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# IGACnews

facilitating atmospheric chemistry research towards a sustainable world

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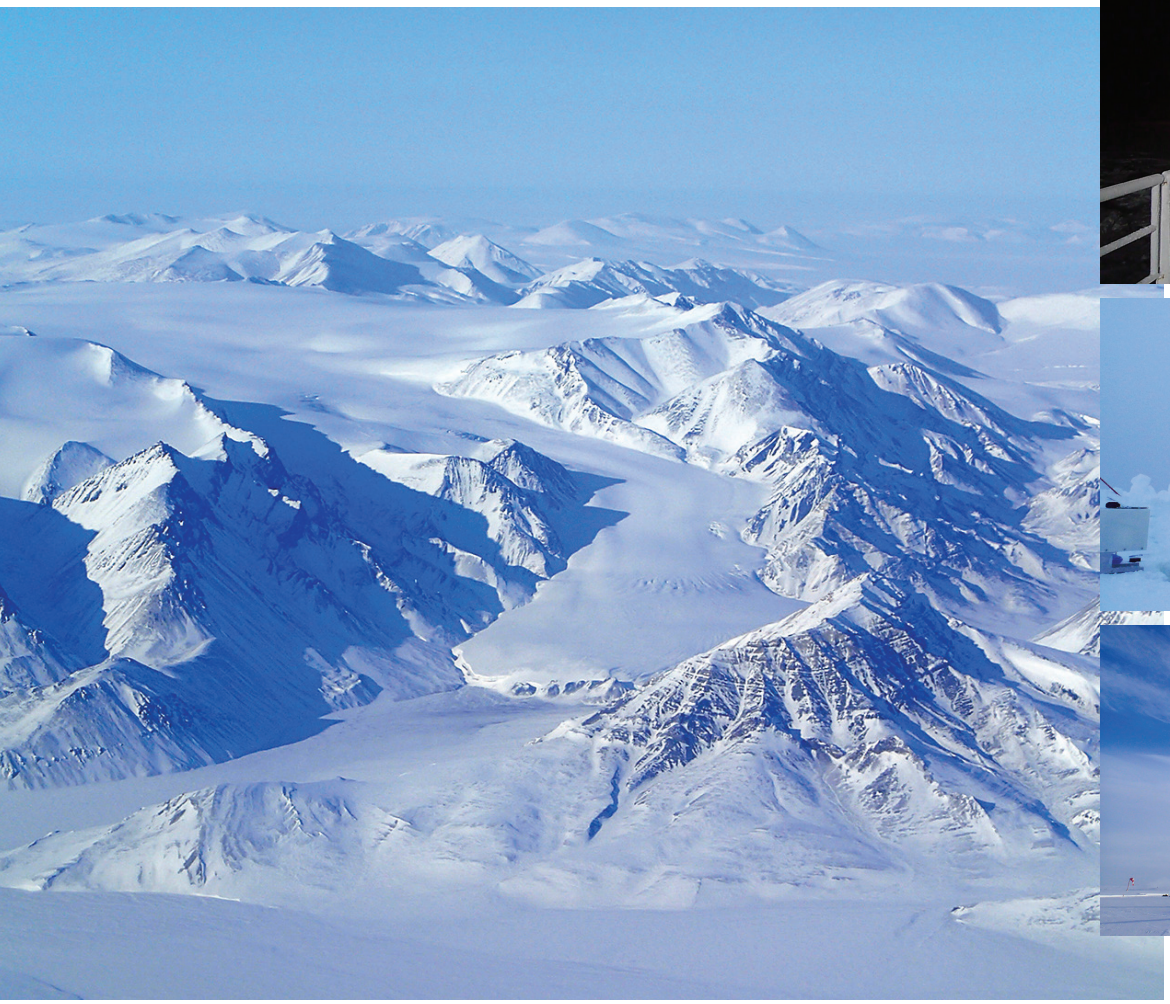
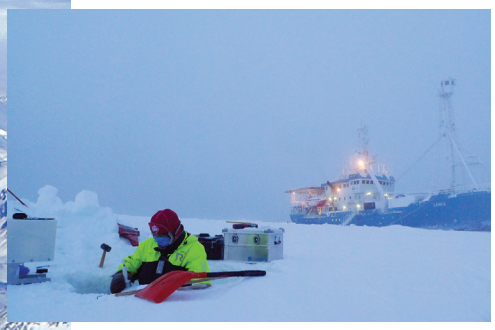
# **CATCH**: Chemistry, Biology, & Physics in Cold Regions





*See CATCH Workshop Summary, page 13*

# contents







## On the Cover

**CLOCKWISE FROM LEFT:** View of Ellesmere Island, Nunavut from Polar 6 during NETCARE 2015. **BY MEGAN WILLIS, UNIVERSITY OF TORONTO, CANADA**

Polar night rendezvous during the Norwegian Young Sea Ice Cruise (N-ICE 2015): the Norwegian Coast Guard ice breaker KV Svalbard (background) opens a path for RV Lance in the pack ice at 82°N to reach starting position of the pack ice drift. **BY MARKUS FREY, BAS, UK**

Sampling on a sea ice floe North of 82°N during N-ICE2015 to measure snow physical and chemical properties. **BY MARKUS FREY, BAS, UK**

Polar 5 and 6 at Alert, Nunavut during NETCARE 2015. **BY MEGAN WILLIS, UNIVERSITY OF TORONTO, CANADA**

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

## departments



## igac event summaries



## early career spotlight



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.

# The 46th Session of the IPCC

I recently had the opportunity to attend the 46th Session of the Intergovernmental Panel of Climate Change (IPCC-46) in Montreal, Canada 6-10 September as part of the Future Earth delegation. There were a variety of reasons why I attended IPCC-46, all of which are related to the scientific research the international atmospheric chemistry community does.

Working Group I, which addresses the physical science basis of climate change, proposed a new comprehensive chapter on Short-lived Climate Forcers (SLCF) and Air Quality.

Working Group II, which addresses climate change impacts, adaptation and vulnerability, proposed a chapter on Cities, Settlements and Key Infrastructure, in which although not explicitly in the chapter outline, air quality should be covered.

Working Group III, which addresses options for reducing GHGs and mitigating climate change, proposed a chapter on Cities and Urban Systems and Other Developments, in which a reference to air quality was included in the proposed chapter outline.

The IPCC Task Force on National Greenhouse Gas (GHG) Emission requests to have an expert meeting on SLCFs during the sixth assessment period (AR6).

The main goal of the IPCC-46 was to have all the nations approve of the chapter outlines for each working group. Watching this process unfold in front of me, it became very clear how terminology in the scientific community can have political implications. In order to get all nations to approve the chapter outlines, it takes hours of negotiations to maintain scientific topics in chapters without using terminology that has political implications.

This was evident in the negotiations that resulted for the chapters using the term "air quality" across all working groups. In the end, Working Group I will have a chapter entitled Short-lived Climate Forcers and the connection to air quality and atmospheric composition is a bullet in that chapter since several countries were not okay with air quality being used in the chapter title. Working Group II added the term air quality as part of a bullet in the chapter outline on Cities, Settlements and Key Infrastructure, while Working Group III ended up deleting any reference to air quality specifically in their chapter outline on Urban Systems and Other Settlement.

The negotiations were fascinating to witness, but the main take away for the atmospheric chemistry community is it's clear SLCFs and air quality are now getting attention across all three working groups.

Finally, I am on the Scientific Steering Committee for the upcoming 2018 IPCC Cities and Climate Change Conference (**citiesipcc.org**) that will take place in Edmonton, Canada 5-7 March 2018. I believe there is a great opportunity for the international atmospheric chemistry community to draw attention to the linkages between air quality in climate change in cities at this conference. I therefore encourage the IGAC community to submit session proposals and abstracts to this conference. The deadline for session and abstract submissions is 6 October 2017.

Happy reading!

**MEGAN L. MELAMED**
IGAC Executive Officer
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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.

# updates

## Save the Date

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

25-29 September 2018

14th iCACGP 15th IGAC
TAKAMATSU KAGAWA JAPAN
2018

**icacgp-igac2018.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)

### 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 February/March issue of the IGACnew is 15 February 2018. Send all submissions to **info@igacproject.org**.

### IGAC ON SOCIAL MEDIA

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**.

**27-29 MARCH 2017**
**UNIVERSITY OF CHILE, SANTIAGO, CHILE**

*IGAC Endorsed*

# Towards a first emission inventory in South America


**AUTHORS**
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**HOST INSTITUTIONS**

**FUNDING**

**PARTICIPANTS**
Argentina, Brazil, Chile, Colombia, France, Netherlands, Peru, United States

**BACKGROUND**

This workshop was endorsed by the jointly sponsored iGAC/iLEAPS/AIMES Global Emissions Initiative (GEIA) and the IGAC Americas Working Group. GEIA is a community initiative that builds bridges between environmental science and policy, by bringing together people, data, and tools to create and communicate the highest quality information about emissions. This workshop was organized by the GEIA Latin America/Caribbean (LAC) Emission Working Group.

