Kobus Pienaar of North-West University, South Africa, a former IGAC Scientific Steering Committee (SSC) member, at the IGAC DEBITS observation site in Kruger Park, South Africa. Data collected at this site was part of a large assessment on deposition featured in this newsletter.
The Origins of IGAC

This article is written from the point of view of a European physical chemist who started his study of the chemistry of the atmosphere in 1968 when photochemistry was mostly a stratospheric phenomenon and tropospheric chemistry was thought to be dominated by reactions occurring in clouds and fog.

The only exception to this rule was Los Angeles smog, which was considered to be exotic by most Europeans. This situation has now completely changed and the photochemistry and free radical chemistry causing the Los Angeles smog phenomenon has been shown to be near universal throughout the troposphere. IGAC has played a large role in this.

Starting in the 1970s several theories regarding tropospheric chemistry were advanced to explain various aspects of pollution, such as acidity in rain and photochemical smog, and the chemical cycling leading to the removal of sulphur and nitrogen compounds from the atmosphere. For instance it was proposed that tropospheric chemistry was mostly driven by the widespread presence of hydroxyl radicals at concentrations around 1 x 10^6 molecules ml^-1, and that much of the ozone observed in the troposphere was a result of in-situ chemistry rather than transfer from the stratosphere. It was also proposed that much of the acidity in rain in the form of sulfuric acid was due to the oxidation of sulphur dioxide (SO2) in cloud and rain droplets by ozone and peroxides formed as a result of the free radical chemistry in the troposphere. All of these issues were identified in a report produced by the US National Research Council’s Committee on Atmospheric Sciences’ Global Tropospheric Chemistry Panel [NRC, 1984] that suggested the need for a worldwide program of research to be carried out by the international atmospheric science community. This led directly to the setting up of IGAC, which occurred at a meeting of many scientists of different disciplines in Dookie, Victoria, Australia in 1988.
ACHIEVEMENTS The achievements of IGAC have been documented extensively in the scientific literature with several special issues in journals such as the Journal of Geophysical Research – Atmospheres and especially in the book Atmospheric Chemistry in a Changing World [eds Brasseur, Prinn and Pszenny, 2003]. This book concluded that:

The IGAC Project of the International Geosphere-Biosphere programme (IGBP) has been directly responsible for stimulating a large amount of research into virtually all aspects of the chemistry of the troposphere. In the particular area of photochemistry, the research has had many successes that have considerably improved our understanding of the nature of atmospheric chemical processes and of their overall impact on the composition of the troposphere.

These successes included:

• Showing that the distribution and extent of ozone in the troposphere is mostly controlled by in-situ chemistry and transport, rather than simply by injection from the stratosphere and deposition at the surface.

• Validating the basic free radical chemistry theory of the troposphere involving HOx under conditions of low NOx.

• Demonstrating that transport of pollution from the continents has a large impact on the composition of most of the troposphere. This includes ozone and its precursors, and associated photochemically produced products, particularly nitrogen compounds.

• Proving the existence of other types of free radical chemistry including halogen and nitrate radical chemistry.

IGAC research has also considerably improved knowledge of emissions from the biosphere and from anthropogenic activity. There are now global satellite maps of gases such as formaldehyde, which is a product of the oxidation of isoprene emitted from the biosphere, and of nitrogen dioxide that is primarily produced from man-made sources. Large strides have also been made in determining the detailed composition of the atmospheric aerosol particularly with respect to its organic content.

The overall conclusion is that atmospheric chemistry in the troposphere plays a pivotal role in determining its composition, certainly at the trace gas level. Without chemical processing, the products of the biosphere, including man-made emissions, could build up to levels where life would become unsustainable. IGAC has made a substantial contribution to society’s acceptance of this conclusion.

FUTURE IGAC research is an essential component of earth system science, which attempts to understand the interaction between solid earth, atmosphere and ocean, with particular emphasis on atmospheric composition. It is therefore a basic planetary science and its study should reflect this the requirement for a large database of atmospheric composition and the processes that affect this. In the past IGAC has focused its attention on process studies carried out in a series of experiments designed to reveal and quantify known and suspected phenomena such as hydroxyl chemistry, long-range transport, emissions and uptake of particular gases such as DMS and isoprene, and on the composition of the atmospheric aerosol. In the future IGAC also needs to seek more overlap with longer-term observational programs, such as the World Meteorological Organization (WMO) Global Atmosphere Watch (GAW) Programme, which focuses on establishing trends, and with satellite programs that can reveal the geographical extent of concentration fields.

