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IGACnews

coordinating and fostering atmospheric chemistry research towards a sustainable world

issue 54
april/may 2015

WORKSHOP SUMMARY

Arctic Air Pollution

» SCIENCE FEATURE
The Great Acceleration

» EARLY CAREER PROFILE
Sarah Monks on what she thinks is the most pressing issue in Arctic air pollution research

iCACGP
GLOBAL IGBP CHANGE

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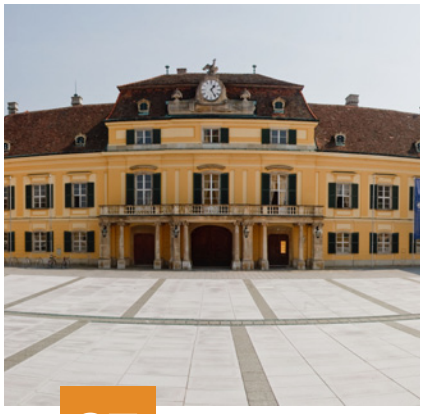

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Editor: Megan L. Melamed
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IGAC was formed in 1990 to address growing international concern over rapid changes observed in Earth's atmosphere. IGAC operates under the umbrella of the International Geosphere Biosphere Programme (IGBP) 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.

Cover photo courtesy of Julie Cozic.

IGAC Developments

initatives, sponsorships, workshops, and much more...

Welcome to the redesigned IGACNews! The goal of the redesign is to help the reader better understand what IGAC is and how it functions. In each issue of IGACNews, I will use this space to inform the community about recent IGAC developments and how they link to the articles presented in IGACNews.

Throughout IGACNews there are several articles focused on Arctic air pollution. IGAC is currently working with the community to develop a new Arctic air pollution initiative. The new initiative will build on previous activities, in particular POLARCAT-IPY that was sponsored by IGAC and summarized in Law et al., 2014. The first workshop to develop this initiative was held in February 2015 and is summarized in this issue of IGACNews. Sarah Monks, an early career scientist that attended the Arctic air pollution workshop, is profiled in this issue. IGAC looks forward to the development of a strong international initiative on Arctic air pollution.

Another area of focus for IGAC is Fundamentals of Atmospheric Chemistry. Last spring, IGAC did a call for proposals on workshops related to this topic. IGAC received thirteen proposals and was unfortunately only able to provide financial support for two of those proposals. However, the proposals were so strong, that IGAC sought to endorse the workshops that would still take place in spite of not receiving financial support from IGAC. In this issue, two such workshops are summarized, one on OH reactivity and another on chemical mechanisms.

IGAC continues to have a strong focus on building an international network of scientists whose sum is greater than its parts. This was exemplified in March 2015 at a workshop aimed at developing a framework for cooperation throughout Asia for the atmospheric sciences community. A summary of this workshop appears in this issue.

In addition to representing the international atmospheric chemistry community, IGAC also contributes to understanding the Earth system by collaborating with other core projects and its parent organization the International Geosphere-Biosphere Programme (IGBP). In this issue, the science feature, written by form IGBP Deputy Director Wendy Broadgate, brings together Earth system and socio-economic trends to indicate that since the 1950's a great acceleration of human impacts on the Earth system has occurred.

Finally, I hope other IGAC related organizations/events take advantage of the Open Section of IGACNews. In this issue HTAP summaries a workshop on global air pollution and emission scenarios.

I hope you enjoy reading the new design! Please do not hesitate to provide me with questions or comments on how to make IGACNews better.

MEGAN L. MELAMED
IGAC Executive Officer
megan@igacproject.org

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.

IGAC Says Goodbye to Paul Monks as IGAC Co-Chair

Paul Monks from University of Leicester, UK served on the IGAC SSC as a member from 2008-2009 and then as co-chair from 2010-2014. To list all of Paul's contributions to IGAC would take up an entire IGAC News, so we will just highlight a couple here. Paul's leadership has led IGAC into its third phase of enhancing its connection between strong laboratory, field and modeling studies on emissions, atmospheric processes and atmospheric composition to the larger global change and sustainability community. Paul has been lead author or co-author on numerous IGAC publications including but not limited to Atmospheric Composition Change – Global and Regional Air Quality (2009), Impacts of Megacities on air Pollution and Climate (2012), Fundamentals of Atmospheric Chemistry: Keeping a three-legged stool balanced (2013), and is also leading an effort to synthesize the efforts of IGPB to underpin Earth system science research over the last 25 years through its core projects. On behalf of the entire IGAC community, we thank Paul for his excellent leadership, scientific insight, uncanny ability to eloquently summarize meetings and of course his funny jokes. If you happen to cross paths with Paul, please thank him for his service and leadership on the IGAC SSC.

IGAC Welcomes Mark Lawrence as the new IGAC Co-Chair

Mark Lawrence from the Institute for Advanced Sustainability Studies (IASS), Germany will replace Paul as co-chair of the IGAC SSC. Mark has served on the IGAC SSC since 2010 and in that time has consistently shown strong leadership and a dedication to IGAC's vision.

Arctic Air Pollution:
New Insights From POLARCAT-IPY


ARCTIC AIR POLLUTION
New Insights from POLARCAT-IPY

POLARCAT provided a wealth of data on the concentrations and sources of short-lived climate pollutants (aerosols, ozone) and their precursors in the Arctic.

A review paper is recently out in BAMS (**Law et al., 2014**) which highlights findings from the international POLARCAT (Polar Study using Aircraft, Remote Sensing, Surface Measurements and Models, Climate, Chemistry, Aerosols and Transport) project which was an IGAC task and International Polar Year (IPY) activity (2006-2014) and coordinated by Andreas Stohl (NILU) and Kathy Law (LATMOS/CNRS/UPMC/UVSQ). It was also co-sponsored by iLEAPS and SPARC. POLARCAT's main goal was to improve understanding about the origins of air pollution transported to the Arctic. The review highlights results based on more than 85 papers published on POLARCAT results including analysis and modeling of data collected during POLARCAT aircraft, ship and ground-based field campaigns in spring and summer 2008. Major findings center around origins and transport of pollution to the Arctic, processes governing aerosol composition and their impact on climate, chemical processes governing tropospheric ozone, and the role of boreal forest fires compared to anthropogenic pollution. Areas requiring further investigation are also highlighted.

next steps

SEE Arctic Air Pollution summary on p. 14

IGAC Says Goodbye to Three SSC Members

At the end of 2014, IGAC sadly said goodbye to three IGAC SSC members: **Jon Abbatt** from the University of Toronto, Canada; **Olga Mayol-Bracero** from the University of Puerto Rico, Puerto Rico; and **Rokjin Park** from Seoul National University, Korea. Jon Abbatt spearheaded the IGAC activity on Fundamentals of Atmospheric Chemistry and also provided important insight to research in the polar regions. Olga Mayol-Bracero was a key leader in the formation of the IGAC Americas Working Group and provided important insight on atmospheric chemistry research in the Caribbean. Rokjin Park helped to guide IGAC toward developing collaborations within Asia. Although IGAC will miss the participation of these three exemplary scientists on the SSC, IGAC looks forward to their involvement in IGAC Science Conferences and activities for years to come.

IGAC Welcomes Five New SSC Members

As of January 2015, IGAC is pleased to welcome five new members to its scientific steering committee (SSC).

J.P. (Paul) Beukes
North-West University, South Africa

PAUL BEUKES is a Chief Research Scientist at the North-West University (NWU), Potchefstroom Campus, South Africa. He received his PhD (Chemistry) in 1999 from the then Pothefstroom University for CHE. Paul worked in the metallurgical industry for almost a decade after completing his PhD, holding various senior positions such a production manager and operations manager at large ferrochromium smelters. In late 2007 he returned to academia and is currently co-managing the Atmospheric Chemistry Research (ACRG) and Chromium Technology groups (CTG) at the NWU. The ACRG focuses on in-situ atmospheric measurements, but research related to laboratory investigations, satellite observations and modelling is also conducted, while the CTG concentrate on metallurgical process improvements with associated atmospheric and/or other environmental co-benefits, e.g. reduced energy consumption, carbon footprint and atmospheric emissions. Paul is a South African National Research Foundation (NRF) rated scientist.

James Crawford
NASA, USA

JIM CRAWFORD received his B.S. in Mathematics from the United States Military Academy in 1986 and his Ph.D. in Atmospheric Chemistry from the Georgia Institute of Technology in 1997. Since that time, he has been a research scientist at NASA's Langley Research Center. From the start of his graduate studies in 1991 and throughout his career, his research has been associated with airborne field studies conducted across the globe by NASA's Tropospheric Chemistry Program and collaborating partners. His interests include the photochemistry of tropospheric ozone and free radicals, the global budget of reactive nitrogen, the influence of clouds on trace gas transport and chemistry, and the use of satellites to study long-range pollution transport and air quality. Most recently, he has served as the principal investigator for an air quality focused field study (DISCOVER-AQ) aimed to improve the diagnosis of surface air quality conditions from satellite observations. He currently serves as the Atmospheric Chemistry Editor for the Journal of Geophysical Research - Atmospheres. He is also co-lead of the recently formed IGAC/SPARC joint activity on Atmospheric Composition and the Asian Monsoon (ACAM).