**Workshop Participants**

In Latin American and the Caribbean (LAC) countries, national emission inventories of greenhouse gases (GHGs) are being prepared as part of the obligations of the Parties to the United Nations Framework Convention on Climate Change (UNFCCC) within the framework of their national communications. These inventories vary in completeness and coverage and in some cases include non-GHG species subject to complementary reporting under the Convention. However, several pollutants with important impact on climate change and air quality (AQ) are not or are only partly included. Currently emission inventories other than those for GHG in LAC focus mainly on growing megacities in an effort to understand the interactions and feedback mechanisms between (transport) emissions, AQ, and public health. Often, no national coverage for the air pollutants is available with the spatial and temporal detail needed for AQ policy support and analysis.

A workshop was held in Santiago, Chile 27-29 March 2017, gathering experts in emissions from five South American (SA) countries (Argentina, Brazil, Chile, Colombia and Peru) and members of the Global Emission

**Santiago, Chile**

InitiAtive (GEIA) Latin America/Caribbean (LAC) Emissions Working Group. In addition, international emission experts from France, the Netherlands, and the USA participated. An initiative (working title Emissions Inventories in South America, EMISA) was started to build such emission inventories in LAC countries. The aim is to provide governments, stakeholders, and scientists with qualified scientific emission information to support the development and further evaluation of policies to minimize (health and climate relevant) atmospheric pollutant emissions. In the short term, the objective focuses on five countries Argentina, Brazil, Colombia, Chile, and Peru. The long-term objective, however, is to expand this effort to all countries in LAC. Data generated within EMISA are envisaged to support local, national and regional AQ and climate modelling, assessments of the potential environmental impacts and implications of different mitigation strategies, and support evaluation of the environmental costs and benefits of different AQ and climate policies.

During this workshop, the status and quality of the emission products available for South America was presented and discussed. The workshop highlighted the rather wide spread between the emission estimates in various global inventories for LAC counties (in line with **Granier et al., 2011**). The reasons for these discrepancies are currently poorly understood. Moreover, by definition the global products lack representation of typical local/national country "traits" which may have large impacts on both the absolute emission levels as well as the spatial and temporal distribution within the country. This highlights the need to harmonize, or at least understand discrepancies, in currently used estimates and the impact on model-derived assessments of e.g., radiative forcing or AQ. To make progress it is essential to fill the gap associated with the knowledge of spatially distributed and temporally disaggregated emissions. The workshop findings and recommendations are summarized in a document that will be used to seek international funding to generate a consistent emission inventory across each one of these South American countries. IGAC

**30 - 31 MARCH 2017**
**UNIVERSITY OF CHILE,**
**SANTIAGO, CHILE**

*IGAC Sponsored*

**AUTHORS**
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**Nestor Yezid Rojas Rojas**, Universidad Nacional de Colombia, Colombia

**HOST AND FUNDING INSTITUTIONS**

**FUNDING**

**BACKGROUND**

The IGAC Americas Working Group aims to provide equal opportunity for all scientists in the Americas by building a cohesive network and fostering the next generation of atmospheric scientists with the ultimate goal of contributing to the development of a scientific community focused on building collective knowledge in/for the Americas. This was the second meeting of the IGAC Americas Working Group.

# 2017 IGAC AWG Meeting

**IGAC AWG Meeting Participants**

The implementation committee of the IGAC Americas Working Group (AWG) gathered at the *Center for Climate Science and Resistance (CR)²*, which is a center of excellence founded by the University of Chile and in partnership with Universidad Austral and Universidad de Concepción. The meeting focused on: (1) the organization of the School of Atmospheric Measurements in Latin America and the Caribbean: Atmospheric Particles and Reactive Gases (SAMLAC), to be held in 2018 in Puerto Rico, (2) the assessment of the status of the early career scientists' network, and (3) database building.

SEMLAC, which is being organized together with the Caribbean Aerosol-Health Network (CAHN) and the World Meteorological Organization (WMO) Global Atmosphere Watch (GAW), aims to: (1) Improve regional capacity and stimulate development of aerosol and reactive gas monitoring in the region; (2) Foster building a community of atmospheric scientist

**Universidad de Chile, Facultad de Ciencias, Santiago, Chile**

in the Latin America and Caribbean (LAC) region; (3) Educate early career scientists on the global and regional aspects, including impacts, of atmospheric composition; and (4) Promote best practices of open data sharing and open access publications within the LAC region. Early career scientists, epidemiologists and air quality technicians working in the region will be invited. The IGAC AWG reviewed the positive and negative aspects related to the organization and implementation of two prior training courses at the meeting (*Latin American and Caribbean Aerosol Measurements School: from measurements technologies to applications*, held in La Paz, Bolivia, in June 2015, and *Remote Sensing Techniques Applied to Atmospheric Chemistry*, held in Mexico City in December 2015). These lessons learned will be applied to the 2018 Training Course in an effort to provide the best training possible for scientists in the region.

Julian Gelman Constantin reported on the Latin America Early Career Earth System Scientists Network (**LAECESS**), which is a group of young scientists from Latin America aiming to promote networking, integrated science, and soft skills. They are seeking to increase the number of participants, especially young researchers from the region who participate in various IGAC activities. In tune with the AWG committee, the young researchers of the region express their interest in building a database of people and data. During the meeting the format of the database was discussed. The use of the system developed by the *Unidad de Informática para las Ciencias Atmosféricas y Ambientales* (**http://uniatmos.atmosfera.unam.mx**) will be explored, with the aim to begin the activities with researcher's data, and continuing in the medium term with air quality and emissions data.

The meeting concluded with a discussion about the organization of the AWG. Topics discussed were the rotation of members, nominations of new members, terms of membership, and connections to IGAC Activities. The IGAC AWG will be issuing a call for nomination to the committee in late 2017. In addition, the AWG is working on a couple papers related to tropospheric aerosols and emissions inventories (joint with the GEIA LAC Emission Working Group, see page 5). IGAC

**APRIL 2, 2017**
**PRAGUE, CZECH REPUBLIC**

*IGAC Endorsed*

**AUTHORS**
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**Sandy Starkweather**, NOAA, USA

**HOST INSTITUTIONS**

**FUNDING**

**PARTICIPANTS**
Denmark, Finland, China, Japan, France, Sweden, UK, USA, Portugal, Switzerland

**BACKGROUND**

IGAC endorsed this workshop under the jointly sponsored IGAC/IASC PACES activity, which aims to build strong interdisciplinary and international collaborations to coordinate research efforts on Arctic air pollution. This particular workshop was aimed at highlighting the social science perspectives related to Arctic air pollution and exploring ways that the social and natural sciences could collaborate on mutual interests.

# Towards an Interdisciplinary Research Agenda for Arctic Air Pollution

**Workshop Participants**

Using the Arctic Science Summit Week (ASSW) 2017 as a platform, the international project PACES – Air Pollution in the Arctic: Climate, Environment and Societies – brought together researchers from the social sciences, humanities and natural sciences to discuss an interdisciplinary research Agenda for Arctic air pollution.

The Arctic is increasingly considered an Anthropocene climate frontier, as the consequences of global warming look set to first and foremost impact the circumpolar hemisphere. The region is expected to become increasingly important as climatic changes look set to spark industrial-scale resource extraction and increased transport and commodity shipping, in turn, spelling severe impacts for the regions ecological and cultural landscapes due to industrialisation and consequent increases in pollution emissions from local sources related to mining and shipping. Simultaneously, the IPCC has called for enhanced involvement of the social sciences in formulating research responses to climate change as part of furthering collaboration between the natural and social sciences. In studying the developments that are happening right now, research

**Prague, Czech Replublic**

exchange and collaboration is timely not only between academic disciplines, but also increasingly, with relevant local partners and society at large.

The objectives of this workshop were:

a) to develop joint and concrete research questions among social and natural sciences on local Arctic air pollution sources and their impacts in the Arctic,
b) to identify the geographical, cultural and scientific scope of the PACES activities, and
c) to gain members for the interdisciplinary working group within the PACES activity on the theme "Arctic Air Pollution and Societies" that will be in charge of facilitating the inter- and transdisciplinary research in the coming years.

"Research exchange and collaboration is timely not only between academic disciplines, but also increasingly, with relevant local partners and society at large."

As a result of the workshop PACES members that are also actively involved in the International Arctic Science Committee (IASC) Working Groups for the Atmosphere, Terrestrial Environment and Social and Human dimensions submitted a joint cross-cutting proposal to IASC to further develop the research agenda to plan an on the ground field campaign in the Arctic. The proposal was funded and the next workshop is planned for spring 2019.

**2-6 APRIL 2017**
**BAD HONNEF, GERMANY**

*IGAC Endorsed*

# Aerosols-Clouds-Precipitation and Climate (ACPC) Workshop


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**Kentaroh Suzuki**, University of Tokyo, Japan
**Sue van den Heever**, Colorado State University, Fort Collins, USA
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**HOST INSTITUTIONS**

Physikzentrum Bad Honnef

Wilhelm und Else Heraeus Stiftung

**FUNDING**

Wilhelm und Else Heraeus Stiftung

ileaps

Global Energy and Water Cycle Experiment GEWEX WCRP

**PARTICIPANTS**
Australia, Colombia, Finland, France, Germany, Israel, Japan, The Netherlands, United Kingdom, United States of America

**BACKGROUND**

ACPC

The Aerosols-Clouds-Precipitation-and-Climate (ACPC) initiative is an IGAC Endorsed Activity. IGAC therefore was proud to endorse this workshop.

