

2012-2013 Annual Report

International Global Atmospheric Chemistry Project



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1 Background and Objectives

The International Global Atmospheric Chemistry (IGAC) Project was formed in 1990 to address growing international concern over rapid changes observed in Earth's atmosphere. IGAC operates under the umbrella of the International Geosphere Biosphere Programme (IGBP) and is jointly sponsored by the international Commission on Atmospheric Chemistry and Global Pollution (iCACGP). IGAC's mission is to *coordinate and foster atmospheric chemistry research towards a sustainable world* by integrating, synthesizing, guiding, and adding value to research undertaken by individual scientists through initiating new activities, acting as a hub of communication for the international atmospheric chemistry research community, and through building scientific capacity. IGAC accepts there is a need to develop a multi-disciplinary approach to address global sustainability and embraces this challenge by integrating IGAC's core activities that focus on emissions, atmospheric processes, and atmospheric composition with sustainability issues such as climate, human health, ecosystems, and how individual and societal responses feed back into the core IGAC research-led activities.

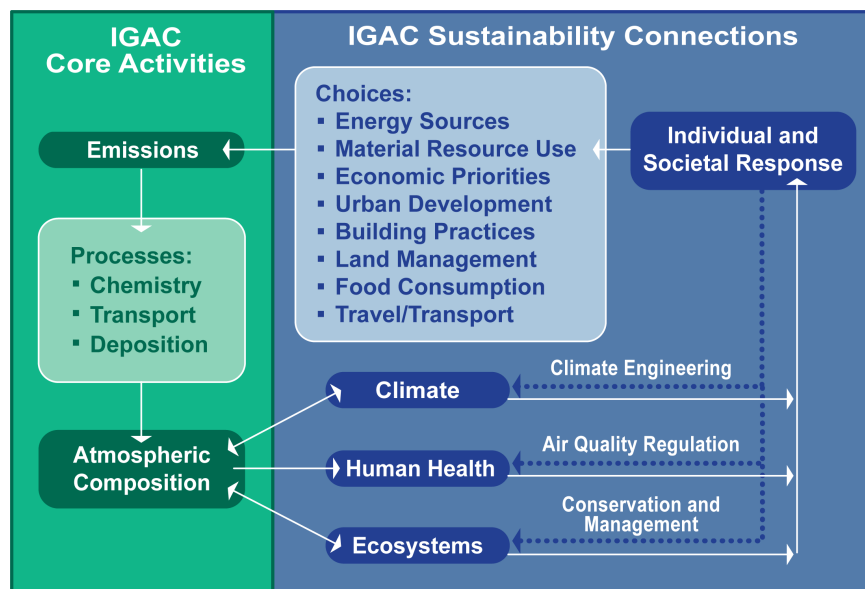


Figure 1: IGAC's role in Earth System Sustainability Science

2 Participants

The International Global Atmospheric Chemistry (IGAC) Project's Core Project Office has since July 2012 been located at the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado, Boulder. The IGAC Core Project Office is funded equally by the U.S. National Science Foundation (NSF), NOAA, and the National Aeronautics and Space Administration (NASA). Two employees have been supported within the IGAC Core Project Office from 2012 to 2013. Dr. Megan L. Melamed works 100% time as the IGAC Executive Officer. Since October 2012, Jeff Jennings has worked 10-15 hours per week as part-time student assistant. In addition to the permanent IGAC staff, IGAC also works with a graphic designer and web developer on an as needed contractual basis.

However, there is a much wider participation in the IGAC project than just those whose pay is covered under this grant. The project activities are guided and, in many cases, implemented by an international Scientific Steering Committee (SSC), which acts on a volunteer basis. The current IGAC SSC members are listed below.

Table 1: IGAC SSC Members 2013

Name	Country	Institute
Monks, Paul (co-chair)	UK	University of Leicester
Goldstein, Allen (co-chair)	USA	University of Berkeley
Abbatt, Jonathan	Canada	University of Toronto
Barth, Mary	USA	National Center for Atmospheric Research (NCAR)
Granier, Claire	France	Laboratoire Atmosphères, Milieux, Observations Spatiales
Heald, Colette	USA	Massachusetts Institute of Technology
Keywood, Melita	Australia	Common Wealth Scientific and Industrial Research Organization
Lawrence, Mark	Germany	Max Planck Institute for Chemistry
Longo, Karla	Brazil	National Institute for Space Research
Lung, Shih-Chun Candice	Taiwan	Academia Sinica
Mayol-Bracero, Olga	Puerto Rico	University of Puerto Rico
Pandis, Spyros	Greece	University of Patras
Park, Rokjin	South Korea	Seoul National University
Pienaar, Kobus	South Africa	North-West University
Rudich, Yinon	Israel	Weizmann Institute of Science
Sharma, Chhemendra	India	National Physical Laboratory
Tanimoto, Hiroshi	Japan	National Institute for Environmental Studies (NIES)
Wang, Tau	China	Hong Kong Polytechnic University
Zhu, Tong (ex officio)	China	Peking University