Michel Grutter
UNAM, Mexico

MICHEL GRUTTER is professor at Universidad Nacional Autónoma de México (UNAM) in the Earth Sciences Undergraduate and Graduate programs. He is Head of the Department in Atmospheric Observation and Instrumentation at the Center of Atmospheric Sciences and leads an active research group in the field of spectroscopy and remote sensing. His main research areas are aimed to detect and characterize changes in the Earth's composition by means of optical methods, using primarily Fourier-Transform InfaRed (FTIR) spectroscopy and Multi-AXis Differential Optical Absorption Spectroscopy (MAX-DOAS). He is part of the Infrared Working Group (IRWG) in the Network for the Detection of Atmospheric Composition Change (NDACC) and participates in the validation of satellite products (science team member of the TEMPO mission and participant in a TROPOMI-S5P validation initiative). Currently, he is coordinating a project in Mexico to establish a university network of atmospheric observatories nationwide to foster multidisciplinary collaboration and education in atmospheric sciences.

Alastair Lewis
University of York, UK

ALASTAIR LEWIS is currently professor of atmospheric science at University of York and Science Director at the UK National Centre for Atmospheric Science. He is a Fellow of the Royal Society of Chemistry and has held their John Jeyes lectureship in Environment, Energy and Sustainability. Alastair's research expertise is in reactive atmospheric chemistry, particularly that of organic compounds in the troposphere and their role in health, ozone and aerosols. He is active in the development of instruments for atmospheric measurements, and the associated chemical metrology, using chromatographic, mass spectrometric and sensor based methods. Alastair is a member of the WMO-GAW science advisory group on reactive gases and works with industry and government on the assessment of hazardous chemicals in the environment.

Kim Oanh
Asian Institute of Technology, Thailand

KIM OANH is a professor at Environmental Engineering and Management (EEM), Asian Institute of Technology (AIT), Thailand. She got Dipl. Eng. in Meteorology (1978) from Odessa Hydrometeorology Institute, Ukraine; M. Eng. (1991) and Dr. Eng. (1994) in Environmental Technology and Management from AIT, Thailand. Currently, her professional interest also extends to include short-lived climate pollutants (SLCP), and co-benefit quantification for source emission reduction. Under her supervision as of 2015 there are 110 master and 11 Ph D AIT graduates who are specialized in research on air pollution and atmospheric science. She published 2 books (ed), and authored/co-authored 9 monographs, 34 book chapters; 72 peer-reviewed papers in international referred journals; and a number of conference papers and keynote presentations. Her publications are found at: **https://www.researchgate.net/profile/Nguyen_Thi_Oanh**. With her extensive experiences and professional connections for international networking she has conducted, in capacity of PI or Co-PI, more than 30 regional research projects. Her detail profile is found at: **http://www.asdu.ait.ac.th/interimcodes/faculty/FacultyByID.cfm?FacultyID=145**.

Save the Date!

The 14th biennial IGAC Science Conference will be held 26-30 September 2016 in Breckenridge, CO USA. The Local Organizing Committee is chaired by Christine Wiedinmyer (NCAR, Boulder, CO, USA). The Scientific Programme Committee is co-chaired by IGAC SSC members Claire Grainer (LATMOS, Paris, France and NOAA CSD/CU CIRES, Boulder, CO) and Hiroshi Tanimoto (NEIS, Japan). Please stay tuned for more details at **www.igac2016.org**!

IGAC moves to e-bulletins

Tired of seeing too many emails from IGAC in your inbox? We listened and IGAC will now send an e-bulletin for most announcements on the first of each month. The e-bulletins include information on upcoming IGAC sponsored and IGAC related events, IGAC publications and information regarding the larger Global Environmental Change community. With the introduction of e-bulletins, IGAC will no longer be sending individual emails for non-IGAC Sponsored or Endorsed events. If you would like an event or anything else to be included in the IGAC e-bulletin, please email **info@igacproject.org** and we will include it in the next monthly e-bulletin.

Submit Articles to the next IGAC newsletter

IGAC is now accepting article submissions for the next IGAC News. 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 a maximum of 1 image. Please provide high-resolution image files. The deadline for submissions for the June/July issue of the IGAC Newsletter is 29 May 2015. 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**.

IGBP @ AGU

The International Geosphere-Biosphere Programme is planning a series of events at the 2015 AGU Fall Meeting to celebrate our past and to transition to Future Earth. We invite all our networks and partners to participate.

PLANNED EVENTS AND ACTIVITIES

(dates to be confirmed)

- Union session/Great Debate
- IGBP and projects integrated sessions
- Young scientist event
- Booth and networking event
- Evening reception recognising and celebrating the people and projects that made IGBP a success for three decades

THE EVENTS ARE DESIGNED TO:

- present IGBP's second Earth-system synthesis
- bring together IGBP's projects, networks, partners and staff past and present
- celebrate the legacy of IGBP and our transition to Future Earth

IMPORTANT DATES

AGU Session proposals open: mid-February
AGU Abstract submission open: June

GLOBAL CHANGE IGBP International Geosphere-Biosphere Programme

AGU American Geophysical Union

FOR MORE INFORMATION

admin@lgbp.kva.se

www.igbp.net

fallmeeting.agu.org

@IGBPComms

Please forward to your networks and let us know if you plan to attend AGU2015.

We will be in touch throughout 2015 with updates and more information.

Chemical Atmosphere-Snow-Sea Ice Interactions (CASSII) Workshop

13 to 15 October 2014
Cambridge, UK

IGAC Sponsored

AUTHOR
Markus M. Frey, British Antarctic Survey, Cambridge, UK

HOST

TRINITY HALL CAMBRIDGE

FUNDING

NATURAL ENVIRONMENT RESEARCH COUNCIL

British Antarctic Survey
NATURAL ENVIRONMENT RESEARCH COUNCIL

PARTICIPANTS
Australia, Austria, Belgium, Canada, Czech Republic, Denmark, France, Germany, Japan, South Korea, Spain, Sweden, Switzerland, The Netherlands, UK and USA

BACKGROUND

The CASSII workshop was financially sponsored by IGAC and was part of the IGAC activities OASIS and AICI, which aim to increase knowledge on atmospheric chemistry at the air-ice/snow/ocean interfaces.

Autumn colors at Trinity Hall — where the CASSII workshop was held — one of the oldest Colleges of Cambridge University, founded in 1350.

More than 60 scientists from 15 countries in Europe, North America and Asia gathered last October in Cambridge (UK) for a 3-day workshop on Chemical Atmosphere-Snow-Sea Ice Interactions. The meeting objectives were to discuss research status and future science priorities of a highly inter-disciplinary field of research, which is being fostered by the IGAC activities AICI (Ice Air Chemical Interactions) and OASIS (Ocean – Atmosphere – Sea Ice - Snowpack). CASSII was organized locally by the British Antarctic Survey and generously sponsored by IGAC and EGU to enable the participation of 15 early career scientists.

Within the AICI/OASIS community it is now recognized that the air-snow-sea ice system plays an important role in the global cycling of nitrogen, halogens, trace metals or carbon, including greenhouse gases (e.g. CO_2 air-sea flux), and therefore may also influence climate.

PHOTO COURTESY MARKUS M. FREY, DURING THE N-ICE-2015 WINTER CRUISE

Frost flowers forming on a refrozen open lead in the Arctic sea ice zone at 83°N. Frost flowers are important air-ice interfaces, which are many times more saline than sea water.

Its impact on atmospheric composition is illustrated by dramatic ozone and mercury depletion events that occur within or close to the sea ice zone (SIZ) mostly during polar spring and are catalyzed by halogens released from SIZ ice, snow or aerosol. Recent field campaigns in the Arctic and Antarctic highlight the importance of the SIZ as a biologically active area and as a chemical reservoir and reactor, even during polar night. The growing literature on lab experiments and field studies allows to develop and improve parameterizations of processes at the snow grain or even molecular scale for use in regional or global climate models. But to date climate models with coupled snowpack or sea ice chemistry are still in their infancy. The research of the past 15 years has been reviewed recently in two AICI special issues of *Atmospheric Chemistry and Physics* (ACP 2007 & 2013).

Much progress has been achieved since the inception of OASIS in 2002. However, large uncertainties remain regarding the regional or global impacts of air-ice-ocean chemical exchange processes, e.g. their role in the natural variability of tropospheric ozone, for the surface energy budget or for cloud formation in the high latitudes. More research is needed to understand chemical species and processes involved, the role of ice microbial communities as chemical sinks or sources, as well as feedbacks with a very dynamic snow and ice environment, which is currently undergoing rapid change. For example, the sources of reactive halogens (e.g. bromine and iodine) and of their precursor species such as organic halogens are still poorly known, but are important to assess the variability of polar tropospheric ozone or quantify linkages to the formation of cloud condensation nuclei and clouds. Complex questions are impossible to answer within a single scientific discipline, hence it will be critical to better integrate the communities of atmospheric and cryospheric sciences as well as oceanography. This can be achieved for example through special sessions or town hall meetings at scientific conferences, but also by better publicizing of ongoing projects, collaboration opportunities or an "expert" directory. For further detail see the scientific program and list of attendees of CASSII at **http://www.antarctica.ac.uk/about_bas/events/cassii2014/index.php**.