**Workshop Participants**

The Aerosols-Clouds-Precipitation-and-Climate (ACPC) initiative aims at a better understanding and quantification of the impact of aerosol perturbations on clouds, radiation, precipitation, latent heating, and atmospheric circulation. The initiative focuses on two cloud regimes, namely shallow marine clouds and deep convective clouds. Ongoing work and recent results were discussed at a workshop at the Physikzentrum Bad Honnef, Germany, 2-6 April 2017.

The research on deep convective clouds currently concentrates on isolated convective cells in the region of Houston (Texas, USA). This research is guided by the substantial perturbation in cloud condensation nuclei (CCN) concentrations by pollution from the city of Houston in onshore flow that is in contrast to much less polluted conditions in the vicinity.

On the observations side, emphasis is placed on the analysis of radar measurements. Groups at the NASA Goddard Institute for Space Studies, Texas A&M University, the National Atmospheric and Oceanic

**Physikzentrum Bad Honnef, Germany**

Administration, and the National Severe Storms Laboratory identified convective cells in polarimetric radar data from the NEXRAD radar network and tracked them over their lifetime. Preliminary analysis of the NEXRAD data and collocated Lightning Mapping Array observations indicate that characteristics of isolated cell evolution differ between situations subject to relatively high vs. low CCN conditions. One study by the Texas A&M University and the Hebrew University of Jerusalem proposed from a statistical analysis of observations that these clouds had greater vertical development, larger hydrometeors and enhanced lightning, hypothesizing that this might be due to invigoration. On the basis of these results, ACPC is working towards a first field campaign in which at least one US mobile radar could be deployed so that the methods for rapid scanning and statistical assessment of the observations can be tested on site in the Houston region.

On the modelling side, a common case study protocol for simulations of deep convective clouds has been defined (details available at **acpcinitiative.org**) and first simulations were conducted with two cloud-resolving models. These simulations from the Colorado State University and the University of Oxford showed distinct differences between the high- and low-CCN simulations both in terms of vertical wind and specific ice content. There was little CCN signal in surface precipitation. However, other properties differed notably but not entirely consistently across the two models; such differences between models are expected based on substantial uncertainties in microphysics schemes, in part motivating a strong parallel effort on the observation side. We plan to invite the wider modelling community to contribute more simulations and to forward-simulate polarimetric radar signals from the simulations to test the hypotheses on aerosol signals proposed on the basis of the observational analysis.

With regard to shallow clouds, research has focused on the southeastern Pacific stratocumulus region, where the VOCALS field campaign made comprehensive measurements in October-November 2008. Statistical relationships between aerosol optical depth and cloud droplet number concentration, $N_d$, and between $N_d$ and cloud liquid water path are being assessed from available simulations and satellite retrievals and put into context of the anthropogenic perturbation. A new effort is now directed at running large-eddy simulations (LES) along Lagrangian trajectories derived from a coarse-grid WRF model. This amounts to a downscaling exercise in which the LES provides a more detailed view of aerosol and cloud processes along the stratocumulus to cumulus transition. The shallow cloud working group, in concert with other efforts along these lines, will broaden the focus to also consider stratocumulus and their transition to cumulus in the Southeast Atlantic under influence of biomass burning smoke (ORACLES/CLARIFY/LASIC campaigns), as well as trade-wind cumulus clouds that will be observed along with a comprehensive characterization of the large-scale meteorological conditions in the **EUREC4A campaign**. Finally, because the shallow cloud group to a large extent assesses satellite data, one ongoing effort within ACPC is to characterize capabilities and uncertainties of current $N_d$ calculations based on satellite-based cloud optical depth and drop effective radius retrievals, and to assess new and upcoming approaches.

A follow-up workshop is planned for 3-6 April 2018 in Boulder, Colorado (USA). The ACPC group welcomes interested persons or groups to join the activities.

**19-21 APRIL 2017**
**GUYANCOURT, FRANCE**

*IGAC Sponsored*

**AUTHORS**
**Markus Frey**, British Antarctic Survey, UK
**Jennie Thomas**, LATMOS, France
**Thorsten Bartels-Rausch**, PSI, Switzerland

**HOST INSTITUTIONS**

**FUNDING**

**PARTICIPANTS**
Canada, Czech Republic, Denmark, Finland, France, Germany, India, Korea, Norway, Spain, Switzerland, UK, USA

**BACKGROUND**
IGAC financially sponsored the first Cryosphere and Atmospheric Chemistry (CATCH) workshop to support this emerging IGAC activity on Chemistry, Biology and Physics in Cold Regions, which will be developed over the next two years.

# 2017 CATCH Workshop - Community Workshop on the Development of CATCH

**2017 CATCH Workshop Participants**

The first workshop of the emerging IGAC activity 'Cryosphere and Atmospheric Chemistry (CATCH)' took place at the Laboratoire Atmosphères, Milieux, Observations Spatiales (LATMOS) in Guyancourt, France from 19 to 21 April 2017. CATCH aims to build a network of scientists to facilitate atmospheric chemistry research within the international community with a focus on the chemistry, biology and physics of the natural environment in cold regions. The two main objectives of the workshop were 1) to foster future collaborative work by highlighting cross-disciplinary research questions and 2) to identify future research needs and opportunities.

Forty-eight scientists from 14 countries representing a wide range of disciplines and all career stages, including many graduate students and postdocs, came together to present over two days their science related to CATCH in short talks or posters and to discuss ways of how to develop this new initiative. The themes of a total of 8 sessions were each introduced with a general overview talk accessible to the non-specialists followed by shorter science talks on a specific topic and then a general discussion. Poster sessions during lunchtime provided opportunities for informal discussions and networking. After the workshop the CATCH

implementation team and a group of invited participants met for an extra day to strategize the future of CATCH.

**The science** – The cold and Polar regions are currently undergoing significant change with implications for regional and global climate, ecosystems and society. The underlying natural chemical, biological and physical processes and feedbacks, which control the Earth system in the cold regions are still poorly understood. However, reliable predictions of environmental change requires a quantitative understanding of processes and feedback mechanisms, which can only be achieved through trans-disciplinary and international collaboration. The workshop succeeded in attracting scientists from a wide range of scientific disciplines relevant to the CATCH theme as reflected by the session themes: aerosol and clouds, biogeochemistry and biology, halogens, ozone, and mercury, surface processes and ice, fundamentals of chemistry in cold regions, as well as project overviews and facilities. The discussions were used to brainstorm and identify issues and open questions

**Atmospheric aerosol** and associated climate impacts, particularly in cold regions have one of the largest model uncertainties (IPCC 2013), which need to be resolved. In particular, origin, fate and cloud forming capability of particles formed at or near the surface in the Arctic and Antarctic are not well understood. However, a quantitative understanding of natural processes is needed, e.g. to reduce the model bias above the Southern Ocean linked to errors in representation of clouds and precursors (Flato et al., 2013) or to assess and mitigate the anthropogenic impacts from increased ship emissions in the high Arctic. Furthermore, fundamental aspects of the ability of aerosol to form clouds such as the difference in importance as cloud condensation nuclii (CCN) or ice nuclii (IN) are still unresolved. It became clear that better links to the aerosol and cloud microphysics community, facilitated by CATCH, would likely enable a step change towards answering some of the open questions.

Changes in the cryosphere such as those observed in seasonality, extent and thickness of sea ice have profound impacts on **biogeochemistry and biology**. These include impacts on ecosystems, feedbacks on greenhouse gas emissions, and changes in the cycling of elements. Therefore, the engagement of scientists investigating the biology of the surface ocean and sea ice is crucial to CATCH. Workshop participants who are also involved in BEPSII ( Biogeochemical exchange processes at Sea Ice Interfaces) and SOLAS (Surface Ocean – Lower Atmosphere Study) highlighted that many areas of research at the air-sea ice – ocean interface would benefit tremendously from collaboration and joint activities with CATCH.

Even though the atmospheric chemistry of trace gases, such as **halogens, ozone, nitrogen oxides, and mercury**, above snow and ice covered regions has been the subject of research for the last 30 years the relevant processes are not yet systematically integrated into regional and global models. A recent report evaluated air pollution in the Arctic focusing on short-lived climate forcers such as ozone and black carbon (AMAP Assessment 2015). But associated wider impacts of natural air-snow processes on climate and air quality have not been evaluated systematically. It was also pointed out that in some areas the fundamental process understanding is not yet mature enough to be included in GCMs. Another issue raised was that the interpretation of atmospheric observations needs to integrate better available information and expertise from the fields of atmospheric boundary layer physics as well as snow physics and chemistry. Better integration of the science community can be achieved by network initiatives such as CATCH. And finally, it was recognised that results from lab experiments (e.g. reaction rates) need to be evaluated critically before they are transferred to the real world.

An on-going debate related to **surface processes and ice** and **fundamentals in chemistry** revolves around the nature of the air-ice interface and how it affects uptake, release and chemical reaction rates (e.g. Bartels-Rausch et al., ACP, 2016). A challenge researchers are facing is to identify the origin of model errors. Knowing the source of uncertainties would allow to better target relevant and important processes in field and lab experiments. To do this field and modelling communities need to work together to develop hypotheses, which are then tested in the lab. It is recognised that scale matters, i.e. global models may not be sensitive to some parameters (e.g. reaction rate constants) and therefore reducing their uncertainty would not result in much improved model performance.