In addition to SSC members, IGAC relies on the involvement of the entire international atmospheric chemistry community in order to carry out its activities. Leads of current IGAC activities (described under Activities and Findings) are listed below:

Table 2: International Leaders of IGAC Activities

Activity	Name	Country	Institute
ACCMIP	Jean Francois Lamarque	USA	NCAR
	Drew Shindell	USA	NASA-GISS
Atmospheric Chemistry & Health	<i>Candice Lung</i>	<i>Taiwan</i>	<i>Academia Sinica</i>
	Christine Wiedinmyer	USA	NCAR
ACPC	Graham Feingold	USA	NOAA
	Meinrat O. Andrea	Germany	Max Planck
AICI	V. Faye McNeill	USA	Colombia University
	Thorsten Bartels-Rausch	Switzerland	Paul Scherrer Insitut
Air Pollution & Climate	<i>Paul Monks</i>	<i>UK</i>	<i>University of Leicester</i>
	Kathy Law	France	CNRS
Bounding the Role of Black Carbon in Climate	Tami Bond	USA	University of Illinois
	Sarah Doherty	USA	University of Washington
	David Fahey	USA	NOAA
	Piers Forster	UK	University of Leeds
Chemistry-Climate Model Initiative (CCMI)	Veronika Eyring	Germany	DLR
	Jean-Francois Lamarque	USA	NCAR
DEBITS	<i>Kobus Pienaar</i>	<i>South Africa</i>	<i>North-West University</i>
GEIA	Greg Frost	USA	CU/CIRES and NOAA/ESRL
	Leonor Tarrason	Norway	NILU
HiTT	Roland von Glasow	UK	University of East Anglia
	Ulrich Platt	Germany	University of Heidelberg
Interdisciplinary Biomass Burning Initiative (IBBI)	Johannes Kaiser	UK	ECMWF
	<i>Melita Keywood</i>	<i>Australia</i>	<i>CSIRO</i>
Megacities Assessment	<i>Tong Zhu</i>	<i>China</i>	<i>Peking University</i>
China Working Group	<i>Tong Zhu</i>	<i>China</i>	<i>Peking University</i>

Current IGAC SSC members are in italics.

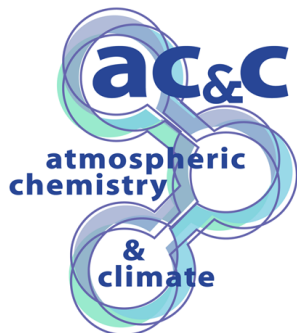
3 Activities and Findings

IGAC carries out its activities via four main pathways:

1. **Activities:** The IGAC community identifies issues in fundamental and sustainability research that require synthesis and integration of research across disciplines and/or geographical boundaries and facilitates their implementation.
2. **National/Regional Working Groups:** IGAC sponsors national/regional working groups that aim to facilitate the coordination of research both within the nation/region and between the nation/region and the international atmospheric chemistry community.
3. **Events:** IGAC co-sponsors small, focused meetings, workshops, and conferences that kick-start new directions in atmospheric chemistry research or support planning, data analysis/synthesis, or assessments related to current IGAC Activities or IGAC’s Vision. IGAC also holds a biennial open science conference that is the primary mechanism for dissemination of scientific information across the IGAC community.
4. **Communications/Networking:** This covers a myriad of activities including a newsletter sent to over 3,000 researchers around the world, webpage, and miscellaneous networking activities conducted throughout the year.

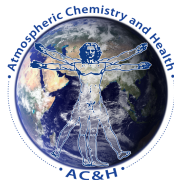
Initiatives

- **AC&C Model Intercomparison Project (ACCMIP)**



ACCMIP is providing extensive coordinated model simulations, diagnostics, and evaluations of the effect of short-lived species on climate, in coordination with the climate model intercomparison effort (CMIP). The main focus is on the role of tropospheric ozone and aerosols, which both have substantial climate forcing that varies widely in space and time. The first set of model runs for ACCMIP were completed this past year and a first workshop was held in April 2011 in Toulouse, France. A follow-up workshop was held in February 2012 in Pasadena, CA USA in conjunction with an HTAP meeting (see below). The model evaluation is expected to be completed in time to support the International Panel on Climate Change's (IPCC) Fifth Assessment Report (AR5) and will result in 13 peer-reviewed publications. Visit <http://www.giss.nasa.gov/projects/accmip/> for more information.