Each of these longer-term observational programs have their limitations and here IGAC can seek to fill gaps in knowledge particularly with respect to the extent of speculation of both gases and aerosols in the atmosphere, and with the vertical profiles of these same species collected by aircraft using similar instruments to those being used at the surface. IGAC should also spend time designing simple repeatable experiments such as the use of aircraft to perform the same experiment with the same payload over a period of years. A good example of this, although only for half a year, was the TOPSE experiment that studied the build-up of ozone in the free troposphere of the North American Arctic by frequent flights from 40°N to 80°N. Similar experiments could be conducted over other continents to study phenomena revealed by satellite. An example here is the distribution of formaldehyde build-up and change with season over Africa and elsewhere. Much has been learnt in the past from sustained study of a particular species or a particular phenomenon, and much can be learnt in the future.

In many respects IGAC science is a study of atmospheric gases other than CO2 and of the atmospheric aerosol. It has strong interests in the sulphur cycle and the nitrogen cycle as well as aspects of the carbon cycle. Future research must go hand-in-hand with the intensive carbon cycle studies that are planned if we are fully to comprehend the threats to overall sustainability we all face in the future.

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IGATION AUGUST 2014

IGAC UPDATES

OCEAN-ATMOSPHERE-SEA ICE-SNOW PACK (OASIS), chaired by Faye McNeill of Columbia University, is a new IGAC Activity working in conjunction with our current Activity, ALC. OASIS is a program initially created in 2002 to bring together an international group of multidisciplinary field researchers, laboratory scientists, and modelers to study chemical and physical interactions and exchange processes between the title reservoirs, with a primary focus on the impact on tropospheric chemistry and climate feedbacks.

During the International Polar Year (IPY), OASIS was involved in a number of large-scale field studies including the Circumpolar Flaw Lead icebreaker cruise in the Canadian Arctic and OASIS 2009 in Barrow, Alaska, and was most recently involved in the Bromine, Ozone, and Mercury Experiment (BROMEX) in 2012. For a current list of OASIS publications see the OASIS website.

THE TROPOSPHERIC OZONE ASSESSMENT REPORT (TOAR) is an Activity addressing global metrics for climate change, human health and crop/ecosystem research. Chaired by Owen Cooper of the NOAA Earth Systems Laboratory/ University of Colorado, TOAR addresses questions such as:

• Which regions of the world have the greatest human and plant exposure to ozone pollution?

• Is ozone continuing to decline in nations with strong emission controls?

• To what extent is ozone increasing in the developing world?

TOAR thus has two main objectives: answer these questions and update our current understanding of ozone, and for the first time generate ozone metrics at hundreds of measurement sites around the world, freely accessible for research on the global-scale impact of ozone on climate, human health and crop/ecosystem productivity.

In response to IGAC’s call for proposals for Workshops on Fundamentals of Atmospheric Chemistry, we received 13 excellent proposals from prominent scientists all over the world. The response IGAC had to the call for proposals strongly indicates the international atmospheric chemistry community is in need of and values the IGAC Activity on Fundamentals. IGAC is an organization that responds to the community’s needs and therefore IGAC intends to continue having an annual open call for proposals for Workshops on Fundamentals of Atmospheric Chemistry and look for other opportunities to support the community on this topic.

The IGAC Scientific Steering Committee (SSC) selected the proposal for the workshop entitled “Nitrile Radicals and Biogenic Volatile Organic Compounds (VOCs): Oxidation, Mechanisms and Organic Aerosol” to tentatively take place 19-20 March 2015 at Georgia Institute of Technology, USA.

The response IGAC had strongly indicates the international atmospheric chemistry community values the IGAC Activity on Fundamentals.
**IGAC Updates**

**IGAC Activity DEBITS Contributes to International Assessment of Deposition**

The IGAC Activity Deposition of Biogeochemically Important Trace Species (DEBITS) is central to the recently published assessment entitled "A global assessment of precipitation chemistry and deposition of sulfur, nitrogen, sea salt, base cations, organic acids, acidity and pH, and phosphorus". The assessment is available in an open access Special Issue in Atmospheric Environment. DEBITS chair and former IGAC SSC member Kobus Pienaar (2009-2014) from North-West University, Potchefstroom, South Africa is an author on the assessment and led the effort to establish an Africa wide dry deposition monitoring network. This issue of the IGAC Newsletter contains a summary of the major finding from the assessment.