The study of natural processes in the cold and polar regions is highly inter-disciplinary, logistically challenging and expensive. It therefore relies heavily on international collaboration, which enables shared access to research **facilities** and collaborative **research projects**. Presentations highlighted existing opportunities for field work at research stations in the Arctic (e.g. **Villum Station North** or **Summit Station** in Greenland), in the Antarctic (e.g. **Halley Station**), terrestrial snow sites (e.g. **Finse Research Station**, **Joseph Fourier Alpine Station**), on research ice breakers, but also in mesocosms such as the **R.v.Glasow Air-Sea-Ice Chamber** in the UK. Existing network activities and projects such as **PACES**, **BEPSII** or **NETCARE** have overlap with CATCH and a liaison with some of them would clearly enhance CATCH research and impact.


**Next steps of CATCH** – There was consensus that the focus in the next 2 years will need to be on identifying key research questions CATCH will then address through a number of activities. Such activities can include developing a white paper, scientific reviews, research proposals, a summer school, and coordinated field campaigns.

**Feedback** – Twenty-three responses were received from a post-workshop survey, which rated the workshop as excellent regarding overall quality (60%) and organisation (74%), range of scientific topics covered (52%), and the quality of scientific discussions (39%). The latter may be due to the lack of time for in-depth discussions (48%), which is probably characteristic for inter-disciplinary workshops covering such a large range of topics. The workshop objectives were met (87%), in particular enough time was given for networking and informal discussions (91%). Thus, a majority of participants recognised either many opportunities (30%) or at least some chance for collaborations and future work (52%). An important challenge CATCH is facing based on various comments is that on the one hand CATCH needs to find the right balance of being focused and define research questions, which allow distinction from other initiatives and on the other hand remain inclusive and not too narrow in scope.

Overall everyone left Paris after two full days of intense discussions invigorated and with the positive feeling of having learned about neighbouring science disciplines and having met new collaborators and colleagues. We thank the workshop sponsors and all the participants to have come from near and far to join CATCH, to engage in truly cross-disciplinary and international dialogue and scientific discussions which often require a lot more patience than talking to your specialist colleague. We are also thankful to IGAC executive officer Megan Melamed who moderated the science strategy discussions. We are looking forward to take the next steps in the development of CATCH.

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# Megan Willis

**Megan Willis** is from Nanaimo, British Columbia, Canada. She completed her undergraduate degree in chemistry and math at Vancouver Island University (VIU). Currently, Megan is completing her PhD at the University of Toronto in atmospheric chemistry under the supervision of Jon Abbatt. Her research focuses on using airborne measurements to study sources, sinks and chemistry of aerosol in Arctic regions, and the impact this aerosol has on Arctic climate.

**Megan Willis attended the First CATCH Workshop and is a member of the CATCH Implementation Committee.**

**How did you become part of the IGAC community and do you think as an early career scientist IGAC workshops and conferences will aid or have aided your career as a scientist?**

I first become part of the IGAC community through the emerging IGAC activity CATCH, focusing on the chemistry, biology and physics of cold regions. I also attended my first IGAC meeting in 2016. As an early career scientist, I have felt very welcomed into the IGAC community. Attending IGAC conferences and workshops has been an excellent platform for connecting with other scientists and extending my exposure to atmospheric chemistry research happening all over the world.

**What and/or who motivated you to pursue a career in science and more specifically in atmospheric chemistry?**

Several excellent teachers, from high school to university in Nanaimo, BC, motivated my original interest in science and its connection to our environment. At VIU I was taught fundamental concepts in physical and analytical chemistry in the context of the environment, and this really cemented my excitement about science and its relevance to my everyday life. I was drawn to atmospheric chemistry because of its applicability to environmental issues. My experience in the Abbatt group has motivated me to pursue a career in atmospheric chemistry because it has taught me the global importance of atmospheric chemistry, and has exposed me to the interdisciplinary nature of our field.

**How do you want your career to progress and where do you think you can ultimately have the greatest impact?**

I am most excited about the connections between in-situ observations we make of the atmosphere and our understanding of fundamental chemical processes. Following this interest, I will continue in a research focused career bridging laboratory and field investigations in atmospheric chemistry. I believe I can have the largest impact on our field by sharing my knowledge and enthusiasm for science with others, especially with younger scientists.

**What is your favorite hobby?**

It's difficult to choose a favorite hobby, as long as I'm outside I'm happy. Climbing, cycling, and hiking are some of my favorites.

**You recently attend the CATCH Workshop, what was the highlight for you of this workshop?**

The CATCH workshop was one of the best workshops I have attended. I found everyone's presentations so engaging, and their excitement for studying cold regions so encouraging. One of the major highlights for me was meeting and talking with so many scientists who have formed their career around studying biology, chemistry or physics in cold regions.

**5-9 JUNE 2017**
**JINAN UNIVERSITY, GUANGZHOU, CHINA**

*IGAC Sponsored*


**AUTHORS**
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**Jim Crawford**, NASA Langley Research Center, Hampton, VA, USA
**Xuemei Wang**, Jinan University, Guangzhou, China
**Jianchun Bian**, Institute of Atmospheric Physics, Chinese Academy of Sciences, Beijing, China; University of Chinese Academy of Sciences, Beijing, China


**HOST INSTITUTIONS**

**FUNDING**

**PARTICIPANTS (List of countries & regions)**
Bangladesh, China, France, Germany, India, Indonesia, Italy, Japan, Korea, Malaysia, Nepal, Norway, Pakistan, Singapore, Switzerland, Taiwan, Thailand, United Kingdom, United States, Vietnam

**BACKGROUND**

IGAC financially sponsored this workshop to support the jointly sponsored IGAC/SPARC Atmospheric Composition and the Asian Monsson (ACAM) activity, which aims to build strong international collaborations to obtain the diverse expertise, resources, and access to the monsoon region for international research teams.

# Third Workshop on Atmospheric Composition and the Asian Monsoon (ACAM)

**Guangzhou, China**

Following the first and the second workshops in 2013 (Kathmandu) and 2015 (Bangkok), the ACAM community of scientists recently held its third workshop at Jinan University in Guangzhou, China 5-9 June 2017. The participants included 160 scientists from 19 countries. The scientific discussion spanned issues ranging from ground-level air quality to upper atmospheric composition in the Asian monsoon region. The region is unique given the interaction between the monsoon meteorology and emissions from human activity where population and economic development are undergoing rapid change. These interactions have important local implications in terms of the coupling between pollution and monsoon changes and their impacts on human health and the regional economy. The interactions also have global significance, which comes from the effective conduit that monsoon convection provides for pollution to reach the upper atmosphere with potential impacts on climate and stratospheric ozone, which is a topic of intense investigation.

The scientific scope of the workshop followed the four ACAM scientific themes, each representing a key aspect of the connection between atmospheric composition and Asian monsoon dynamics:

**Third ACAM Workshop Participants**

1. Emissions and air quality in the Asian monsoon region. This theme spans all seasons, recognizing issues ranging from summertime photochemical smog to winter pollution episodes.
2. Aerosols, clouds, and their interactions with the Asian monsoon. This theme recognizes the dominant impact of aerosols on this region and the continuing exploration of evidence for feedbacks influencing the monsoon climate system.
3. Impact of monsoon convection on chemistry. This theme focuses on the vertical redistribution of anthropogenic and natural emissions, expanding the impact of Asian emissions on atmospheric chemistry globally.
4. Upper troposphere/lower stratosphere (UTLS) Response to the Asian Monsoon. This theme emphasizes the intersection between Asian emissions and the monsoon anticyclone circulation as a conduit for increased anthropogenic influence on the UTLS environment.

The workshop included 80 oral and 50 poster presentations on recent science results. Many of the oral and poster presentations are available at the **workshop website**. To encourage more collaboration among the ACAM community of scientists, the meeting agenda also included a series of talks on research opportunities. These talks highlighted currently active field observations, proposal opportunities for future field studies, data resources, and other community efforts that would benefit from the involvement of ACAM scientists.

Discussion sessions were devoted to a number of collaboration topics including data sharing, participation in community modeling efforts, coordination of field observations, and capacity building through training and mentoring of young scientists. Each of these collaboration topics are coordinated through working groups which are described in more detail on the **ACAM website**.

**10-12 JUNE 2017**
**JINAN UNIVERSITY, GUANGZHOU, CHINA**

*IGAC Sponsored*


**AUTHORS**
**Mary Barth**, National Center for Atmospheric Research, Boulder, Colorado, USA
**Ritesh Gautam**, Environmental Defense Fund, Washington, DC, USA
**Federico Fierli**, Institute of Atmospheric Sciences and Climate, Rome, Italy
**Xuemei Wang**, Jinan University, China


**HOST INSTITUTIONS**

**FUNDING**

**PARTICIPANTS (LIST OF COUNTRIES)**
Bangladesh, China, India, Nepal, Norway, Pakistan, Switzerland, Thailand, United Kingdom, and Vietnam
**Lecturers:** China, India, Italy, and United States

**BACKGROUND**

A primary goal of the IGAC/SPARC ACAM activity is the sponsorship of training schools on observation and model use for ACAM regional early career scientists. This was the second ACAM training school and IGAC was a proud financial sponsor of this event.

# 2nd Atmospheric Composition and the Asian Monsoon (ACAM) Training School – *Observations and Modeling of Atmospheric Chemistry and Aerosols in the Asian Monsoon Region*

**2nd ACAM Training School Participants**

Over 40 students and 9 lecturers attended the 2nd Atmospheric Composition and the Asian Monsoon (ACAM) Training School, which had a theme on *Observations and Modeling of Atmospheric Chemistry and Aerosols in the Asian Monsoon Region*, at Jinan University in Guangzhou, China. Specific goals of the training school were to (i) provide training of early career scientists on research topics relevant to ACAM, (ii) create a network of ACAM early career scientists, and (iii) provide resources for improving their science and communication skills.