- **Atmospheric Chemistry & Health (AC&H)**



Research on atmospheric chemistry is motivated by the possible impacts on climate, ecosystems, and human health caused by the changes of atmospheric composition. Research ranges from laboratory measurements on the formation of pollutants, field campaigns on detailed gas and aerosol composition, long term observations at background stations (trend detection), satellite observations, regional and global scale modeling, focusing on short-term periods (weeks) to multi-decadal composition change. Research on health effects of atmospheric pollutants focuses on the relationships between exposure to outdoor air pollution and a range of acute and chronic health effects. This research comprises epidemiologic studies of the effects of short- and long-term human exposure to air pollution and toxicological experiments in animals as well as in-vitro studies of tissues and cells. Epidemiologic studies generally use ground-level measurements of air pollution at a limited number of locations, either alone or as part of spatial and or temporal models, to estimate the exposure of study populations, while toxicological studies use controlled experiments to evaluate toxicity and to understand the mechanism of air pollutants. Despite many shared issues, the atmospheric chemistry and health communities have developed research programs that, for the most part, do not explicitly acknowledge or relate to one another, and, as a result, even basic knowledge is not always widely shared. This initiative brings together these two communities to explore the various and multi-dimensional interactions between atmospheric chemistry and human health, with IGAC leading the atmospheric chemistry research needs.

- **Aerosols, Clouds, Precipitation, & Climate (ACPC)**
Jointly sponsored with IGBP-iLEAPS and WCRP-GEWEX

ACPC

The goal of this initiative is to obtain quantitative understanding of the interactions between aerosols, clouds and precipitation, and their role in the climate system. With the ACPC Science Plan now published (<http://igac.jisao.washington.edu/CurrentProjects/ACPCSciPlan.pdf>), efforts are underway to plan a field campaign in Brazil in 2014. This will leverage a year long effort by the U.S. Department of Energy's (DOE) Atmospheric Radiation Measurement (ARM) Climate Research Facility (ACRF) entitled "MegaCity Outflow in the Tropics." In addition, a new component of ACPC is the SAT-ACPC effort, which seeks to address specifically how satellite-based measurements can be used to improve the understanding of the role of aerosols in precipitations processes.

- **Air-Ice Chemical Interactions (AICI)**



The IGAC SSC first endorsed AICI in 2003 in light of research demonstrating new processes observed in the polar regions at the air-ice interface. The goal of AICI is to assess the significance of these processes at local, regional, and global scales by bringing together the laboratory, field, and modeling communities. The first phase of AICI was very successful providing important information on the full range of processes and trace gases that are exchanged at the air/ice and snow/ice interface and how they related to atmospheric chemistry and climate. The first phase resulted in various publications, including a Special Issue in Atmospheric Chemistry and Physics (http://www.atmos-chem-phys.net/special_issue80.html). In June 2011, AICI held a workshop at Columbia University, USA that brought together new insights from AICI studies over the last eight years, including work carried out at part of Ocean-Atmosphere-Sea Ice-Snowpack (OASIS), International Polar Year (IPY), and another IGAC Activity Halogens in the Troposphere (HitT). The past eight years of research produced new insights into cirrus ice and NO_y chemistry of the upper troposphere, air-snowpack exchange, and the role of halogen activation in the polar boundary layer. Much discussion during the workshop dealt with novel laboratory results that provide a molecular level understanding of the chemistry in snow and with the challenge to connect those to field observations by appropriate models. The challenge to develop detailed snow-chemistry models that better describe and predict air-snow interactions is considerable given that the chemistry proceeds via multiple steps, the snow is highly heterogeneous, and the number of important trace gases and radicals is numerous. The outcome of the Columbia University workshop will be a joint special issue in Atmospheric Chemistry and Physics and Earth System Data on "New Perspectives on Air-Ice Chemical Interactions."

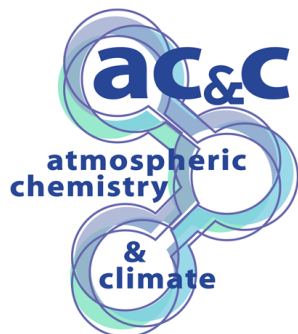
- **Air Pollution & Climate: A Science-Policy Dialogue** An IGBP Synthesis Topic



As part of its second phase synthesis activities, the IGBP has identified several key areas which cut across research in its own core projects and which also reach out beyond IGBP with the aim of exploring future cross disciplinary research needs. The IGBP Air Pollution & Climate initiative, lead by IGAC, seeks to open a science-policy dialogue on the air pollution and climate change challenge. There is still a separation between air pollution and climate change in both the policy and scientific communities. This separation is reflected in the temporal and geographic scales of interest: air

pollution efforts focus on the near-term and the local and regional scales, whereas climate change efforts focus on the long-term and global scale. As with many issues, there also exists a divide between the scientific and policy communities that hinders communication and understanding. The aim of the Air Pollution and Climate Initiative is to break down these divides and clarify the synergies and trade-offs of research and mitigation efforts across a spectrum of air pollution and climate change policies. The next step of the initiative is to develop a Strategic Plan for an Integrated Program on Air Pollution and Climate that engages the international earth system science, social science, and policy communities to be released in 2013.