**Future Earth Permanent Secretariat Announced**

On 2 July 2014 the Science and Technology Alliance for Global Sustainability announced Future Earth will have a globally distributed secretariat with a unique and innovative structure that spans three continents.

The preferred bidder is an international consortium of several lead organizations: Montreal International (Montreal, Canada), the Ministry of Higher Education and Research (Paris, France), the Science Council of Japan (Tokyo, Japan), Royal Swedish Academy of Sciences (Stockholm Sweden), and in Colorado, USA, the University of Colorado (Boulder) and Colorado State University (Fort Collins). This is complemented by regional hubs coordinated by the Inter-American Institute for Global Change Research (for Latin America), the Tyndall Centre for Climate Change Research (for Europe) and The Cyprus Institute (for Asia), the Science Council of Higher Education and Research (Montreal, Canada), the Ministry of Higher Education and Research (Paris, France), the Science Council of Japan (Tokyo, Japan), Royal Swedish Academy of Sciences (Stockholm Sweden), and in Colorado, USA, the University of Colorado (Boulder) and Colorado State University (Fort Collins). This is complemented by regional hubs coordinated by the Inter-American Institute for Global Change Research (for Latin America), the Tyndall Centre for Climate Change Research (for Europe) and The Cyprus Institute (for Asia), the Tyndall Centre for Climate Change Research (for Europe) and The Cyprus Institute (for Europe). The report analyzes collected data on carbon monoxide (CO), nitrogen dioxide (NO2), sulfur dioxide (SO2), ozone (O3), and particulate matter (PM10 and PM2.5) levels and compares them with the Ecuador air quality standards (Norma Ecuatoriana de Calidad del Aire del Distrito Metropolitano de Quito). The report provides the public with an objective analysis of air quality monitoring in Quito.

**IGAC Moves To E-Bulletins**

Tired of seeing too many emails from IGAC in your inbox? IGAC will now send an e-bulletin for most announcements on the first of each month, commencing in September. The e-bulletins will 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.

**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.
During 23-26 April 2014, 33 people from 16 countries with an interest in biomass burning research descended on Max Planck Societies' Ringberg Castle in the Bavarian Alps to participate in the third workshop for the IGAC/iLEAPS/WMO Interdisciplinary Biomass Burning Initiative (IBBI). In the setting of the eclectic castle the workshop discussed opportunities for advancing the scientific understanding of processes in biomass burning (BB) by connecting separate research communities in order to improve air quality forecasts and climate predictions.

During the workshop we discussed gaps in, and contributions to, our understanding of BB via a series of presentations and open discussion focused on the themes identified in previous workshops (summarised in IGAC Newsletter Issue 50). These included fire products (burned area, fire radiative power), fire models and charcoal records, observations of fires and atmospheric composition, the under prediction of smoke aerosol optical depth (AOD) in atmospheric composition and climate models relative to satellite AOD observations, emission factors, the influence of BB on air quality and the link between fires and climate change and fire climate feedbacks. The presentations are available on the IBBI website.

Several new collaborations started during the workshop and two IBBI ad-hoc working groups were formed. The first will develop a historical fire emissions inventory for 1750-2014 that will combine emission inventories, fire models and charcoal records that will be a contribution to the IGAC/iLEAPS/AIMES Global Emission Initiative (GEII) Historical Emissions effort to produce historical emission inventories for use in CMIP6, the IGAC/SPARC Chemistry-Climate Model Initiative (CCMI) and other applications.

The second ad-hoc working group will develop an integrated case study for an individual fire event that will combine fire and plume modelling across scales (from fire behaviour to global) with observations of the fire across platforms.

The workshop also agreed to support other initiatives including the AEROCOM Biomass burning Aerosol Emission Experiments and the Fire Model Intercomparison Project (FireMIP).

The need for continuous network funding was seen as a key requirement for capitalising on the new connections made at the workshop and involving further relevant communities, in particular those from health and economic sciences. We also worked on the development of a COST Action to provide funding for IBBI activities into the future, in particular to support workshops, publications, visitor exchanges and administrative costs.

IBBI will be the subject of a special issue of Atmospheric Environment entitled “IBBI Biomass Burning”. Submissions for this issue are due by 1 November 2014. If you are interested in contributing your research to this special issue please contact Johannes Kaiser or Melita Keywood. If you would like to participate in IBBI activity please join the IBBI mailing list to keep informed of upcoming activities.