Lecturers at the school presented theory and practical information on their expertise, ranging from satellite remote sensing to aircraft


**Jinan University, Guangzhou, China**

observations to analysis of long-term datasets to global and regional modeling of trace gases, aerosols, and meteorological parameters in the Asian monsoon region. Dr. Tianjun Zhou (Chinese Academy of Sciences, China) presented two overview lectures on the Asian monsoon, associated air-sea interactions, and the role of anthropogenic activity on Asian monsoon circulation and rainfall variability. Jessica Neu (JPL/CalTech, USA) and Ritesh Gautam (EDF, USA) discussed satellite measurements and retrieval techniques of atmospheric composition, while Elliot Atlas (U. Miami, USA) and Sachin Ghude (IITM, India) presented methods for sampling trace gases from aircraft and ground-based instruments. Chiara Cagnazzo (ISAC, Italy), Federico Fierli (ISAC, Italy), Mian Chin (NASA/GSFC, USA), and Mary Barth (NCAR, USA) discussed global and regional scale modeling, transport processes and analysis of trace gases and aerosols in relation to the Asian region. Sachin Ghude also discussed emissions inventories and their evaluation.

A highlight of the school was the "Science and Communication Café", at which three topics were addressed. The first was a discussion and exercise on communicating science with the general public in the form of a press release. Participants were exposed to methods for effectively translating research findings into non-technical, jargon-free language. The second topic discussed the organization of slides for oral presentations, for instance discussing the importance of finishing a presentation with the summary/conclusion slide as the last slide, so that the audience can view the main points of the presentation during the question and answer period. The third topic was an exercise of creating a "science elevator speech", a clear, brief message about a research finding and its significance to society. These were all interactive exercises with group presentations of press releases by the participants.

Other activities occurring during the training school were group tasks to propose an aircraft field campaign based on a topic relevant to ACAM, determine the type of instruments needed to address the objectives of the field campaign, and the modeling framework to forecast and analyze field campaign data. These activities created a collegial camaraderie among the participants and lecturers. The participants were enthusiastic about the interactive activities, suggesting that more time be spent on the practical exercises. This training school significantly benefitted from the support of many sponsors as well as the outstanding support from local student volunteers at Jinan University, which the participants were grateful for.

The lectures have been posted at the **ACAM 2nd Training School website**, which is available to reach out to a broader audience. The ACAM Training Working Group web page also contains information on other training schools and resources associated with the ACAM topic.

**7-9 JUNE 2017**
**PRETORIA, SOUTH AFRICA**

*IGAC Sponsored*


**AUTHORS**
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**Rebecca Garland**, CSIR and North-West University, South Africa
**Paul Young**, Lancaster Environment Centre and Pentland Centre for Sustainability in Business, Lancaster University UK


**HOST INSTITUTIONS**

**FUNDING**

**PARTICIPANTS**
Algeria, Botswana, France, Ghana, Kenya, Nigeria, Norway, South Africa, Sweden, United Kingdom, Zambia

**BACKGROUND**
IGAC sponsored this workshop to foster the development of an atmospheric science community in Africa as part of its effort to create National/Regional Working Groups and promote scientific collaborations on scientific issues in Africa.

# IGAC Africa Science Activity: Scoping Workshop

**IGAC Africa Scoping Workshop Participants**

Excellent atmospheric science and air quality research is being done across Africa, but efforts are often limited in duration or regionally isolated, without strong collaboration between researchers across the continent. This hampers the development and impact of atmospheric research locally, regionally and internationally, and also limits the ability to perform cutting-edge research by both individual scientists and institutions, as resources are limited. A better understanding of atmospheric science in Africa would have large impacts on key societal issues for the continent (e.g. air quality, human health, agriculture, climate change). Currently, there is no formal forum or platform to connect African researchers focusing on atmospheric science research.

A three-day workshop was held at CSIR, Pretoria, South Africa in June 2017 with 31 participants from eleven countries. The participants came from universities, research councils, government, and NGOs. The workshop focused on addressing the following questions,

- What are the broad atmospheric science questions for Africa?
- What is the current state of Africa atmospheric science research? What has been done, what does it show, and does it meet stakeholder needs?
- How can the global community collaborate to work towards answering these questions?

Day 1 of the workshop began with scene setting presentations highlighting the current state and gaps in emissions, monitoring,

**CSIR campus, Pretoria, South Africa**

modelling, health impacts, and air quality management policies. In addition, all participants gave an overview of their interests in a lightning round of 1-minute presentations. Days 2 and 3 were the "working" part of the workshop, where participants discussed and answered the three guiding questions in break-out groups, followed by plenary discussions. This format supported a diversity of views being presented and discussed.

During the discussions, overarching research gaps and questions became clear, and were specifically related to emissions, observations and process modelling themes. This was identified across the range of scientists and stakeholders, and the participants highlighted the importance of developing a strong new African network drawn from the current continent's atmospheric science community with a remit for capacity building. The new body would incorporate oversight for continent-scale awareness and development activities to cover: young scientist training, continent-wide conferences, a commitment to open science, data sharing tools, interfacing with the global atmospheric science community, and developing new links with other researcher and stakeholder communities (e.g. urban planners). Development across these issues would allow the pressing issues to be addressed.

In summary, the workshop outcomes were three-fold: 1) The participants concurred that there was a need for an African Working Group on Atmospheric Science and mandated an interim steering committee made up of one member from each African country at the workshop to organize the first meeting of the Africa working group. This meeting will establish the working group, and elect the initial steering committee. 2) The participants developed a Statement of Intent (see text box insert, next page) detailing participant commitments to work together with the new working group to help addressing atmospheric science questions across the continent. 3) The participants will contribute to a position paper clarifying the workshop participants' understanding of current resource deficits, science area priorities, and increased collaboration opportunities. The paper will also highlight where research and resources might be lacking and are needed.

All participants expressed a desire for open and inclusive participation across all African nations and collaboration with the global atmospheric science community to enable scientists to achieve the large impacts on key societal issues for the continent which are possible and urgently needed. IGAC

## Atmospheric Science across Africa: A statement of intent

Arising from the IGAC Africa Scoping Workshop, 7-9 June 2017
Council for Scientific and Industrial Research (CSIR), Pretoria, South Africa

Excellent atmospheric science and air pollution research is being done across Africa, but efforts are often limited in duration, and locally or regionally isolated. A group of 30 atmospheric scientists and stakeholders, from across Africa and the world, participated in the IGAC Africa Scoping Workshop and discussed ways to begin to address this issue. We, the undersigned, are the attendees of this workshop and this document sets out our intent to: 1) unite atmospheric expertise across the African continent, and 2) to work with the global community to identify and address pressing atmospheric science questions that could improve the lives of the continent's citizens and protect the environment.

**Uniting expertise across the African continent: Regional working group**

A clear consensus emerged from the workshop participants to form a regional working group for atmospheric science in Africa, comprised of Africa-based scientists and the diaspora. An interim committee, appointed from the workshop's participants, has been tasked to take the next steps to establish this group and seek the guidance and sponsorship of the International Global Atmospheric Chemistry (IGAC) project. We are clear that IGAC should not be the only scientific community represented in this group, and that it must welcome and encompass a broad range of scientific expertise to advance atmospheric science for the benefit of the continent's citizens.

An initial meeting, with greater geographical and disciplinary representation from across Africa, will define the structure and governance of the Africa group. The interim committee will then dissolve itself and make way for a new leadership to take the group forward. We make no recommendations on the priorities of this group, except that it shall adhere to the principals stipulated and recommended by IGAC, and that it shall welcome and support scientists and stakeholders from all African nations, and from all career stages.

**African science; global collaboration**

It is clear to us that there are several pressing science questions where the African and international science community can work together. We recognize limitations in our understanding of anthropogenic and natural emissions, and the limitations in available observations. These lead to limitations at all scales (local to continental) in applying atmospheric science models to understand issues and impacts across the continent.

Our statement of intent is therefore to work through the new regional group of African atmospheric scientists to make progress in addressing atmospheric science questions, particularly those related to understanding air quality - an issue of great societal and economic importance. We will work together to define projects, seek funds, and engage complementary disciplines including social scientists, decision makers and civil society in our efforts. Our hope is that the nations of Africa can leap-frog the development timeline of the Global North, and that we can help facilitate a pathway to cleaner air.