- **Bounding the Role of Black Carbon in Climate**



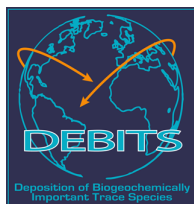
This focused effort is to produce an assessment report that summarizes the most current knowledge on black carbon (BC) and its role in climate as well as provide a best estimate and uncertainty range for the radiative forcing by BC. This effort results from a request for such an assessment by national and international groups trying to formulate policies to mitigate short-term climate warming. It is expected to constitute a direct input to the next Intergovernmental Panel on Climate Change (IPCC) Fifth Assessment Report (AR5), and has been structured to accommodate the IPCC framework.. The report was submitted to *Journal of Geophysical Research - Atmospheres* March 2012.

- **Chemistry-Climate Model Initiative (CCMI)**



CCMI is coordinating model evaluation and associated modeling activities between the domains of chemistry and climate dynamics. To best reflect current understanding, CCMI seeks to frame scientific inquiry in this arena through an integrated stratosphere-troposphere approach. These efforts are meant to culminate in increasingly accurate global atmospheric models and a well-informed IPCC Fifth Assessment Report (IPCC AR5). The first workshop for CCMI was held jointly between IGAC and SPARC on 21-25 May 2012 in Davos, Switzerland.

- **Deposition of Biogeochemically Important Trace Species (DEBITS) Wet and dry**



deposition of chemical species to the Earth's surface plays an essential role in controlling the concentration of gases and aerosols in the troposphere. The chemical composition of atmospheric deposition provides important information on many interacting physical and chemical mechanisms in the atmosphere such as emission sources, atmospheric dynamics and transport, atmospheric removal processes, and nutrient cycling in ecosystems. Long-term research on deposition thus provides critical information on natural and anthropogenic influences on the atmosphere and provides information on the temporal and spatial evolution of atmospheric chemistry. Phase I of DEBITS, which was initiated in 1990 under the first phase of IGAC, focused on the development of an international measurement network of stations to monitor the wet and dry deposition of biogeochemically important trace species. As a result of Phase I, DEBITS stations are of the highest data quality and assurance, following the WMO/GAW data quality objectives. In Phase II, the DEBITS science community has adopted a twofold approach to maintain the present operational structure of DEBITS and to support a new integrated approach to deposition flux measurements and impact studies. Despite the efforts of the DEBITS Task and other research, wet and especially dry deposition remains a large unknown in the chemical budget of the atmosphere. The IGAC SSC believes there is still a strong need for international collaboration and integration of research on atmospheric deposition, especially in implementing and maintaining long-term monitoring networks and understanding the chemical/physical properties of deposition.

- **Fundamentals of Atmospheric Chemistry**

Fundamental atmospheric chemistry research provides essential data used in all practical (laboratory, field measurements, remote sensing) and theoretical (climate modeling, pollution modeling, cloud microphysics) aspects of scientific endeavor. These studies encompass a diverse range of areas including gas-phase kinetics, heterogeneous chemistry, chamber studies, photochemistry, spectroscopic and thermodynamic chemical data, and meteorology that together, with the attendant measurement techniques, deliver the data and the constant evolution required to work in the atmospherically relevant physical and chemical regimes. The evolution of atmospheric chemistry research has resulted in more emphasis on field research and modeling than on fundamental research typically done in the laboratory. Therefore, laboratory studies for atmospheric chemistry stand at a crossroads. In many respects they are decreasing due to shifts in funding towards large field campaigns. Many of the pioneers and innovators of the last great paradigm shift have begun to retire and there is a risk of a shrinking community, yet the need remains the same if not more in light of challenges such as climate change, climate manipulation, and pollution-related health impacts. In response, IGAC is exploring the need for an initiative on Fundamentals of Atmospheric Chemistry that would stress the importance of continued fundamental research in atmospheric chemistry but that would explore innovative ways fundamental research could be sustained and possibly move from the laboratory bench to, for example, a component of field research.

