify chemical tracers for cloud processing.
- 5. Quantify entrainment and transport of chemical constituents into the free troposphere.
- 6. Determine the importance of aqueous-phase biological processes on aqueous chemistry.

With these objectives in mind, workshop participants discussed the capabilities at Whiteface Mountain for conducting a cloud chemistry experiment and how such an experiment would be designed. Whiteface Mountain Summit Observatory routinely collects and analyzes cloud water samples during summertime, while the Marble Mountain Lodge site hosts National Atmospheric Deposition Program (NADP) and Clean Air Status and Trends Network (CASTNet) monitors. Based on hourly data, the summit of Whiteface Mountain experiences cloud 20-60% of the time during June to September, making Whiteface Mountain an excellent location to investigate aqueous chemistry in warm, low-level clouds.

The workshop concluded with the decision to begin with focused measurement and modeling studies at Whiteface Mountain Observatory. Workshop participants are currently analyzing cloud water samples from recent cloud events for coordinated analysis of cloud water composition. Researchers are characterizing typical cloud properties and airflow patterns in the Whiteface Mountain region. Model intercomparisons are being pursued for both regional-scale and chemistry box models. A small-scale pilot study will be conducted to examine water-soluble organic carbon and inform planning of future field intensive operations.

More information on the workshop can be found at https://www2.acom.ucar.edu/cloud-chemistry.



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