**Agreed by the workshop participants (listed alphabetically)**

Katye Altieri, University of Cape Town, South Africa
Paul Beukes, North-West University, South Africa
Johan Boman, University of Gothenburg, Sweden
Douglas Booker, Lancaster University / NAQTS, UK
Christine Braban, Centre for Ecology and Hydrology, UK
Nana Ama Browne Klutse, Ghana Space Science and Technology Institute, Ghana
Roelof Burger, North-West University, South Africa
Constance Colnex Okuk, Kenya Meteorological Department, Kenya
Lisa Emberson, SEI York, UK
Ugwuoke Maximus Emeka, Lagos State Ministry of the Environment, Nigeria
Magnuz Engardt, Swedish Meteorological and Hydrological Institute, Sweden
Mathew Evans, University of York / UK National Centre for Atmosphere Science, UK
Rebecca Garland, CSIR, South Africa
Michael Gatari Gichuru, University of Nairobi, Kenya
Michael Gauss, Norwegian Meteorological Institute, Norway
Bode Gbobaniyi, Swedish Meteorological and Hydrological Institute, Sweden
Merabet Hamza, Centre de Développment des Energies Renouvelables, Algeria
Cheikh Kane, Red Cross Red Crescent Climate Centre, France
Hanlie Liebenberg-Enslin, Airshed Planning Professionals (Pty) Ltd, South Africa
Cathy Liousse, CNRS, France
Andriannah Mbandi, University of York, UK
Mohammed Iqbal Mead, Cranfield University, UK
Baagi Mmereki, University of Botswana, Botswana
Phenny Mwaanga, The Copperbelt University, Zambia
Mogesh Naidoo, CSIR, South Africa
Victor Nthusi, UNEP, Kenya
Philip Osano, Stockholm Environment Institute, Kenya
Odjugo Peter Ovuyovwiroye, University of Benin, Nigeria
Janine Wichmann, University of Pretoria, South Africa
Paul Young, Lancaster University, UK

**13-15 JUNE 2017**
**TOULOUSE, FRANCE**

*IGAC Sponsored*


**AUTHORS**
**Arlene Fiore,** LDEO/Columbia, USA
**Bryan Duncan**, NASA GSFC, USA
**Michaela Hegglin**, University of Reading, UK
**Gunnar Myhre**, Cicero, Norway
**Tatsuya Nagashima**, NIES, Japan
**Fiona O'Connor**, Met Office Hadley Center, UK
**David Plummer**, Environment and Climate Change, Canada
**Seok-Woo Son**, Seoul National University, South Korea
**Paul Young**, Lancaster University, UK


**HOST INSTITUTIONS**

**FUNDING**

**PARTICIPANTS (LIST OF COUNTRIES)**
Australia, Canada, Chile, China, France, Germany, India, Israel, Italy, Japan, Korea, New Zealand, Norway, Switzerland, U.K., U.S.A.

**BACKGROUND**

IGAC financially sponsored this workshop to support the jointly sponsored IGAC/ SPARC Chemistry-Climate Model Initiative (CCMI) activity. This activity was established to coordinate activities addressing chemistry-climate couplings in and between the troposphere and stratosphere. Science foci include the role of atmospheric chemistry and dynamics in controlling the impact of reactive greenhouse gases on the climate system; stratospheric ozone recovery and interactions with climate; connections among anthropogenic emissions, climate, and air pollution.

# IGAC/SPARC Chemistry-Climate Model Initiative (CCMI) 2017 Science Workshop

**Toulouse, France**

The IGAC/SPARC Chemistry-Climate Model Initiative (CCMI) 2017 Science Workshop was held from 13-15 June 2017 in Toulouse, France and hosted by Météo-France. Around 100 participants attended from 16 countries. CCMI Scientific Steering Committee (SSC) meetings were held before and after the workshop. A live-tweet on the workshop was organized by **Alison Ming** (thank you!) to share excitement and happenings at the workshop with the wider CCMI community (**available here**).

The workshop focused on multi-model analyses associated with the IGAC/SPARC CCMI Phase 1 Community Simulations (**Eyring et al., 2013**); please visit the **CCMI website** for additional information on this effort and how you can become involved. The purpose of these simulations is to address emerging science questions in chemistry-climate modelling, improve process understanding, and support upcoming ozone and climate assessments. Details of the models participating in the CCMI Community Simulations effort are given in Morgenstern et al. (2017)


**CCMI 2017 Science Workshop Participants**

and on the **CCMI website**. The agenda also included a number of invited speakers, who spoke on various topics relevant and complementary to CCMI efforts. Workshop presentations were grouped by theme: links to other communities, the stratosphere, novel observational datasets and approaches for model evaluation, stratosphere-troposphere coupling, tropospheric chemistry and dynamics, and an impact-oriented session with a focus on air quality. Sessions were organized around each of these themes (see full **workshop agenda**) and included invited and contributed oral presentations. The oral sessions were complemented by three extended poster sessions, which provided ample time for discussion of exciting studies covering a range of topics related to chemistry-climate interactions including both observational and modelling studies.

Workshop updates included the upcoming deadlines for inclusion in the WMO Ozone Assessment: lead authors should be made aware of relevant work, with a publication acceptance date deadline of 15 May 2018 for inclusion. A call was made for CCMI members to participate in the production and evaluation of CCMI Phase-2 AerChemMIP simulations, in close collaboration with the AeroCom community; check future quarterly CCMI e-News (join by **email**) for details. Workshop participants reflected on CCMI accomplishments to date and future directions. An overarching message emerged that CCMI is perceived as succeeding in building a strong sense of community among chemistry-climate modelers and in providing an appreciated platform for chemistry-climate science discussions. Participants expressed that future CCMI efforts should establish closer connections between the modeling and observational communities and strive to identify tropospheric evaluation approaches and diagnostics for key processes underlying chemistry-climate interactions, and emphasized a need to raise awareness of the CCMI Phase 1 Modeling datasets. To get involved, see **here**; contacting the modeling groups directly is also encouraged. Future plans for CCMI are being developed from workshop discussions, for review by the IGAC Scientific Steering Committee in autumn 2017. If you were not at the workshop and would like to help shape the future of CCMI, please do not hesitate to send your input to the co-leads of CCMI **Bryan Duncan** and **Michaela Hegglin**. IGAC

**27-29 JUNE 2017**
**COAST VICTORIA HOTEL,**
**VICTORIA, CANADA**

*IGAC Sponsored*


**AUTHORS**
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**Kathy Law**, CNRS, Paris, France
**Steve Arnold**, University of Leeds, Leeds, UK
**Knut von Salzen**, Environment and Climate Change Canada, Victoria, Canada


**HOST INSTITUTIONS**

Environment and Climate Change Canada
Environnement et Changement climatique Canada

**FUNDING**

IASC
PARCS POLLUTION IN THE ARCTIC SYSTEM

**PARTICIPANTS**

Canada, China, Denmark, Finland, France, Germany, Italy, Japan, Norway, Sweden, United Kingdom, United States

**BACKGROUND**

PACES air Pollution in the Arctic: Climate Environment and Societies

IGAC sponsored this workshop to support the IGAC Activity air Pollution in the Arctic: Climate, Environment and Societies (PACES). This activity aims to coordinate international research on Arctic air pollution and its impacts.

# 2nd air Pollution in the Arctic: Climate, Environment and Societies (PACES) Science Workshop

**2nd PACES Science Workshop Participants**

More than fifty scientists representing 13 countries with interest in the Arctic atmosphere recently gathered at the Victoria Coast Hotel in Victoria, British Columbia, Canada, for the 2nd PACES Science Workshop. PACES (air Pollution in the Arctic: Climate, Environment and Societies) is a recently launched and growing scientific activity sponsored by IGAC and the International Arctic Science Committee (IASC). PACES aims to review existing knowledge and foster new research on the sources and fate of Arctic air pollution, its impacts on climate, health, and ecosystems, on the feedbacks between pollution and natural sources, on climate responses, and on societal perspectives, including sustainability, adaptation and economic feedbacks. PACES coordinates international research efforts on these topics in collaboration with existing and planned initiatives and motivates trans-disciplinary research related to Arctic air quality.

The Workshop included oral and poster presentations as well as guided open discussion. Each oral session featured one or two invited talks of 20 minutes each followed by presentations of 15 minutes. The session topics were Long Range Transport, Feedbacks between Anthropogenic Pollution and Natural Cycles, Local Processes and Societal Interactions, Improved Predictive Capability, and the IMPAACT field/modeling study. Posters were presented on the second day. Following the close of the PACES Workshop at noon on the third day, an open, joint session was held between PACES participants and scientists attending the meeting of the AMAP Expert Group (EG) on Short-Lived Climate Forcers, which immediately followed the Workshop. This final day concluded with an open discussion of linkages between the PACES and AMAP EG goals and interests.


Victoria, British Columbia, Canada

About 50 scientists attended in person, with another 10 joining remotely. While many scientific topics were discussed in detail, several broader themes dominated throughout the workshop. Jim Overland of the University of Washington opened the Workshop with an invited talk that highlighted the drama, immediacy, and astonishing magnitude of Arctic climate change. The uncertainty in the rate and magnitude of this change was a recurring topic throughout the Workshop. Arctic climate change affects the magnitude of local sources of pollution due to increased economic activity, the amount and type of natural emissions of gas-phase species and aerosols from more-open Arctic waters, the production of dust from newly exposed soils, changes in the deposition of pollutants, and changes in Arctic clouds and precipitation. Because of poor understanding of the causes of Arctic climate amplification, it is difficult to predict with certainty changes in the composition of the Arctic troposphere. More work needs to be done on these topics, and more coordination with climate scientists to better understand feedbacks between Arctic climate change and chemistry should be a priority moving forward.