- **Global Emissions IntiActive (GEIA)** Jointly sponsored by IGBP-iLEAPS, IGBP-AIMES For the



past two decades, GEIA (formerly know as the Global Emission Inventory Activity) has provided access to various global and regional emission inventories in a consistent framework, organized workshops that bring together inventory developers and users, prepared state-of-the-science emission summaries and provided these data to international scientific projects. The joint IGAC/iLEAPS/AIMES GEIA initiative seeks to build on the success of the past two decades by expanding the breadth of GEIAs activities in order to be a forum for exchange of expertise and information that unite the scientific, regulatory, and operational emission communities (see figure below). Under the new GEIA umbrella (<http://www.geiacenter.org/>), the well-respected GEIA emission inventory portal merged with the Emissions of atmospheric Compounds & Compilation of Ancillary Data (ECCAD, <http://eccad.sedoo.fr/>) portal. GEIA also includes the Community Initiative for Emissions Research and Applications (CIERA, <http://ciera-air.org/>), which works to facilitate the consistent, timely, and transparent development of emissions inventories at all scales, including evaluations and analyses of emission datasets, and the inter-operational exchange and communication of emissions information. Significant advances planned for the new GEIA are the introduction of new observations from space and from a variety of Earth-based platforms, and the incorporation of other emission efforts such as operational emissions that can be used for air quality forecasting.

- **Halogen in the Troposphere (HitT)** Jointly Sponsored by IGBP-SOLAS The primary objective



of the SOLAS/IGAC task HitT is to determine and quantify the importance of reactive halogen compounds (RHCs) in tropospheric chemistry and climate forcing. Key themes are the influence of RHC on the oxidative capacity of the atmosphere, the ozone budget, as well as in aerosol nucleation and growth. The goal of HitT is to facilitate international collaboration between laboratory, field, and model activities regarding tropospheric halogen chemistry especially in the following domains: polar regions, salt lakes, marine boundary layer (both remote and coastal), volcanoes, free troposphere, and urban areas. Since HitT was first endorsed as an IGAC Activity in 2007, halogens in the troposphere has become a very active research field publishing special issues in Atmospheric Chemistry and Physics on "Radical Chemistry over sunlit snow: interactions between HOX and halogen chemistry at Summit, Greenland" and "The TransBrom Sonne ship campaign in the West Pacific." HitT also works closely with the AICI IGAC Activity as well as the international multidisciplinary OASIS program. The most recent workshop for this activity was held in Kiel, Germany 17-19 December 2012 (see below).

- **Interdisciplinary Biomass Burning Initiative (IBBI)**
Jointly Sponsored by WMO and IGBP-ILEAPS

Biomass burning changes the land surface drastically and leads to the release of large amounts of trace gases and aerosol particles that play important roles in atmospheric chemistry and climate. In addition, 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 of future atmospheric composition. Therefore biomass burning and its emissions need to be observed and modeled accurately for understanding the composition of the atmosphere and how it changes at different temporal and spatial scales.

Significant gaps remain in our understanding of the contribution of deforestation and savanna, forest, agricultural waste, and peat fires to emissions. Coordinated international activities organized by IGAC, iLEAPS, and WMO (e.g. interdisciplinary laboratory measurements and field campaigns that integrate ground-based and airborne observations as well as detailed analysis of satellite data and numerical modeling results) will help better quantify the present and future impact of biomass burning emissions on the composition and chemistry of the Earth's atmosphere. The first workshop to define this new activity was held at the WMO in Geneva, Switzerland 5-6 July 2012 (see below).

- **WMO/IGAC Impacts of Megacities on Air Pollution and Climate**

Jointly Sponsored by the World Meteorological Organization

As of 2008, for the first time, the majority of the world's population is living in urban areas, many in megacities (with populations over 10 million). Megacities are not only the center of growing economies, but are also large sources of air pollutants and climate-forcing agents. Under this initiative an assessment has been written that for the first time summarizes the current knowledge around atmospheric chemistry in megacities in Africa, Asia, South America, North America, and Europe. The assessment also summarizes past and current research projects on this topic such as MEGAPOLI, CityZen, ICARTT, CalNex, MILAGRO, CareBeijing, PRIDE-PRD, and IMPACT. Finally the report will identify knowledge gaps on atmospheric chemistry in megacities. IGAC plans to provide updates to this assessment every 4 to 5 years. The report was printed and distributed through WMO in 2012.

National/Regional Working Groups

There are many regions of the world where there are many great scientists but often their research is conducted very independently and their results often don't reach the international community. However, as atmospheric chemistry research questions and their connections to societal issues become more global, there is a strong desire to engage these scientists in order to incorporate their research and local knowledge of these regions of the world. Therefore, the goal of IGAC National/Regional Working groups is two fold; one is to create a strong cohesive community of atmospheric scientists in a specific nation/region that together would have a sum greater than its parts, and the second is to connect the regional/national working groups to the larger IGAC community in order to foster international collaboration.