First TOAR Workshop

10-11 December 2014
Boulder, CO, USA

IGAC Sponsored

AUTHOR
Owen Cooper, CIRES, University of Colorado and NOAA/ESRL/CSD, Boulder, CO, USA

HOST INSTITUTION AND FUNDING

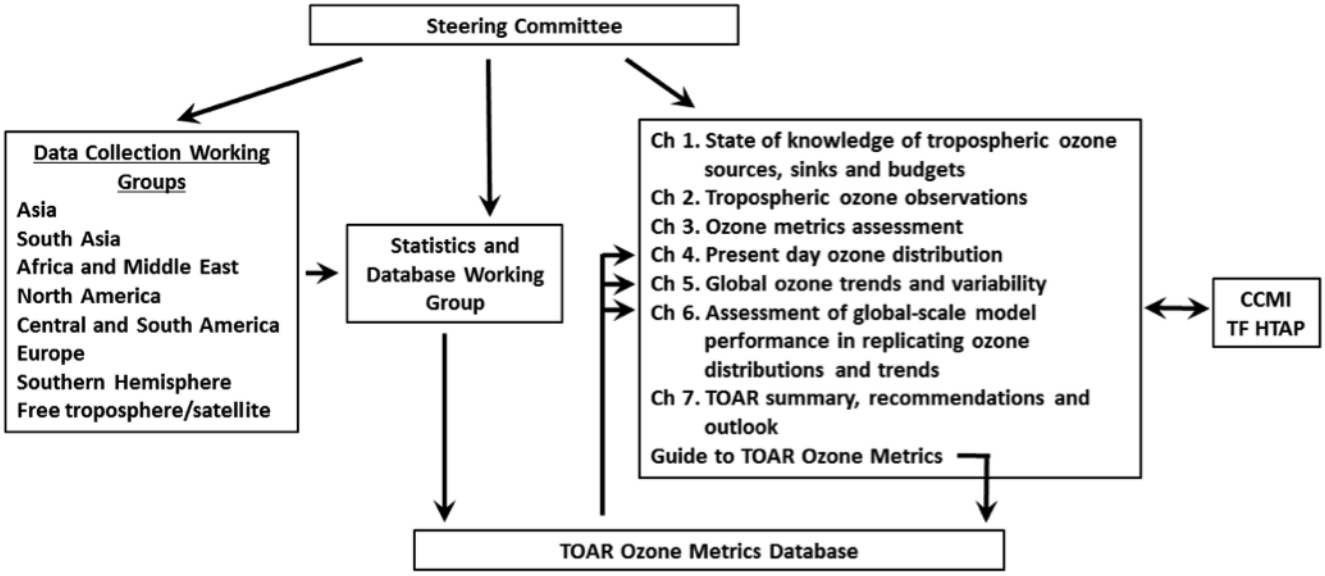
PARTICIPANTS
Canada, China, Germany, Greece, India, Italy, UK, and USA.

BACKGROUND

This workshop was financially sponsored by IGAC in order to support the IGAC activity TOAR, which is writing a report on the global distribution and trends of tropospheric ozone that will include metrics for research on the impacts of tropospheric ozone on climate change, human health and crops/ecosystems.

Tropospheric Ozone Assessment Report (TOAR): Global metrics for climate change, human health and crop/ecosystem research, is a new Activity of the International Global Atmospheric Chemistry Project (IGAC). TOAR's mission is to provide the research community with an up-to-date scientific assessment of tropospheric ozone's global distribution and trends from the surface to the tropopause. In fulfilling this mission, TOAR has two primary goals: 1) Produce the first tropospheric ozone assessment report based on the peer-reviewed literature and new analyses; 2) Generate easily accessible, documented data on ozone exposure and dose metrics at hundreds of measurement sites around the world (urban and non-urban), freely accessible for research on the global-scale impact of ozone on climate, human health and crop/ecosystem productivity.

TOAR was proposed to the IGAC Scientific Steering Committee (SSC) by Owen Cooper, a research scientist at the University of Colorado's Cooperative Institute for Research in Environmental Sciences, based at the NOAA Earth System Research Laboratory (ESRL) in Boulder.



Work flow diagram of the assessment report.

Following the approval of the SSC on March 13, 2014, Dr. Cooper became the chair of TOAR and began to spread the word about this new Activity. Based on the response, Dr. Cooper invited a small group of international experts to Boulder, Colorado to participate in TOAR Workshop 1.01 (the first workshop of the first assessment report). The goal of the workshop was to turn the idea of TOAR into a fully functioning IGAC Activity by developing TOAR's structure and timeline. The workshop was funded by IGAC and the Chemical Sciences Division (CSD) of NOAA ESRL, and held in CSD's new third-floor Collaboratory, offering inspiring views of the Rocky Mountains rising above Boulder. The 15 workshop participants represented the USA, UK, Germany, Italy, China, Canada, and India. The outcome of this 2-day workshop is as follows:

a) TOAR is coordinated by an 11-member Steering Committee, chaired by Owen Cooper

b) The assessment report is targeted towards scientists, with an Executive Summary relevant to policy makers, and will consist of 7 Chapters (Figure 1), to be published as stand-alone peer-reviewed journal papers, linked by a special issue.

c) Forschungszentrum Jülich will host the TOAR database that will store hourly ozone observations from hundreds of surface and vertical profiles sites around the world. The database will make freely available to the research community a variety of ozone metrics calculated from the hourly data. These metrics will be relevant to studies of ozone's impact on climate, human health and crop/ecosystem productivity.

d) The enormous task of identifying the best urban and non-urban ozone time series around the world and uploading these data to the TOAR database will be accomplished by 8 regional working groups. Each working group will comprised of several resident experts who understand the strengths and limitations of ozone observations in each region.

e) The Statistics and Database Working Group is responsible for calculating the ozone statistics and metrics for each observation site.

f) TOAR Workshop 1.02, co-sponsored by the World Meteorological Organization (WMO) will take place at the Agencia Estatal de Meteorología (AEMET) in Madrid, Spain, April 28-30, 2015. There 60 participants will begin writing the assessment report chapters and building the database.

TOAR stakeholders include WMO, the World Health Organization and NOAA. For further information visit the **TOAR webpage**.

3-5 February 2015
Boulder, CO, USA

IGAC Sponsored

Arctic Air Pollution – Advancing Understanding in the Next Decade

AUTHORS

Sandy Starkweather, CU/CIRES and NOAA/PSD, Boulder, CO, USA

Jennie Thomas, Sorbonne Universités, UPMC Univ. Paris 06; Université Versailles St-Quentin; CNRS/INSU, LATMOS-IPSL, Paris, France

Kathy Law, Sorbonne Universités, UPMC Univ. Paris 06; Université Versailles St-Quentin; CNRS/INSU, LATMOS-IPSL, Paris, France

HOST INSTITUTION

University of Colorado Boulder

FUNDING

CIRES Cooperative Institute for Research in Environmental Sciences

IASC

PARTICIPANTS

France, UK, Germany, Finland, Norway, US, Canada, Japan

BACKGROUND

As a follow-up to the IGAC task POLARCAT, IGAC financially sponsored this workshop with the aim of starting a new initiative on Arctic Air Pollution. Although there are many networks and observation sites throughout the Arctic, few of them focus on air pollution. This new initiative aims to change this.

Participants of the Arctic Air Pollution Workshop.

More than 30 members of the research community gathered in Boulder, CO 3-5 February 2015 for a workshop to discuss future directions for internationally coordinated Arctic air pollution research over the next 10 years. Participants represented research institutes from Asia, Europe and North America; their science interests included both aerosols and trace gases with research expertise in campaign and long-term observations, global and regional modeling, and community-based observing.

Workshop objectives included but were not limited to:

- Discussing future directions in Arctic air pollution research and defining outstanding science questions related to air pollution emissions and their impacts on regional air quality, ecosystems (deposition) & climate;
- Discussing the creation of new international initiative on Arctic air pollution - complementary to on-going/planned initiatives (e.g. Year of Polar Prediction and Future Earth).

Identifying outstanding research needs that cannot be accomplished without international collaboration and cooperation was a main focus of discussions in order to address the overarching question: "What research would not be possible without international collaboration?" The organizing committee prepared a survey in advance of the workshop — it was distributed to all invitees and garnered 42 responses. These surveys revealed the diversity of community interests, how researchers are currently collaborating and what questions are most pressing to address in the next 10 years. The survey results served to guide the development of 3 progressive workshop sessions focused on:

- The Key Science Questions (requiring collaborative efforts)
- Advances and Needs in Technology and Modeling
- Building Collaborative Efforts for the Next Decade

The workshop utilized a world café input process to draw out the full diversity of perspectives around these themes, cross-pollinate concepts and identify the strongest conclusions. The majority of workshop attendees, including early career scientists, played a role in either facilitating round-table conversations or reporting back to the group. A final synthesis round concluded that a new international Arctic Air Pollution initiative would add substantial value and serve to raise the profile of this issue in the international arena. It would also serve to improve our understanding about impacts of emissions on air quality, climate and ecosystems.