Several presenters discussed the long-range transport of pollutants from mid-latitude sources to the Arctic. Significant gaps between model simulations of the abundance and distribution of gas-phase and aerosol species and observations remain despite improvements in both models and measurements. Key remaining issues include the lack of a climatology of the vertical distribution of pollutants throughout the troposphere, a paucity of measurements in the Russian Arctic, and the sensitivity of soluble and aerosol species to wet removal, which is poorly constrained in models. The Pan Eurasian Experiment (PEEX), which aims to develop a network of research sites across the boreal and sub-Arctic regions of Eurasia to better understand atmospheric chemistry and transport of pollutants. PEEX provides an opportunity for expanding measurement quality and coverage within the Russian Arctic, and for developing collaborations between Russian, Asian, European and North American Researchers.

The interactions between Arctic societies and air pollution were discussed extensively during the Workshop. Economic activity in both the Eurasian and North American Arctic is increasing, leading to more pollution from shipping, resource extraction and processing, and residential emissions. The impact of these emissions can be hyper-local, with very strong local concentrations in the stratified Arctic troposphere. Community-based monitoring is an approach that may improve understanding of local air quality and its impact on Arctic populations, but Stanley Edwin of the Council of Athabascan Tribal Governments emphasized that local people must be deeply involved in planning and designing measurement programs, and must participate in analysis and interpretation as well.

The final theme of the Workshop was planning for and discussion of a nascent field and modeling experiment, IMPAACT, to examine pollutant transport from East Asia to the North American Arctic. This project, planned for spring 2021, would involve airborne, ground-based and ship-borne measurements across the Pacific Ocean from the South China Sea to Alaska and western Canada. A focus of the project is the effect of wet removal during transport on pollutant concentrations and speciation. Modeling on a range of scales is essential to guide the project design, provide in-field forecasting, and to analyze and interpret the observations. There was keen interest in this project from a number of Workshop participants from Asia, Europe and North America. The IMPAACT Steering Committee will maintain close communication with the PACES community as planning for this project develops.

**10-14 JULY 10-14 2017**
**TAIPEI, TAIWAN**

*IGAC Sponsored*

# Advanced Institute on Disaster Risk Reduction with Systems Approach for Slow-Onset Climate Disasters (AI-SOCD) – Air Pollution, Sensors, and Big Data


## AUTHORS

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**Chia-Hsing Jeffery Lee**, Center for Sustainability Science, Academia Sinica, Taipei, Taiwan; Science Officer of Integrated Research on Disaster Risk, International Centre of Excellence in Taipei (IRDR ICoE-Taipei)


## HOST INSTITUTE

## CO-ORGANIZERS

## PARTNERS

## PARTICIPANTS & SPEAKERS

Australia, Bangladesh, Fiji, India, Indonesia, Japan, Malaysia, Myanmar, Philippines, Taiwan, Thailand, Vietnam, and United States

## BACKGROUND

IGAC sponsored this Advanced Institute (AI) as part the IGAC Monsoon Asia and Oceania Network Group (MANGO). The main objective of IGAC-MANGO is to form a cohesive network of atmospheric scientists in the Asian monsoon region, facilitate collaboration between Asian and international scientists, and foster the next generation of scientists in this region.


**Participants and Speakers of AI-SOCD - Air Pollution, Sensors, and Big Data**

The aim of "AI-SOCD—Air Pollution, Sensors, and Big Data" was to provide early to mid-career practitioners, researchers, and policy makers in Asia and the Pacific region with enhanced understanding, skills, and practical knowledge to apply systems approach in disaster risk reduction (DRR) research focusing on Air Pollution, Sensors and Big Data. It was mainly organized by the Integrated Research on Disaster Risk, International Center of Excellence in Taipei (**IRDR ICoE-Taipei**) and International Council for Science, Regional Office for the Asia and the Pacific (ICSU ROAP). This AI is a continuation of the "Future Earth Asian Perspective Symposium on Air Pollution Transdisciplinary Collaboration" held 29 February – 1 March 2016, in Academia Sinica, Taipei, Taiwan with the aim to establish air pollution transdisciplinary collaboration under the framework of Future Earth in Asia for sustainable development of Asian countries. The organizers and partners of AI-SOCD include academic institutes, citizen's group, and private organizations.


**Academia Sinica, Taipei, Taiwan**

In recent years, the extreme weather events under climate changes have caused increasing causality on human societies worldwide. Air pollution is one of the major root causes of current climate disasters. On the other hand, air pollution, especially aerosols, contributes greatly to the uncertainty of climate change projection. In addition, millions of deaths worldwide were attributable to $PM_{2.5}$ (fine aerosols), which is a human carcinogen and one of the major environmental health concerns, especially in Asian areas. New thinking and new technology could be used to reduce health risks from air pollution. Currently, a set of simple, low-cost and reliable sensors for $PM_{2.5}$ has been developed and begun to be applied in the field. Thus, there is a huge potential to distribute these low-cost sensors (LCS) in large quantities to citizens for detection and monitoring the occurrence and progression of air pollution in their area. However, applications of these sensors and the interpretation of the big data it generates require a stronger multi-disciplinary collaboration among scientists from different fields. And systems thinking is an effective way to facilitate the communication among scientists from different disciplines as well as policy makers. Therefore, this AI focuses on systems thinking, PM2.5 sensory technology, and big data.

Air pollution is one of the major root causes of current climate disasters.

Twenty-two participants from eleven countries were chosen among more than 120 applications, including researchers and policy makers. Some of them are members of IGAC MANGO. Vice President of Academia Sinica, Academician Mei-Yin Chou; Executive Director of IRDR ICoE-Taipei, SC Candice Lung; Interim Director of ICSU ROAP, Sharizad Tegnku-Dahlan; Director of Regional Center for Future Earth in Asia, Hein Mallee; co-chair of IGAC, Hiroshi Tanimoto; and representative of LESTARI UKM, Talib Latif gave the welcome address in the opening ceremony. On behalf of IGAC, Dr. Hiroshi Tanimoto, co-chair of IGAC and IGAC MANGO from Center for Global Environmental Research, National Institute for Environmental Studies, Japan, gave a presentation to give participants a perspective on the

potential application of LCS in atmospheric chemistry research as well as in the transdisciplinary collaborations that IGAC promotes.

In five days, the participants learned one of the systems thinking approach, collaborative conceptual modeling (CCM) with lectures and hands-on practices on CCM diagrams. The development, case studies, and demonstrations of $PM_{2.5}$ sensors in the US, Taiwan, and Africa were presented. Data security and data visualization tools, potential application and limitation of current $PM_{2.5}$ sensors were discussed. After intensive interaction and discussion, the participants developed proposals targeting biomass burning in the Southeast Asia with CCM focusing on applying sensory technology to help provide solutions. Group presentations were given on the last day. Academician Chao-Han Liu of Taiwan gave closing remarks in the closing ceremony and certifications were awarded to the participants. The detailed program can be downloaded from the website. The following paragraphs briefly describe the highlights of this AI.

## Highlights

- **Collaborative Conceptual Modeling (CCM) for Transdisciplinary Collaboration**
  CCM for transdisciplinary collaboration was introduced by Drs. Katrina Proust and Barry Newell from Australia National University. They were leading two days of lectures and hands-on sessions focusing on CCM with the aim to facilitate communication among scientists from different disciplines as well as policy makers. The concept of CCM, the interactions among different systems, the CCM templates constructed for general patterns, the leverage points for policy interventions, and the big pictures shown with CCM diagrams which should be kept in mind while doing individual project were covered in a series of presentations. The participants also had opportunities to discuss with each other in pairs and in groups of 4-5 to draw CCM diagrams to present their views of interactions among systems of interests to their research and to a specific case study of biomass burning in the Southeast Asia.

- **Air Pollution Sensors and Big Data**
  The sensory technology of LCS for $PM_{2.5}$ in research and citizen's science were presented from the perspectives of atmospheric chemistry, information technology, exposure assessment, and indoor air quality research. A large international participatory LCS network focusing on PM2.5 (AirBox) with thousands of LCS worldwide initiated by Academia Sinica in Taiwan with the collaboration of academia, citizen's group, and government agencies were introduced by Dr. Ling-Jyh Chen from Institute of Information Science, Academia Sinica. Dr. Richard E. Peltier from University of Massachusetts Amherst, USA, presented the application of LCS in Africa where it is needed most in long-term monitoring for trends; while Dr. Ronald C. Cohen from University of California Berkeley, USA talked about the experiences in the US and the potentials to apply LCS in air quality and greenhouse gas observations and models. Dr. SC Candice Lung spoke on the applications and potential break-through with $PM_{2.5}$ LCS in exposure science and community source identification using case studies. In addition, Drs. Jose Guillermo Cedeno Laurent and Piers MacNaughton from Harvard T.H. CHAN School of Public Health, USA presented new opportunities for improving exposure science from environmental health perspectives using LCS. The combination of LCS in both pollutant monitoring and health evaluation is a powerful tool to advance exposure-health relation assessment.

  Subsequently, LCS used in atmospheric chemistry, exposure assessment, and indoor air quality in Taiwan, Africa, and the US was demonstrated in hands-on sessions by the above speakers along with Mr. MingWei (Ahai) Cheng, co-Founder of Rododo Science LLC in Taiwan; Ms. Kaitlyn J. Lieschke from UC Berkeley, USA; and Ms. Shu-Juan Joanne Hu and Mr. Chun-Hu Liu from Research Center for Environmental Changes, Academia Sinica. The assembly, set-up, and operations of PM sensors and data transmission were exercised. Moreover, participants and speakers carried two versions of portable LCS on a field trip to one of the night markets in Taipei City in the evening. Spike PM levels while passing wood-burnt, deep fried, barbecue cooking facilities of vendors were observed; and the results were shown in the next day to visually examine and quantitatively evaluate the significant increases in exposure levels caused by close-by sources. These hands-on sessions clearly demonstrated the advantages of LCS with high spatiotemporal resolutions of observations and easy operation.