- **Americas Working Group**

Under the guiding principle of providing equal opportunity for all scientists in the Americas, the IGAC Americas Working Group aims to build a cohesive network and foster the next generation of atmospheric scientists with the ultimate goal of contributing to development of a scientific community focused on building collective knowledge in/for the Americas. There is a priority on bringing together scientists from across the entirety of the Americas. To this end, the Americas Working Group seeks to:

- Improve the collaboration and communication between scientists in Latin America
- Connect the Latin America community to the international community
- Train and foster the next generation of scientists
- Influence and promote a more proportionate distribution of funds for research
- Enhance visibility and credibility of scientists in Latin America

- **China Working Group**



The sheer magnitude of China's landmass coupled with its growing and economically advancing population makes it critical to understand its role in air quality and climate on both regional and global scales. Chinese atmospheric chemists have been conducting frontier research for forty years in areas such as urban and regional air pollution and the climate effects and health impacts of air pollution. IGAC intends to more fully integrate Chinese research experience by establishing its first national working group in China. The goals of the IGAC China Working Group are to:

- Encourage participation of Chinese atmospheric scientists to engage their leadership in international atmospheric chemistry research programs;
- Strengthen ties with IGAC to facilitate the implementation of IGAC related research projects and tasks in China;
- Provide advice or consultation on major research plans in atmospheric chemistry in China to promote funding support;
- Promote academic exchange on atmospheric research in China and internationally, especially with IGBP China Working Groups; and
- Provide a platform in China to facilitate the academic growth and development of young researchers in atmospheric chemistry.

- **India Working Group**

India has been involved in atmospheric chemistry research for over two decades, with atmospheric scientists conducting pioneering research in the field of atmospheric chemistry. The scale of the scientific output from India, however, is highly contradictory to the country's global relevance in atmospheric chemistry, a relevance accelerated by increasing emissions from rapid industrialization and urbanization. The vast geographical extent of India, its growing and economically advancing population, and the role of distinct and cyclic seasons makes it "imperative and precarious" that we make efforts in combining these issues to better understand their role in air quality and climate at a regional scale. Further, we must initiate conclusive efforts in the right direction, a current caveat due to isolated efforts of the scientific community in India. The goal of the India Working Group is to bring the Indian atmospheric chemistry community together to enhance scientific coordination and output from India, while simultaneously improving the scientific understanding of this region of the world at an international level.

Workshops

IGAC has co-sponsored the following workshops in 2012-2013.

- **5-6 July 2012, IGAC/iLEAPS/WMO Workshop on Biomass Burning, Geneva, Switzerland**

This workshop at the WMO Headquarters gathered 20 participants from 11 countries, each representing different topics linked with the impact of fires on the Earth system, to discuss the formation of an international and interdisciplinary activity on biomass burning. The workshops presentations and discussions emphasized the fact that fires are an integral part of the Earth Systems, and that their atmospheric and radiation impacts, as well as socio-economical and ecological impacts need to be analyzed in an integrated way. In order to make progress in this field, the

discussions identified emerging directions for fire research and offered first insights for the focus of the future activity on fires.

- **15-19 October 2012, A U.S. - Japan Workshop on the Tropical Tropopause Layer, Honolulu, HI, USA**
Here 50 participants gathered at the East-West Center of the University of Hawaii to discuss the Tropical Tropopause Layer (TTL). Nearly 20 of the participants were graduate students and young scientists. The workshop summarized the current state of understanding of the TTL with tutorial presentations, summarized and formulated key questions surrounding the TTL, and discussed and coordinated observations planned over the next few years in the tropical Pacific region.
- **11-13 December 2012, SOLAS/IGAC Workshop on the role of marine gel for the emission of primary organic aerosols from the ocean, Kiel, Germany**
This workshop convened 15 participants to form a deeper understanding of the biogenic sources of primary organic aerosol from the ocean, their chemical composition and of their physical properties. The attendees identified priority questions needing to be addressed by the community, some potential controversies on the topic, and a way forward to fill the knowledge gaps.
- **17-19 December 2012, SOLAS/IGAC Halogens in the Troposphere (HitT) Workshop, Kiel, Germany**
For this workshop, 25 attendees assessed current knowledge surrounding the relevance and also atmospheric reaction cycles of natural chlorine in the troposphere. Participants identified areas where a deficit in understanding existed; discussed the potential for new advances in atmospheric detection, laboratory studies, and modelling; and designed observational strategies to improve understanding of photochemical processes and assess the impact of chlorine chemistry on the marine boundary layer.
- **28-30 January 2013, First IGAC Americas Working Group Workshop, Bogota, Colombia**
At this preliminary workshop, 24 participants from 16 countries across the Americas joined to address questions on the current state of research and funding mechanisms in their respective countries, the institutions in place, and the scientific needs of each participant nation. The workshop culminated in a perspective piece on "Atmospheric Chemistry: Scientific Needs and Questions in Latin America," as well as the formation of an Implementation Committee tasked with laying the foundation for the IGAC Americas Working Group.
- **1-3 May 2013, International Workshop on Changing Chemistry in Changing Climate (C4): Monsoon Focus, Pune, India**
This workshop is bringing over 20 participants together to address topics ranging from new insights in variability of atmospheric chemistry through observations and processes to key opportunities and major challenges in prediction and predictability of air quality. The workshop is fostering a collaborative effort between international scientists and those working on the Indian sub-continent. From the workshop is expected to come a consensus on linkages between atmospheric chemistry, climate change and the Asian monsoon.
- **13-17 May 2013, SPARC/IGAC Chemistry Climate Model Initiative (CCMI) Workshop, Boulder, CO, USA**
This workshop will bring international scientists together to discuss current CCMI model evaluations and simulations meant to address emerging science questions, improve process understanding, and support upcoming ozone and climate assessments.