Several science issues were highlighted as priorities in the coming decade:

- Improved understanding of the relative roles of local versus remote Arctic emissions including natural and anthropogenic sources and their response to past and future Arctic and global change;

The workshop utilized a world café input process to draw out the full diversity of perspectives around these themes, cross-pollinate concepts and identify the strongest conclusions.

SEE
Sarah Monks
Early Career Scientist Profile
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- Improved understanding of long-range transport, pollutant processing, scavenging, wet/dry deposition processes and improved representation in models;
- Improved understanding of current and projected impacts of emerging local Arctic pollution sources;

At the same time various approaches leading to improved understanding were also discussed:

- Extensive and sustained vertical sampling that is well-coordinated with surface-based sites, while targeted at process understanding importantly during poorly understood periods like polar night;
- Promotion of open access for scientific research in all areas of the Arctic as well as expanded platforms for sharing metadata (field campaigns, surface, satellite) and model outputs;
- Improved connectivity with Arctic communities and engagement in citizen science initiatives to increase sampling network, improve knowledge exchange and increase the relevancy of new understanding. Similar discussions were had about improved connectivity with industry and the regulatory community.
- Improved links at the science-policy interface including communication of the current state of knowledge, impacts of pollution, and mitigation options.

The workshop outcomes will be detailed in a short White Paper that will be published over the summer, which encapsulates the key conclusions from the workshop and provides a framework for the development of a new internationally collaborative Arctic Air Pollution research initiative, initially under the auspices of IGAC. An international steering committee for the new initiative is currently being established. Watch this space! IGAC

2-3 March 2015
Bangkok, Thailand

IGAC Sponsored

Planning Workshop for Developing a Framework for Cooperation Between IGAC Activities in Asia

AUTHORS

Hiroshi Tanimoto, Global Atmospheric Chemistry Section, National Institute for Environmental Studies, Tsukuba, Japan.

Nguyen Thi Kim Oanh, School of Environment, Resources and Development, Asian Institute of Technology, Bangkok, Thailand.

Mark G. Lawrence, Sustainable Interactions with the Atmosphere, Institute for Advanced Sustainability Studies, Potsdam, Germany.

HOST INSTITUTION

FUNDING

National Institute for Environmental Studies, Japan

PARTICIPANTS

Germany, Bangladesh, India, Nepal, Pakistan, Indonesia, Laos, Malaysia, Myanmar, Philippines, Singapore, Thailand, Vietnam, Australia, Taiwan, Korea, China and Japan.

BACKGROUND

IGAC sponsored this workshop at part of its effort to foster National/Regional Working Groups. The goal of IGAC National/Regional Working groups is to create a cohesive community of atmospheric scientists in underrepresented regions of the world and also connect the scientists to the larger IGAC community in order to foster international collaborations.

During the annual IGAC SSC meeting in October 2012 in Beijing, China, IGAC SSC members Hiroshi Tanimoto from National Institute for Environmental Studies proposed the formation of a Working Group would be beneficial for Southeast Asia where atmospheric chemists are currently under-represented to the international science community. In spite of worldwide largest cumulative effects of air pollution in Asia, and correspondingly rapidly-growing atmospheric chemistry programs and communities there, there is large asymmetry between countries - some with their own national communities, some with only a handful, if any, atmospheric chemists. Hence, strong need for coordination beyond national levels was recognized, also supported by international science communities such as the joint IGAC/SPARC Atmospheric Composition and the Asian summer Monsoon (ACAM) activity.

A scoping activity to explore the sensibility of a working group related to the activities of ACAM was accepted by the IGAC SSC. At first, there were distinct interests in establishing Working Groups for Southeast Asia and South Asia, which was followed by the idea of merging these and including further other Asian countries to form an overarching Asia Working Group came up. To explore this, an organizing committee consisting of IGAC SSC members mainly from Asia, Hiroshi Tanimoto,

Participants of the IGAC Asia Working Group Workshop.

Candice Lung (Taiwan), Chhemendra Sharma (India), Tao Wang (China), Melita Keywood (Australia), and Kim Oanh (Thailand), along with Jim Crawford (ACAM liaison), Mark Lawrence (IGAC co-chair), and Megan Melamed (IGAC IPO), began to consider the steps towards the possible formation of an IGAC Overarching Asia Working Group, and decided to have a workshop to bring Asian scientists together to discuss this idea.

In March 2015, the first workshop toward the formation of the IGAC Asia Working Group, entitled "Planning Workshop for Developing a Framework for Cooperation Between IGAC Activities in Asia" was held on 2-3 March 2015 at Asian Institute of Technology in Bangkok. The workshop brought together 18 scientists from 16 different countries across Asia.

The workshop consisted of presentations on IGAC, its parent organization International Geosphere-Biosphere Programme (IGBP) and Future Earth, the joint IGAC/SPARC activity ACAM, and a proposal of IGAC Overarching Asia WG. Following these introductory presentations, representatives from the 16 different countries including South Asia, Southeast Asia, Northeast Asia, and Oceania gave presentations on the current status of atmospheric chemistry research in their countries.

Representatives from the 16 different countries including South Asia, Southeast Asia, Northeast Asia, and Oceania gave presentations on the current status of atmospheric chemistry research in their countries.

The country presentations were followed by breakout sessions to discuss how to move forward. The breakout and plenary discussions resulted in several specific outcomes. The first outcome of the workshop is a clear and strong expression of the community to develop an IGAC regional framework for working groups in Asia. The second outcome was Asian scientists could and should be more involved in IGAC science activities including ACAM, IBBI, TOAR, CCMI, and GEIA for example. The participants agreed to have the next workshop in June 2015, immediately following the ACAM workshop in Bangkok, with a provisional title of "Workshop for developing priority themes and activities for IGAC Monsoon Asia and Oceania Networking Group (IGAC-MANGO)". The workshop will hopefully include participants from the countries missing in this workshop such as Cambodia, Korea, Brunei, Timor, Sri Lanka, and Bhutan.

13-15 October 2015
Mainz, Germany

IGAC Endorsed

AUTHORS

Jonathan Williams,
Max Planck Institute for Chemistry,
Mainz, Germany

William Brune,
Pennsylvania State University,
University Park, Pennsylvania, USA

HOST INSTITUTION

MAX-PLANCK-INSTITUT FÜR CHEMIE

MAX-PLANCK-GESELLSCHAFT

FUNDING

DFG

PARTICIPANTS

Germany, France, Finland, United Kingdom, Unites States, Netherlands, Japan, China, Chile, and Switzerland.

BACKGROUND

The ORSUM meeting was endorsed by IGAC as part of the IGAC activity Fundamentals of Atmospheric Chemistry, which eamphasizes the importance of and fosters fundamental research in advancing the field of atmospheric chemistry. The meeting was also endorsed by iLEAPS.

OH Reactivity Specialist Uniting Meeting – The first ORSUM Meeting

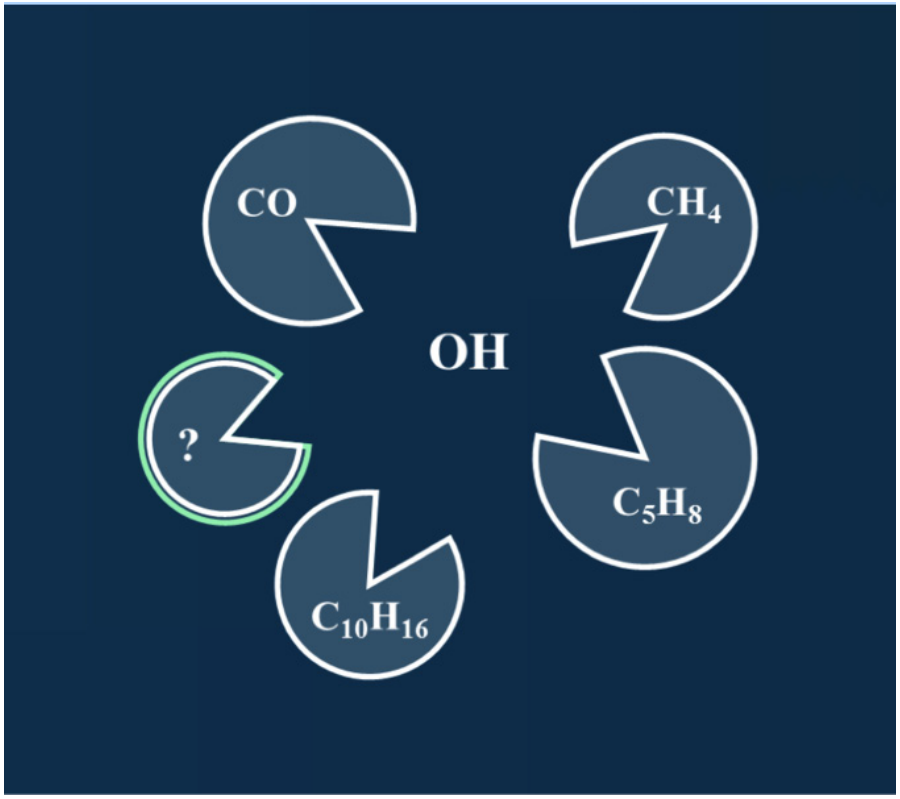
PHOTO COURTESY OF MPI, A. REUTER

Max Planck Institute for Chemistry in Mainz, Germany.