  Besides the application of LCS, the interpretation, security and visualization aspects of LCS data were also presented. Mr. Noah Kittner from UC Berkeley presented the possible application of LCS in combination with other research methods in energy researches. Mr. Jason Wang from Cypress River

"There are limitations in the current low cost sensors (LCS); thus, the application and interpretation of the LCS observations need to be cautious."

Advisors spoke on IoT information security and implications in crowd sourced data, and Mr. Jeffery Cheng from Trend Micro emphasized that device security is a shared responsibility borne by everyone. Possible ways to enhance data security were also presented. Moreover, various data visualization tools were demonstrated with case studies by Dr. Ling-Jyh Chen.

Afterwards, discussion sessions were held focusing on big data analytics and interpretation of the air pollution monitoring information from IT, atmospheric chemistry, and environmental health perspectives. The pros and cons of LCS were discussed in different aspects including applications in citizen's science, governmental agencies, long-term monitoring in developing countries, high spatiotemporal observation to understand mechanisms in atmospheric chemistry research, human exposure assessment to identify/quantify unknown sources in community scales and human activities, and indoor air quality evaluation along with health impact assessment.

- **Potential Application and Limitation of LCS**
  With the rapid development of LCS, advancements in the scientific understanding of quite a few topics can be anticipated. Therefore, atmospheric chemists should take advantages of high spatiotemporal resolutions of new LCS, which may be able to answer the following scientific questions and provide solutions. For ambient air quality, LCS may be used in (a) taking measurements where no government monitors' available, (b) identifying/quantifying pollution sources in community scales, and (c) getting mass media, social media, the publics' attentions on the severity of air pollution. Especially in Asian countries where mixed sources (restaurants, temples, traffic within communities, home factories, etc.) existing in the communities resulting in highly variable $PM_{2.5}$ distribution within short distances, LCS is particularly useful. In the field of human exposure assessment, LCS may be applied to (a) identify/quantify unknown sources/activities/events, (b) assess exposure-health relationships, and (c) give the public advice whether to proceed or avoid certain activities (for children, athletes, daily routines, etc.). For indoor air quality studies, LCS may be used in (a) identifying/quantifying unknown sources/activities/events, (b) assessing exposure-health relationships, and (c) alerting people to high-level events to change their behaviors and reduce health risks.

  There are limitations in the current LCS; thus, the application and interpretation of LCS observations need to be cautious. Due to their accuracy, precision, and stability problems, current LCS is not suitable for the regulatory purpose and for emission inventory. The lifetime of current LCS is still in question. The data transmission depends on the quality of local infrastructure; significant data loss may be encountered. Most importantly, LCS needs to be calibrated against reference instruments in order for those data to be used for scientific research purpose. Current networks of LCS is in particularly useful in evaluating the trends. The calibration issue may be tackled by looking at the network rather than individual LCS.

## Path Forward

A side meeting focusing on the potential architect of an international PM sensor network and roles of partners were held with all the speakers and representatives of IGAC and IGAC MANGO. Possible follow-up actions were discussed. It was agreed to begin with the following activities: 1) share data at open platforms; 2) share codes at Github; 3) improve the current PM sensors via discussion with experts; 4) discuss with manufacturers; 5) compare sensor performance with co-location sensing for long-term monitoring; and 6) facilitate the collaboration. This AI has provided an important platform for early and mid-career scientists in the Asia and the Pacific region, LCS experts, NGOs, and private entrepreneurs to learn and interact with each other. This was a good start, in the future, Future Earth and IGAC may play a vital role in facilitating the collaboration and maintaining interactions among scientists from different disciplines interested in using LCS in research to improve air quality for better health and well-being of our society.

**10-11 JULY 2017**
**BOULDER, CO, USA**

*IGAC Sponsored*

# 2017 Fifth Interdisciplinary Biomass Burning Initiative (IBBI) Workshop


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CIRES

**FUNDING**


IGAC provided financial sponsorship for this workshop to support the jointly sponsored IGAC/iLEAPS/WMO Interdisciplinary Biomass Burning Initiative which aims to foster international and interdisciplinary collaboration of research activities dealing with vegetation fires leading to improved atmospheric composition and air quality monitoring and forecasting through better scientific understanding of the various processes around biomass burning.


**PARTICIPANTS**
Australia, Brazil, China, Colombia, France, Germany, India, Indonesia, Japan, Netherlands, Singapore, Switzerland, Thailand, United Kingdom, United States

**BACKGROUND**

**2017 IBBI Workshop Participants**

Fifty-three participants from 15 countries gathered in July 2018 in Boulder, Colorado, for the Fifth IBBI Workshop. Biomass burning occurs on every continent except Antarctica. As well as changing the land surface, it releases large amounts of trace gases and aerosols to the atmosphere that play important roles in atmospheric chemistry and climate. However, there is large uncertainty on how climate change and global change will impact the frequency, intensity, duration, and location of biomass burning in the short- and long-term, making their emissions a large source of uncertainty in future atmospheric composition.

In the U.S., there are currently several research campaigns underway to study the impact of fires on the atmosphere. They include integrated laboratory, field, and modeling activities, with the following major field activities taking place in 2018 and 2019 funded by the National Oceanic and Atmospheric Administration (NOAA), the National Aeronautics and Space Administration (NASA), the National Scientific Foundation (NSF), and the Joint Fire Science Program Project, respectively.

- Fire Influence on Regional and Global Environments Experiment (**FIREX**)
- **FIREChem**
- Western wildfire Experiment for Cloud chemistry, Aerosol absorption and Nitrogen (**WE-CAN**)
- Fire and Smoke Model Evaluation Experiment (**FASMEE**)

In addition, the U.S. Department of Energy (DOE) Biomass Burning Observation Project (**BBOP**) took place in 2013 and the National Center for Atmospheric Research (NCAR) Atmospheric Chemistry Center for Observation Research and Data (**ACCORD**) is coordinating an effort to synthesize the various data related to open fires. At the same time, operational global fire observation capabilities are currently being greatly improved with the series of **Sentinel satellite** launches by the European Space Agency (ESA) and the geostationary **GOES-R** and **Himawari-8** satellites launched by the U.S. and Japan, respectively. Furthermore, ESA is developing a stable long-term time series of fire observations in its **Climate Change Initiative**. All these activities will contribute significantly to the understanding of the role of biomass burning in the climate system and to operational air quality forecasting applications.

The aim of the workshop was to capitalize on the U.S. research campaigns in the global and operational contexts. The workshop brought together the international biomass burning research community to discuss how to leverage the efforts in the U.S. and Europe to improve scientific research and understanding of open biomass burning around the world and maximize the benefits from the new satellite instrumentation.

The workshop took place over two days and included plenary talks, breakout groups, and plenary discussions. The workshop opened with welcomes and introductory presentations from the host institution and sponsors of the workshop, including David Fahey from NOAA who discussed a newspaper article from the same day describing current fires raging in California and British Columbia. Alexander Baklanov from the World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) announced the publication of *Vegetation Fire and Smoke Pollution Warning and Advisory System (VFSP-WAS): Concept Note and Expert Recommendations*, which was the outcome from the 2016 Fourth IBBI Workshop reported in **IGACnews Issue 58**.

Other plenary sessions included descriptions of the 2018/19 U.S. field campaigns, the challenges of forecasting and modelling biomass burning, where forecasting systems from Europe, Australia, the US and Singapore were described, and fire products available from satellites. On the second day, after a plenary session in which the ACCORD project and selected non-US based activities were described, a World Café-style break out session was carried out. In this session participants circulated between tables, and discussed: (1) How the outcomes of the U.S. Field Campaigns can be transferred beyond the U.S. and into the Future; (2) How the U.S. Field Campaign can serve to verify and enhance satellite products; (3) How the U.S. Field Campaigns, satellite products, and non-U.S. activities can address the challenges of forecasting and modelling biomass burning; and (4) How the U.S. Field Campaigns can help to meet the goals and needs of biomass burning research outside the U.S.. Two themes emerged repeatedly amongst a wealth of ideas:

The U.S. Field Campaigns should link the smoke plume properties to fire characteristics like flaming versus smoldering fire type, temperature and radiative fire power (FRP), in order to make their results applicable to large-scale satellite observation analysis for smoke forecasting. This is also highly relevant in view of the strong fire temperature-dependence of the smoke composition that has been observed during the BBOP campaign. It may, however require an additional aircraft dedicated to the observation of the evolution of the fire(s) that emit(s) an observed smoke plume.

Developing programs for visiting scientist from outside the U.S. to observe aircraft experiment activities directly from the campaign bases was expected to be most effective in making results and know-how from the U.S. campaigns accessible to scientific groups worldwide. In particular, this would likely have a long-lasting effect by initiating research collaborations for years to come.

Other suggestions included ensuring the products and information are discoverable and usable to the international community, expanding the scope of U.S. campaigns, e.g. adding fuel types from outside the US such as peat and Eucalypt to laboratory burning experiments, and building capacity by developing "best practice" guidelines based on the U.S. Field Campaigns.

IBBI is currently developing follow-up activities to implement the themes that emerged from this workshop.

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