Open Science Conferences

IGAC's biennial Open Science Conferences are the primary mechanism for dissemination of scientific information across our community. The conference is held jointly with iCACGP quadrennially. A special effort is made to engage young and developing country scientists. Since 2004 we have had a Young Scientists Program as an integral part of the conference. The following Open Science Conferences were held between 2009 and 2012.

- 17-21 September, 2012, Atmospheric Chemistry in the Anthropocene, Beijing, China**
 The 12th IGAC Science Conference was held at the China National Convention Center in Beijing, with a theme of Atmospheric Chemistry in the Anthropocene to address the critical interactions between the atmosphere and human activities in an era when humans have fundamentally altered the composition and chemistry of our atmosphere. Greater than 500 scientists and students from more than 40 countries, including over 100 scientists, were in attendance. The conference had six sessions: 1) Atmospheric Chemistry in the Anthropocene; 2) Atmospheric Chemistry and Megacities; 3) Atmospheric Chemistry and Climate; 4) Atmospheric Chemistry and Health; 5) Atmospheric Chemistry and Surface-Atmosphere Exchange; 6) Atmospheric Chemistry Fundamentals. The conference included keynotes, 12 invited and 60 submitted oral presentations, and poster sessions during which conference participants discussed the 400 posters on display. The conference included live webcasting of all oral presentations. To encourage growth in the field of atmospheric chemistry, the conference supported 54 young scientists to participate in the conference. The Young Scientists Program Committee was formed, which planned activities including an icebreaker with the IGAC scientific steering committee, young scientist excursion to the Summer Palace, young scientist - senior scientist mixer, and a young scientist visioning meeting. One hundred young scientists attended the Young Scientists Program keynote talk. The young scientist poster competition was held throughout the conference, with six best poster awards presented.

Communications/Networking

- IGAC Newsletter**

IGAC continues to produce a scientific newsletter on a four-month basis that is distributed internationally to ~3,000 scientists. While many peer-reviewed publications result from IGAC Activities, the primary product resulting directly from this grant is the IGAC digital newsletter. Megan L. Melamed (funded under this grant) is fully responsible for planning newsletter issues, recruiting article authors, and editing of the newsletter. A graphic designer at the University of Washington, Dept. of Atmospheric Sciences, is paid under this grant to do article layout. All past issues of the newsletter (now numbering 47 in total) are downloadable from the IGAC web page.

- IGAC Website**

<http://igacproject.org/>

This past year a primary focus of the IGAC International Project Office was to redesign the IGAC webpage. The web site highlights IGAC's current activities, conferences, workshops, and IGAC related events. In order to enhance networking, we have two new special features: a listing of job openings related to atmospheric chemistry and an events calendar. It is our goal to create an interface that is more accessible for the international IGAC community.

- IGAC Mailing List**

IGAC this past year launched a new email based mailing list that gives individuals control over how much they want to hear from IGAC. Community members can choose to receive a hard or digital copy of our newsletter or can decide to keep in closer touch with the IGAC community by signing up to be notified of upcoming IGAC related conferences, workshops, and other grand gatherings.

Journal Articles

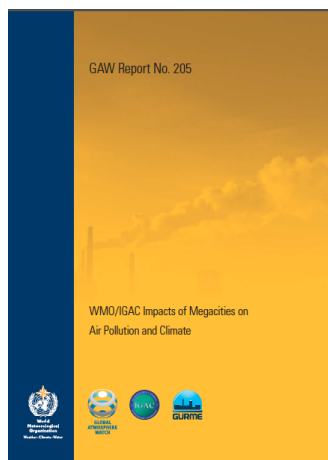
- 2012**
- The Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP) Special Issue (2012) Eds. M. Dameris, D. Spracklen, and H. Tost. *Atmos. Chem. Phys. Discuss.*
- New perspectives on Air-Ice Chemical Interactions (AICI) Special Issue (2012) Eds. V. F. McNeill, E. Wolff, T. Bartels-Rausch, and H. Pfeiffenberger. *Atmos. Chem. Phys. Discuss.*