In October 2014 a three day meeting was convened at the Max Planck Institute for Chemistry in Mainz, Germany, to unite the rapidly growing community of scientists focused on researching atmospheric OH reactivity. With over 60 international scientists hailing from throughout Europe and as far as USA, China and Japan, this gathering of the OH reactivity community enabled a first exchange of experience and pooling of knowledge for modeling and measurement groups alike. The meeting was endorsed by IGAC and iLEAPS, and funded by the German Research Council.

OH reactivity is a fundamental property of the atmosphere, being defined as the total gas-phase reaction frequency with OH (measured in s^{-1}), or in other words the combined loss term for OH radicals. Its inverse is the lifetime of the OH radical itself, which has been found to vary from a few seconds in the clean upper troposphere to below 10 ms in forests and polluted city environments. Thinking in terms of the total OH reactivity represents a departure from the way air chemistry has been typically conducted to date. Rather than examining global air chemistry on a molecule by molecule basis, the integrative technique of OH reactivity permits a

Thinking in terms of the total OH reactivity represents a departure from the way air chemistry has been typically conducted to date.



more holistic and direct approach to key issues. Measurements of OH reactivity have only recently become available to atmospheric chemists based on two separate techniques 1) in-situ laser induced fluorescence detection of OH, and 2) detection of a non-ambient VOC with proton transfer reaction mass spectrometry (PTR-MS) at relatively high concentration. These measurements have a rapidly expanding number of practitioners providing datasets to challenge current photochemical models.

Three key issues emerged from the meeting. Firstly, significant missing reactivity (reactivity not currently accounted for by the measurement of individual species), is being found near ground level and in particular in forested environments. Secondly, models are unable to satisfactorily simulate measured total OH reactivity in many but not all cases and it is not clear whether this is due to incomplete chemical mechanisms (including unmeasured species and reaction rates) or the relatively unconstrained gas-to-surface deposition terms. Thirdly, even in clean remote regions over the Pacific Ocean missing reactivity can be appreciable. This is a serious issue for photochemical and climate modelers because if models underestimate the OH reactivity on local-to-global scales, it can be argued that OH is over predicted and that in turn lifetimes of radiatively active gases such as ozone and methane are underestimated.

Measurements of OH reactivity presented at the meeting included ground sites, aircraft, branch cuvettes and photochemical chamber measurements. At the conclusion of the meeting it was decided that an inter-comparison opportunity was necessary in order to ensure that the various measurement techniques are equivalent under all conditions. This comparison will be conducted in September 2015 at the photochemical chamber of the Jülich research center, Germany. A further result of the meeting is the establishment of a portal for exchange on OH reactivity matters (**https://sites.google.com/site/reactivitywiki/home**). In summary, this meeting was a complete success, networking the community, promoting exchange of ideas and defining the way ahead in this field.

SEE
J. Williams and W. Brune.
A roadmap for OH reactivity research,
Atmospheric Environment, New Directions (2015)

Atmospheric Chemical Mechanisms Conference

10-12 December 2014
Davis, CA, USA

IGAC Endorsed

AUTHORS:

Dick Derwent, rdScientific, Reading, UK

Bill Carter, University of California Riverside, California, USA

Ajith Kaduwela, California Air Resources Board and University of California Davis, California, USA

HOST INSTITUTION AND ORGANIZER

UC DAVIS UNIVERSITY OF CALIFORNIA

AIR QUALITY RESEARCH CENTER

FUNDING

California Environmental Protection Agency AIR RESOURCES BOARD

PARTICIPANTS

USA, UK, Canada, Ireland, Australia, Germany, Denmark, Norway, Finland, Belgium, France, Croatia, China, and Chile.

BACKGROUND

FUNDAMENTALS ATMOSPHERIC CHEMISTRY

The Atmospheric Chemical Mechanisms Conference was endorsed by IGAC as part of the IGAC activity Fundamentals of Atmospheric Chemistry, which emphasizes the importance of and fosters fundamental research in advancing the field of atmospheric chemistry.

The 5th international biennial conference on atmospheric chemical mechanisms, ACM-2014, was hosted at the University of California Davis by the Air Quality Research Center 10-12 December 2014. It was sponsored by the California Air Resources Board and endorsed by IGAC. There were two invited keynote addresses, 43 podium papers and 66 posters, and was attended by 141 atmospheric and laboratory scientists from 14 countries. The keynote addresses included a presentation by Ron Cohen of the University of California at Berkeley on atmospheric nitrogen oxide chemistry and a presentation by Carl Percival of the University of Manchester on Criegee intermediates and tropospheric ozonolysis of organics. The sessions covered reactions of peroxy radicals, atmospheric chemistry of organic and inorganic nitrogen, atmospheric reactions of volatile organic compounds (VOCs), and a summary session on the state of science and regulatory implications.

The issues covered during the peroxy radical sessions included the current state-of-the-science with hydroperoxy (HO_2) and organic peroxy (RO_2) radical observations and their comparison with model predictions. There was an important focus on peroxy and hydroxyl radical recycling

Participants in the ACM Conference at UC Davis.

in isoprene photo-oxidation in laboratory and field experiments. Results of several quantum chemical studies of organic peroxy radical reactions were also reported.

The reactive nitrogen sessions addressed nitrous acid (HONO), nitrate radical (NO_3) reactions with oxygenated VOCs, the role of organic nitrates, and atmospheric trends in ammonium nitrate in California. New laboratory kinetic and theoretical studies were also reported on the fundamentally important OH + NO_2 and HO_2 + NO reactions.

Presentations in the organics sessions ranged over Criegee intermediates, aromatic, PAH, and terpene oxidation reaction mechanisms and low vapour pressure organic compound formation and reactivity. These studies involved laboratory kinetics, smog chamber and field investigations, and theoretical chemistry calculations. Laboratory studies were reported on hydroxyl radical yields from peroxy radical reactions and on isoprene hydroxyl hydroperoxide formation and fate. Results of the theoretical studies on Criegee reactions and aromatic photooxidation mechanisms were also reported.

The summary session covered international transport, heterogeneous chemistry and atmospheric models, measurements of ozone sensitivity to emissions, the current status of the UK Master Chemical Mechanism, and thoughts on the current state and future of atmospheric chemical mechanism development in general.

The ACM series of conferences have always had an important focus on the regulatory policy implications of atmospheric chemistry mechanisms and their development. This focus was highlighted by the final presentation on the chemical mechanism development needs of the California Air Resources Board. An emerging regulatory policy issue for California is that of intercontinental (trans-boundary) ozone transport, which may have its own requirements in terms of chemical mechanism development.

AUTHOR

Wendy Broadgate, formerly IGBP Deputy Director of Natural Sciences. Currently Director of The Fisheries Secretariat, Stockholm, Sweden

BACKGROUND

The Great Acceleration indicators, which were first published in the IGBP synthesis, *Global Change and the Earth System* in 2004, have now been updated a decade later by IGBP in collaboration with the Stockholm Resilience Centre.

GLOBAL IGBP CHANGE

Stockholm University

Stockholm Resilience Centre
Sustainability Science for Biosphere Stewardship

This article first appeared as a post on the **Future Earth blog**.

THE GREAT ACCELERATION

In September, nations will meet to agree on the universal Sustainable Development Goals. The deadline for the goals is set for 2030. Indicators will be essential to measure progress — you can't manage what you can't measure.

The International Geosphere-Biosphere Programme and Stockholm Resilience Centre published a dashboard of 24 indicators which depict the dramatic acceleration in human enterprise and the impacts on the Earth system over the last two centuries (Figure 1). What is apparent is the synchronous acceleration of trends from the 1950s to the present day — over a single human lifetime — with little sign of abatement. These trends are known as the Great Acceleration.

Led by former IGBP Executive Director, Will Steffen, and first published as part of the first IGBP synthesis (Steffen et al., 2004) the 24 graphs — 12 socio-economic and 12 Earth system trends from 1750 to present — are strong evidence that the Earth system has moved to a new state. Some have even proposed Earth has entered a new geological epoch – the Anthropocene. Changes in human production and consumption, indicated by gross domestic product, direct foreign investment, energy consumption and telecommunications, are reflected in changes in the Earth's natural systems: climate (greenhouse gas levels, global temperature), ocean acidification, terrestrial biosphere degradation and fish capture.