MELITA KEYWOOD CSIRO MARINE AND ATMOSPHERIC RESEARCH, AUSTRALIA (MELITA.KEYWOOD@CSIRO.AU) AND JOHANNES KAIser KCL, LONDON, UK (J.KAIser@KCL.AC.UK)
might take advantage of the WMO GAW, Network for the Detection of Atmospheric Composition Change (NDACC) and GCOS Reference Upper-Air Network (GRUAN) observation networks. The final session was called “Linking model performance to future projections: dynamics, transport and chemistry,” including talks that considered the influence of chemistry-climate feedbacks when making climate projections, the importance of accounting for long-term natural variability in model analysis, projections of future stratospheric variability in the Arctic, future changes in stratosphere-troposphere coupling and ozone, and the impact changes in stratosphere-troposphere coupling and ozone, and the impact of short lived bromocarbons on ozone recovery.

On the last day of the workshop the participants were split into several groups, which were all given the task of discussing:

1. CCMi objectives and potential links with the aerosol community and the wider climate modeling community
2. Routine benchmarking for CCMi models
3. Definition of simulations and scenario runs within CCMi. Items arising from the group discussions were presented to the workshop as a whole to stimulate further discussion. The workshop then closed with a meeting of the CCMi Scientific Steering Committee.

The 16th CCMi Conference helped identify topics that will be further investigated over the next two years by the CCMi community, through working groups and collaborations, online discussion forums, and preparations for the 17th CCMi Conference. CCMi will be paying particularly close attention to the following issues in the next two years:

1. LAND USE. Tracking land use changes with satellites and ground-based observations is central to quantifying how these changes are driving emissions in different parts of the world.
2. FIRE EMISSIONS. New multichannel satellites and extensive field measurements are enhancing assessments of emissions from wildfires, prescribed burning, and agricultural fires, enabling better characterization of sources, identifying smaller fire events, and quantifying water burning as a potential source of toxic compounds.
3. ENERGY PRODUCTION. Extensive analysis of methane and hydrocarbon emissions from energy production and distribution, including conventional and unconventional extraction and leaks from abandoned sites, is essential for informing choices about energy sources.

16th GEIA Conference - Bridging Emissions Science & Policy
10-11 JUNE 2014 // NCAR, BOULDER, COLORADO, USA

The 16th GEIA Conference, a forum for exploring the role of emissions as a crucial link between scientific innovation and societal development, was organized around four questions:

- How are recent measurement advancements helping to better quantify emissions?
- What are new developments in emissions process understanding?
- What are challenges in interpreting past emissions trends and projecting future emissions?
- How does improved emissions knowledge inform critical societal issues?

Presentations, panels, demonstrations, and discussions involved about 200 participants from 6 continents representing a variety of stakeholder groups and highlighted progress and challenges in addressing these questions. Abstracts, presentations, and other conference materials can be found here.

The 16th Conference helped identify topics that will be further investigated over the next two years by the GEIA community, through working groups and collaborations, online discussion forums, and preparations for the 17th GEIA Conference. GEIA will be paying particularly close attention to the following issues in the next two years:

1. AGRICULTURAL EMISSIONS. Assessing the emissions of methane and reactive nitrogen, particularly ammonia, from agriculture and livestock remains an important challenge, and will benefit from more extensive deployment of in-situ measurements and better characterization of satellite information.
2. VOC SPECIFICATION. Expanding direct measurements of individual volatile organic compounds (VOCs) remains critical for understanding the contributions of specific VOCs to ozone and fine particle production, exposure to toxics and climate impacts.
3. ASIAN EMISSIONS. Recent significant progress validating Asian emissions should be extended to other parts of the world, such as Africa and South America. Continued quantification of emissions in this rapidly developing part of the world is essential.
4. URBAN AREAS. Ambient air monitoring and roadside sampling combined with fuel usage and traffic density accounting improves the quantification and resolution of emissions in cities, demonstrates the benefits of vehicle emissions controls, and provides constraints on regional and global inventories.
5. HISTORICAL EMISSIONS. GEIA is leading an effort to quantify global emissions trends over the past 250 years and to harmonize them with future emissions projections. Open-source systems are being developed to allow updates and to assess uncertainties in historical inventories.
6. CLOSING GAPS. Field campaigns, satellite data, and direct source measurements in more regions of the world are providing essential information for improving emission factors and quantifying emissions at a basin level, with the goal of narrowing the discrepancies between bottom-up inventories and top-down approaches relying on observations.