- Atmospheric Chemistry of Iodine (2012) Saiz-Lopez, A., J. M. C. Plane, A. R. Baker, L. J. Carpenter, R. von Glasow, J. C. Gmez Martn, G. McFiggans, R. W. Saunders. *Chem. Rev.*, 112 (3), pp. 1773-1804. doi: 10.1021/cr200029u.
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- **2013**
- The Atmospheric Chemistry and Climate Model Intercomparison Project (ACCMIP) Special Issue (2013) Eds. M. Dameris, D. Spracklen, and H. Tost. *Atmos. Chem. Phys.*
- Bounding the role of black carbon in the climate system: A scientific assessment (2013) Bond, T.C., S.J. Doherty, D.W. Fahey, P.M. Forster et al. *J. Geophys. Res.-Atmos.*, DOI 10.1002/jgrd.50171.
- Megacities and Large Urban Agglomerations in the Coastal Zone: Interactions Between Atmosphere, Land, and Marine Ecosystems (2013) von Glasow et al. *AMBIO* 42:1328, DOI 10.1007/s13280-012-0343-9.

Major Publications

- **WMO - IGAC Impacts of Megacities on Air Pollution and Climate**

This impact assessment, a joint effort between the World Meteorological Organization (WMO) and IGAC, details the unique challenges that urban areas pose to air quality and climate now and in the coming decades. Emphasis is on an assessment of the state of information regarding air pollution in megacities across five continents, including an integrated analysis for North America. An overview of current international collaborative research, key issues and a broad outlook are also discussed.



- **Bounding the role of black carbon in the climate system: A scientific assessment**

This assessment, co-authored by 29 scientists and the summation of a four-year effort compiling over 200 pages, serves as the first quantitative and comprehensive analysis of black carbon. The report finds black carbon to be the second largest man-made contributor to global warming with an influence on climate that has been greatly underestimated. The landmark study published in the *Journal of Geophysical Research-Atmospheres* states the direct influence of black carbon, or soot, on warming the climate could be about twice previous estimates. The assessment's release was met with international media attention from the most prolific news organizations globally.

4 Contributions

The role of the IGAC Project is twofold. Its first responsibility is to coordinate and foster atmospheric chemistry research at an international level. Although IGAC does not conduct research, it does provide an “added value” to atmospheric chemistry research. Examples of this are facilitation of international collaboration for research field campaigns, which means that scientists funded at the national level gain access to resources, knowledge, and coordination thus getting more “bang for their buck” from their research grants, e.g. AICI. IGAC also has organized international efforts to address research needs in specific regions of the world, e.g. AMMA-AC, or on specific topics in atmospheric chemistry, e.g. the IGAC/iLEAPS/GEWEX ACPC initiative. In addition, IGAC coordinates the synthesis, assessment, and summary of research that would otherwise not occur, e.g. the *Bounding the Role of Black Carbon* as part of the IGAC/SPARC AC&C initiative. IGAC, through the Atmospheric Chemistry & Climate (AC&C) initiative is contributing to the IPCC assessment process by providing key bounds on the role of aerosols in radiative forcing and for the first time providing model estimates of radiative forcing by short-lived species across a suite of models following a unified framework. IGAC also has a strong focus on engaging the next generation of young atmospheric scientists by providing travel grants to IGAC co-sponsored workshops, meetings, and conferences as well as highlighting their work in the IGAC newsletter. Therefore, from early in their careers, these young scientists join an international network of atmospheric scientists that will further facilitate atmospheric chemistry research at an international level.

IGAC's second responsibility is to act as a liaison between the atmospheric chemistry community and the broader Earth System Research community. As part of the IGBP, IGAC contributes to understanding the current state of knowledge of the Earth System and identifying the most pressing issues in the Earth System. IGAC facilitates integrative research and synthesis efforts that leverage atmospheric chemistry research to address larger Earth System questions, e.g. Global Emissions Initiative (GEIA). In addition, IGAC publishes books such as the IGAC/WMO *Impacts of Megacities on Air Pollution and Climate* that can reach a wider audience than individual papers published in atmospheric chemistry journals. IGAC also works to reach across the aisle into different disciplines in order to bridge the divide between scientific experts, i.e. the IGAC Atmospheric Chemistry & Health (AC&H) initiative. Finally, IGAC is also engaging stakeholders in order to address the most pressing issues of our time with activities such as the IGBP Air Pollution & Climate: A Science-Policy Dialogue initiative. Through its activities, IGAC provides an invaluable service to the international atmospheric chemistry community, the wider Earth System Research community, and to stakeholders both by advancing atmospheric chemistry research and contributing to understanding of the Earth System.