We have now updated the graphs to 2010 and include an analysis of the relative contributions of wealthy nations, emerging economies and the developing world to the human enterprise. The analysis highlights the

continued on p. 25

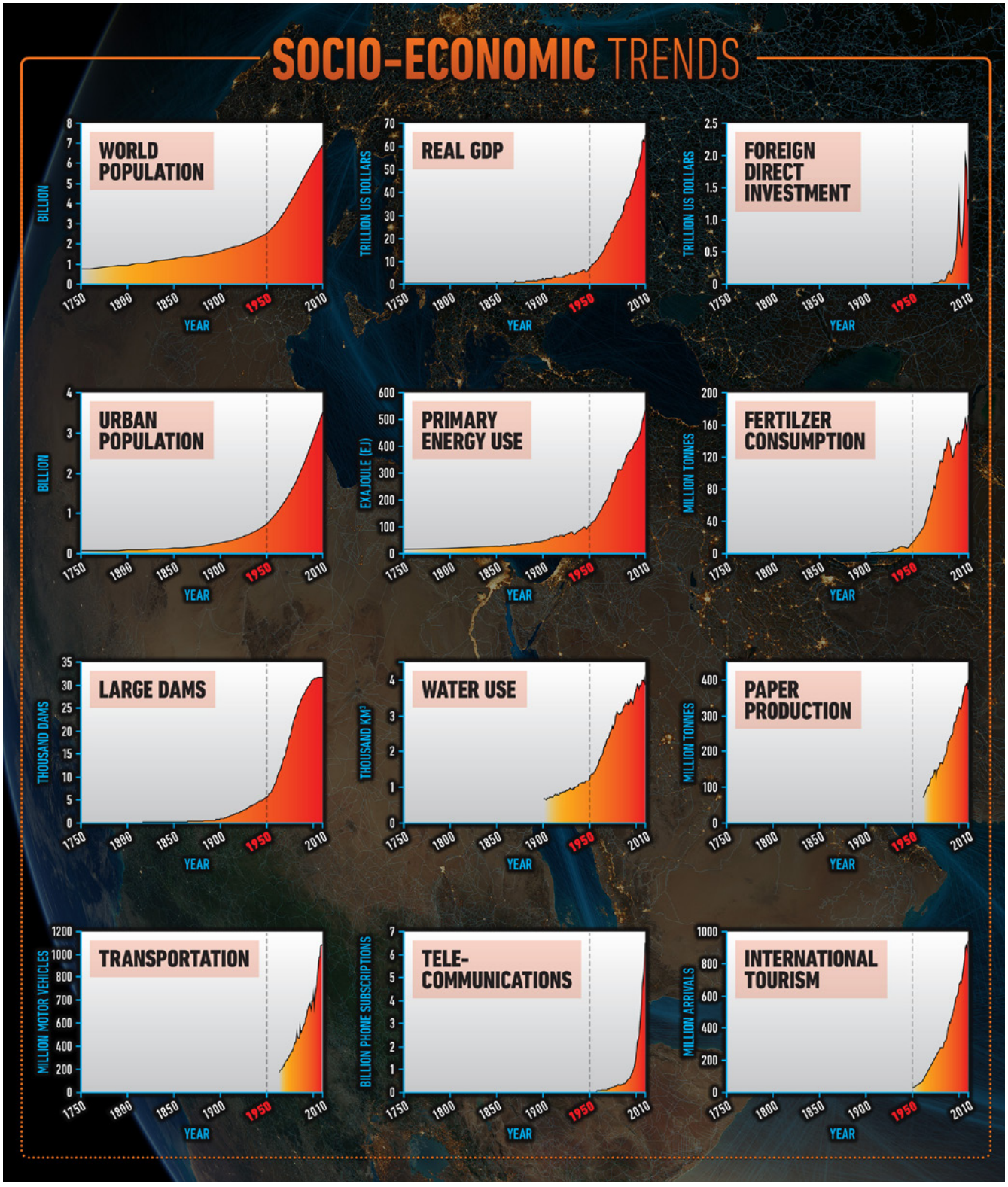


Figure 1: Twelve socio-economic trends from 1750 to present.

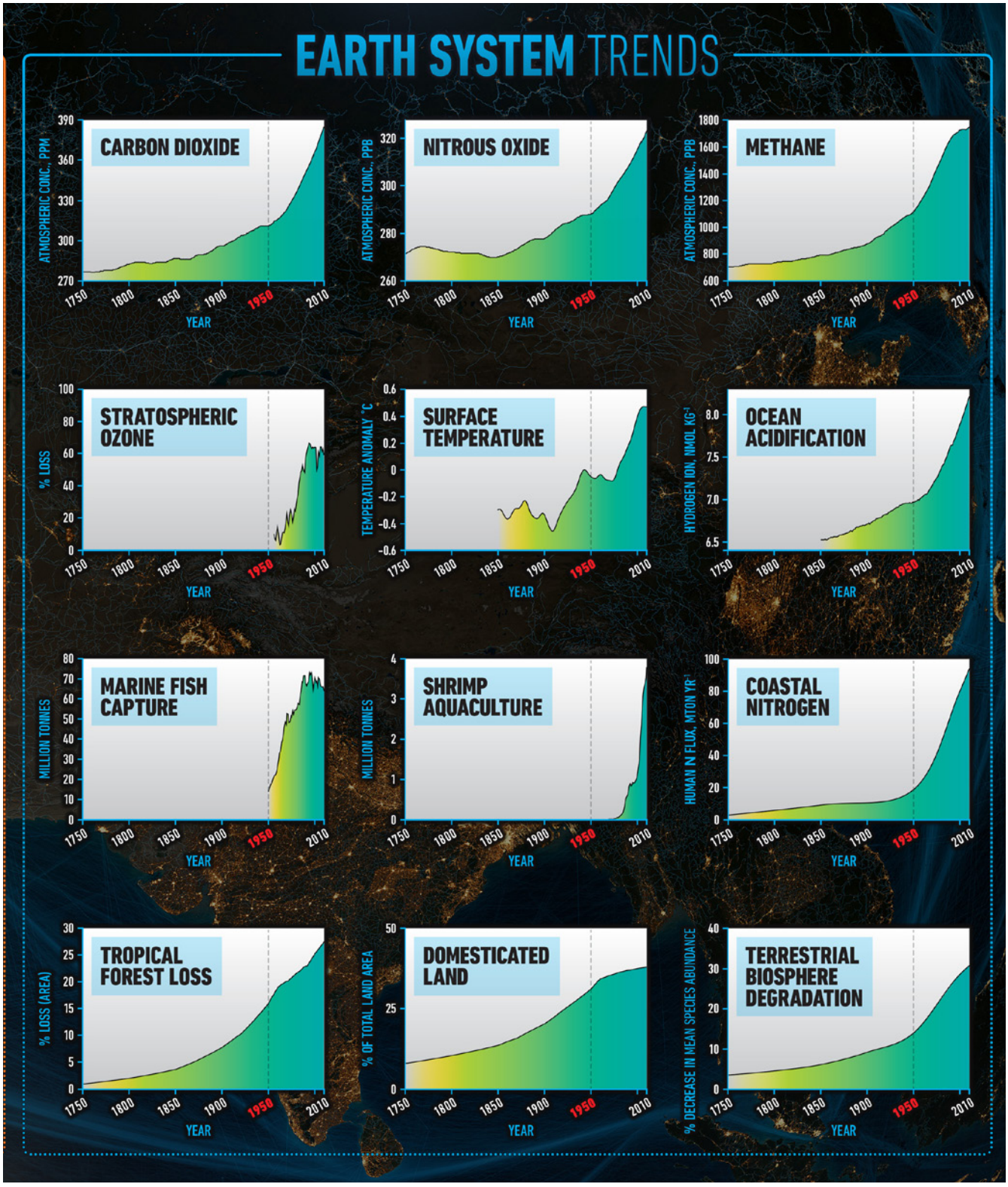


Figure 2: Twelve Earth system trends from 1750 to present.

continued from p. 22

inequities between nations. The emerging economies of the BRICS (Brazil, Russia, India, China and South Africa) now show a significant contribution to production, but the lion's share of consumption still lies within the developed OECD world, despite its relatively small proportion of the global population.

When viewed together, the indicators allow us to distinguish the signal from the noise. Many indicators are now beyond natural variability and Earth is in a quantifiably different state than before. Several significant Earth system processes are now driven by human consumption and production.

When Paul Crutzen first proposed the idea of the Anthropocene, he suggested it probably began as the Industrial Revolution kicked off around 1800. He changed his mind recently, saying the 1950s is a more likely candidate. We agree. This analysis offers evidence from an Earth system perspective that the beginning of the Great Acceleration marks the start date of the Anthropocene. Are any of the curves bending towards a more sustainable path? Some trends are beginning to show signs of slowing. The construction of large dams, domesticated land and fish capture are beginning to flatten out. Unfortunately this stabilisation is limited by capacity: we are reaching our limits in the number of large rivers, available land and fish stocks.

We are seeing an intensification of agriculture and a move to aquaculture to meet the demands for crops and seafood. Fertiliser consumption in OECD nations has decreased since the 1970s, but consumption switched to the BRICS nations, resulting in a steady increase in the global trend.

There are glimmers of hope. A success story is the Montreal Protocol, banning ozone-depleting substances. Antarctic ozone loss is apparently stabilising. Many other indicators — carbon dioxide, temperature, ocean acidification, terrestrial biosphere degradation — however, remain on an unsustainable trajectory.

Many issues, for example air pollution or severe eutrophication, could be avoided if developing nations bypassed — or leapfrogged — some of the polluting stages of development that wealthy nations have put behind them. One example of leapfrogging is how mobile telephones, now included in the Great Acceleration, have negated the need to install expensive landline infrastructure throughout Africa. Furthermore, phone infrastructure can be powered by renewable energy in remote places. Like telecommunications, not all upward trends need to be perceived as negative. The rapid rate of urbanisation has the potential to create new, more sustainable ways of living and organising society, and urban dwellers tend to have a smaller carbon footprint than those living beyond city limits.

When Paul Crutzen first proposed the idea of the Anthropocene, he suggested it probably began as the Industrial Revolution kicked off around 1800. He changed his mind recently, saying the 1950s is a more likely candidate. We agree.

This update of the Great Acceleration indicators is part of IGBP's final synthesis, which will be complete by the end of the year. The synthesis, which involves all IGBP projects, brings together the results from thousands of scientists around the world who have contributed to IGBP over the years. As these networks transition to Future Earth, we hope that the Great Acceleration project will continue and be regularly updated.

Other indicators could be added, particularly as new datasets come online. For example, rare earth elements, international trade, steel, Arctic sea-ice loss and renewable energies are possibilities.

By 2030, when time is up for the new UN goals, their success, or not, will be etched in the Great Acceleration graphs.

Further reading

The trajectory of the Anthropocene: The Great Acceleration, 16 January 2015, *Anthropocene Review*, Will Steffen, Wendy Broadgate, Lisa Deutsch, Owen Gaffney, Cornelia Ludwig

IGBP First Synthesis, Global Change and the Earth System: a planet under pressure (2004), *Springer*, Steffen, W., Sanderson, R.A., Tyson, P.D., Jäger, J., Matson, P.A., Moore III, B., Oldfield, F., Richardson, K., Schellnhuber, H.-J., Turner, B.L., Wasson, R.J. [available for free download] IGAC

Sarah Monks

Sarah Monks is currently a research scientist in NOAA's Chemical Sciences Division in Boulder, CO, USA. Sarah was born and grew up in a village on the outskirts of a town called Bradford, located in West Yorkshire, UK. She earned a BSc in Mathematics with Management at the University of Liverpool and a MRes in Physics of the Earth and Atmosphere and a PhD on "A Model Study of Chemistry and Transport in the Arctic Troposphere" at the University of Leeds. Sarah's research is focused on evaluating model simulations of ozone (O_3) in the troposphere as part of the IGAC/SPARC Chemistry-Climate Model Initiative (CCMI). A large part of the work involves using available aircraft observations of O_3 and its precursors to examine O_3 production in continental outflow in a chemical transport model. Accurately simulating O_3 with changes in emissions and climate is vital for air quality and climate impact studies.

| Sarah Monks participated in the IGAC sponsored workshop on Arctic Air Pollution – Advancing Understanding in the Next Decade. *(see workshop summary on page 15.)*

Was there an event, influential individual or childhood dream that lead you to become a scientist? If not, what lead you to pursue a career in science?

As I was growing up my parents taught me to care about and enjoy the natural environment. I loved spending time outside and tried to do my small part by recycling, walking/using public transport and turning off lights/electronic devices when I wasn't using them. I think this respect for the environment is what led me to ultimately choose a career in science. I loved mathematics at school so it seemed natural to continue with this at university. After my degree I spent a year working in the finance industry and realized that it wasn't for me. I wanted to do something that I really cared about. This is why I went back to university to do my masters in a subject that could help me pursue a career in an environmental discipline. I was particularly interested in understanding how human activities were changing the environment that we live in, which is what led me to choose a MRes project with a focus on the impact of surface emissions on atmospheric chemistry.

What do you believe is the most pressing issue in Arctic air pollution research that needs to be addressed?

I have just been involved in a multi-model intercomparison project that focused on the Arctic. One of the things we found is that the current generation of chemical transport models simulate highly varying concentrations of reactive gases in the Arctic troposphere and differences in the rates of O_3 production. Whilst the concentrations of O_3 agree relatively well with observations, the production and loss processes in the models are likely to be highly variable making it difficult to assess the impact of different sources on O_3 in the Arctic with certainty. If we want to properly understand the changing Arctic environment with changing emissions and climate then we really need to improve model simulations of important trace gases.

What is the most useful piece of advice you have received from the numerous senior scientists you have worked with?

Publish your work. I don't think I really understood how important this was when I was doing my PhD but I've since realized that this is the most valuable thing for career progression. It's easy to get excited about the next bit of new work or get distracted by model coding but it's vital to make sure you publish your results as you go.

Outside of science, what are some of your other interests/hobbies?

I really enjoy spending time outside walking. As I have just moved to Boulder I'm excited to explore the numerous hikes that start right here in town. I also love exploring new places and being exposed to different cultures, working in science is great for this as you meet lots of people from different backgrounds. I enjoy trying new things, which is how I got into scuba diving and climbing even though I'm scared of water and heights! On a more day-to-day level I love watching films, reading or doing yoga and eating good food and drinking good wine!

What do you think the number one benefit is of participating in an IGAC workshop as an early career scientist?

Meeting other scientists. I think a big part of science is getting to know people. I find it quite difficult to speak to anyone that I don't know so participating in smaller workshops is a great way to meet people who are working in areas similar to you. This helps you get known in the community, which can open up lots of opportunities for the future. IGAC

LRTAP Task Force on Hemispheric Transport Air Pollution and Task Force on Integrated Assessment Modelling workshop on global air pollution emissions scenarios

11-13 February
Laxenburg, Austria

AUTHORS

Terry Keating, US EPA, USA

Frank Dentener, EC – JRC, Italy

Rob Maas, RIVM, Netherlands

Stefan Åström, IVL, Sweden

Markus Amann, IIASA, Austria

Zbigniew Klimont, IIASA, Austria

HOST INSTITUTION AND CO-ORGANIZER

IIASA Science for Global Insight

CO-ORGANIZER

LRTAP Long-range Transboundary Air Pollution

PARTICIPANTS

Argentina, Austria, China, India, Indonesia, Italy, Japan, Netherlands, South Korea, Sweden, Thailand, and USA.

BACKGROUND

Under the UNECE Convention on Long Range Transboundary Air Pollution, TF HTAP is an expert group charged with coordinating atmospheric science and other research to improve the understanding of the intercontinental transport of air pollution. TF HTAP and IGAC share common goals and draw upon that same community of scientists. Thus, there are on-going efforts to coordinate TF HTAP and IGAC Activities.

Supporting the UNECE Convention on Long-range Transboundary Air Pollution (LRTAP), the Task Force on Hemispheric Transport Air Pollution (TF HTAP) and the Task Force on Integrated Assessment Modelling (TFIAM) jointly organized a workshop to evaluate global air pollution emissions scenarios with respect to bottom-up knowledge available in countries, regions, and specific sectors. The workshop brought together 31 participants, including experts from emerging economies such as China, Korea, and India. The discussion focused on evaluating a set of global emissions scenarios out to 2050 developed by the International Institute for Applied Systems Analysis (IIASA) using the GAINS model in the context of the European ECLIPSE project (ECLIPSEv5). Spreadsheets summarizing the global scenarios and presentations from the workshop are available at **www.htap.org**. Gridded versions of the emissions fields for different years are available at IIASA, ECLIPSE, and GEIA's ECCAD Portal.

Submit articles to ACP Special Issues entitled "Global and regional assessment of intercontinental transport of air pollution, results from HTAP, AQMEII and MICS"

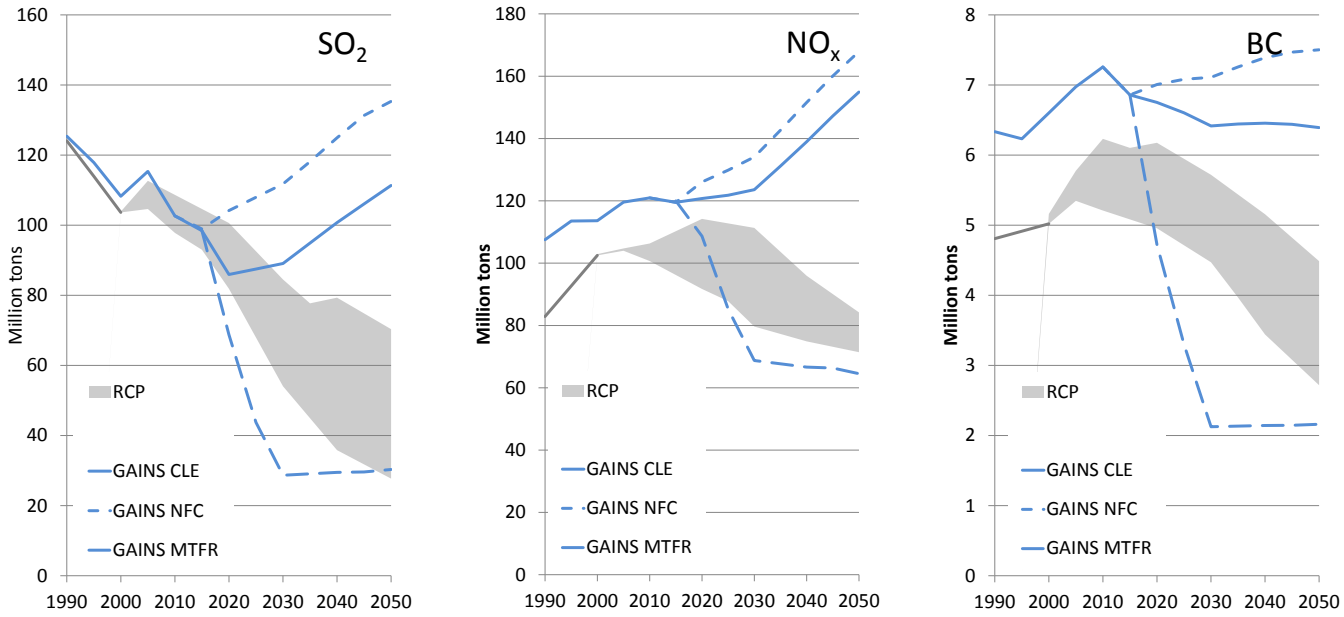


Figure 1. **TF HTAP-adopted envelope of global emissions developed at IIASA for the ECLIPSE project using the GAINS model. The range of air pollutant emissions is larger than in the RCP scenarios. Climate and energy policies may lead to additional emission reductions.**

The workshop discussion focused on evaluating a set of global emissions scenarios out to 2050 developed by the International Institute for Applied Systems Analysis (IIASA) using the GAINS model in the context of the European ECLIPSE project (ECLIPSEv5).

Three "benchmark" scenarios, shown in Figure 1, were discussed at the workshop: No Further Control (NFC), in which air pollution control measures remain at their pre 2015 status; Current Legislation (CLE), in which existing and planned legislation or regulation is implemented; and Maximum Technically Feasible Reduction (MTFR), in which best available technologies in all sectors are implemented ignoring potential cost and policy implementation barriers. Workshop participants agreed that these scenarios produced a plausible envelope of global emissions futures. However, more detailed regional projections of specific sectors' emissions could differ substantially from these global estimates. The workshop concluded that the global scenarios were useful to illustrate and evaluate the benefits of a cooperative hemispheric approach towards abating air pollution as compared to isolated national or regional approaches.

There is increasing evidence that ground level ozone formation is a shared problem that may only be addressed effectively with cooperative action on global or hemispheric scales. Such a cooperative strategy would yield substantial benefits in some of the most polluted regions, especially for health and food production in South and East Asia. Impacts of particulate matter have a strong regional character, but as this problem is similar in all regions, universal solutions for key sources, such as vehicles, ships, residential heating and combustion plants, can increase their cost-effectiveness. Such sectoral solutions could decrease costs due to technological learning and economies of scale and will avoid distortions in competitiveness between regions.

IGAC International Project Office
University of Colorado, CIRES
Boulder, CO USA

Megan L. Melamed
IGAC Executive Officer
megan@igacproject.org

IGAC SSC Members

Allen Goldstein (Co-Chair)
University of California, Berkeley
Department of Environmental Science, Policy, and Management
Berkeley, California, USA
ahg@berkeley.edu

Mark Lawrence (Co-Chair)
Institute for Advanced Sustainability Studies (IASS)
Sustainable Interactions with the Atmosphere
Potsdam, Germany
mark.lawrence@iass-potsdam.de

Mary Barth
NCAR
Earth System Laboratory
Boulder, Colorado, USA
barthm@ucar.edu

Paul Beukes
North-West University
School of Physical and Chemical Sciences
Potchefstroom,
South Africa
Paul.beukes@nwu.ac.za

James Crawford
NASA
Langley Research Center
Hampton, VA, USA
James.h.crawford@nasa.gov

Claire Granier
LATMOS-IPSL
Paris, France
Claire.Granier@latmos.ipsl.fr

Michel Grutter
UNAM
Center for Atmospheric Sciences
Mexico, D.F., Mexico
grutter@unam.edu

Colette Heald
Massachusetts Institute of Technology
Department of Civil and Environmental Engineering
Boston, Massachusetts, USA
heald@mit.edu

Judith Hoelzemann
UFRN
Natal, Brazil
judith.hoelzemann@ect.ufrn.br

Melita Keywood
CSIRO and Bureau of Meteorology
Centre for Australian Weather and Climate Research
Melbourne, Australia
Melita.Keywood@csiro.au

Alastair Lewis
University of York
Wolfson Atmospheric Laboratories
York, UK
Ally.lewis@york.ac.uk

Shih-Chun Candice Lung
Academia Sinica
Research Center for Environmental Changes
Taipei, Taiwan
sclung@rcec.sinica.edu.tw

Kim Oanh
Asian Institute of Technology
Environmental Engineering and Management
Pathumthani, Thailand
kim@ait.ac.th

Spyros Pandis
University of Patras
Patras, Greece
Carnegie Mellon University
Pittsburgh, PA USA
spyros@chemeng.upatras.gr

Yinon Rudich
Weizmann Institute
Department of Environmental Sciences
Rehovot, Israel
Yinon.Rudich@weizmann.ac.il

Chhemendra Sharma
National Physical Laboratory
Radio and Atmospheric Sciences Division
New Delhi, India
csharma@mail.nplindia.ernet.in

Hiroshi Tanimoto
National Institute for Environmental Studies
Center for Global Environmental Research
Tsukuba, Ibaraki Japan
tanimoto@nies.go.jp

Tao Wang
Hong Kong Polytechnic University
Department of Civil and Environmental Engineering
Hong Kong, China
cetwang@polyu.edu.hk

Noureddine Yassaa
CDER
Algiers, Algeria
n.yassaa@cder.dz

Join the IGAC Community

Don't forget to join the IGAC community to stay apprised of the most current news on conferences, workshops and publications, as well as receive our newsletters by email.

calendar 2015-2016

Visit **igacproject.org** for updates to the calendar

APRIL

Air Quality Challenges: Tackling the Changing Face of Emissions
12-16 April 2015
San Diego, CA, USA

TOAR Workshop II
(hosted by Spanish Met Service, AEMET)
IGAC Sponsored
27-30 April 2015
Madrid, Spain

MAY

TF HTAP Global and Regional Model Evaluation Workshop
11-13 May 2015
Boulder, CO, USA

2015 Global Monitoring Annual Conference
19-20 May 2015
Boulder, CO, USA

2015 Future Earth Early Career Scientists' Networking Conference
Future Sustainability - The Role of Science in the Sustainable Development Goals
24-30 May 2015
Lake Como, Italy

JUNE

Southeast Atmosphere Studies Workshop: Intensive Observation Period Modeling to Improve Mechanistic Representation Trends
IGAC Endorsed: Fundamentals of Atmospheric Chemistry
8-10 June 2015
Princeton, NJ, USA

ESA Conference: ATMOS2015
Advances in Atmospheric Science and Applications
8-12 June 2015
Crete, Greece

2nd ACAM Workshop
IGAC Sponsored Event
8-10 June 2015
Bangkok, Thailand

The Future of Laboratory Studies in Atmospheric Chemistry
IGAC Sponsored: Fundamentals of Atmospheric Chemistry
(Invite only)
17-19 June 2015
Boulder, CO, USA

Nitrate Radicals and Biogenic VOCs Workshop
IGAC Sponsored: Fundamentals of Atmospheric Chemistry
June 2015
Atlanta, GA, USA

JULY

Our Common Future Under Climate Change
7-10 July 2015
Paris, France

Composition and Transport in the Tropical Troposphere and Lower Stratosphere
IGAC Endorsed
20-23 July 2015
Boulder, CO, USA

AUGUST

GRC on Atmospheric Chemistry Multiphase Processes: Observations and Fundamentals
2-7 August 2015
Waterville Valley, NH, USA

SEPTEMBER

Asia Oceania Geosciences Conference (AOGS)
2-7 September 2015
Singapore

SOLAS Open Science Conference
7-11 September 2015
Kiel, Germany

OCTOBER

CCMI/AeroCom Workshop
IGAC Sponsored
5-9 October 2015
Rome, Italy

2015 Acid Rain Conference
19-23 October 2015
Rochester, NY, USA

NOVEMBER

2nd Symposium of the Committee on Space Research
Water and Life in the Universe
9-13 November 2015
Foz do Iguacu, Brazil

17th GEIA Conference
IGAC Sponsored
18-20 November 2015
Beijing, China

IGBP @ AGU Conference
14-18 December 2015
San Francisco
See ad on p. 9

2016

14th IGAC Science Conference
26-30 September 2016
Breckenridge, CO, USA

APRIL/MAY 2015
ISSUE 54

GLOBAL
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