Tighter pollution standards aimed at protecting human health, coupled with rapid societal and land use changes, have increased the urgency for producing accurate, comprehensive, and harmonized emissions datasets. GEIA community members serve as sentinels, translators, and communicators of emissions and their impacts. By sharing, analyzing, and synthesizing up-to-date emissions knowledge, GEIA informs researchers and policy makers engaged in environmental protection, pollution mitigation, and adaptation strategies, and increases the capacity for understanding emissions around the world.

Global Assessment of Precipitation Chemistry & Deposition:
A PROJECT OF THE WORLD METEOROLOGICAL ORGANIZATION GLOBAL ATMOSPHERE WATCH PROGRAMME (WMO GAW)
SCIENTIFIC ADVISORY GROUP FOR PRECIPITATION CHEMISTRY.

An international team of 21 scientists gathered, quality assured, and assessed available information on precipitation chemistry and deposition for sulfur, nitrogen, sea salt, base cations, organic acids, acidity and pH, and phosphorus from almost every region of the world including the oceans. The resulting data set includes high quality regionally-representative precipitation chemistry and wet deposition data from 533 measurement stations worldwide for two averaging time periods: 2000-2002 and 2005-2007. These data are available on the World Data Centre for Precipitation Chemistry website. Observations from the earlier period were combined with global chemical transport modeling results for 2001 from Phase 1 of the Coordinated Model Studies Activities of the United Nations Economic Commission for Europe’s Task Force on Hemispheric Transport of Air Pollution (UNECE TF HTP) to provide more insight into the global patterns of precipitation chemistry and deposition. The assessment also includes measurement-based inferential estimates of dry deposition for a few geographic areas. All of this information is presented in a
collection of global and regional maps. The assessment by Vet et al. (2014) is published as an open access Special Issue of Atmospheric Environment.

The assessment was designed to provide the science and policy communities with the best available answers to three science questions:

1. What do measurement and model estimates of precipitation chemistry and wet, dry and total deposition of sulfur, nitrogen, sea salt, base cations, organic acids, acidity, and phosphorus show globally and regionally?
2. Has wet deposition of major ions changed since 2000 (and, where possible, since 1990)?
3. What are the major gaps and uncertainties in our knowledge?

This information is basic to the successful understanding of many contemporary global environmental problems, including ecosystem acidification and eutrophication, loss of biodiversity, air pollution and global climate change. Deposition of major ions in precipitation is a major loss mechanism for several common anthropogenic and naturally occurring chemicals in the atmosphere. Understanding and quantifying pollutant loss from the atmosphere is an important component of many areas of environmental research, including air quality modeling, spatial characterization of total atmospheric deposition, ecosystem effects monitoring, critical load modeling, climate studies and human health risk assessments.

**Major Findings SULFUR**

An integrated review of measurements and ensemble-mean modeling results showed that non-sea-salt sulphate (nnSS) wet deposition is highest (> 10 kg S ha\(^{-1}\)) in the major established and emerging industrial areas of the world, principally eastern North America, western Europe and East Asia. In North America and Europe nnSS wet deposition decreased significantly after 1990 and particularly between 2000 and 2007, while wet nnSS deposition in Asia and Africa increased between 2000 and 2007. The decreases in North America and Europe are attributed to the success of sulfur dioxide (SO\(_2\)) emission reduction programs. Regional model-based estimates of dry and total deposition are available for selected sites in North America, Europe, Africa, Japan and Australia. The HTAP ensemble-mean model estimates of dry and total deposition show that the global patterns closely mimic the wet deposition patterns, and that the highest percent contributions of dry deposition to total deposition occur in the driest continental areas of the world.

**NITROGEN**

Comprehensive measurements and ensemble-mean model results showed the highest levels of nitrogen wet deposition (> 8 kg N ha\(^{-1}\) a\(^{-1}\)) in eastern North America, southern Europe, and southeast Asia. While oxidized nitrogen (nitrate) is a more important contributor to wet deposition in industrialized areas and areas of very low precipitation, reduced nitrogen (ammonium) is more important in agricultural areas and the oceans of the southern hemisphere. Similar to sulfur, nitrogen wet deposition decreased in North America and Europe and increased in Asia and Africa during the 2000 to 2007 period. These changes coincide with changes in precursor emissions around the world over the same time period, including decreases in NO\(_x\) emissions in North America and Europe and major NO\(_x\) and NH\(_3\) emission increases in Asia. Also as in the case of sulfur, regional model-based estimates of dry and total deposition are only available for selected sites in North America, Europe, Africa, Japan and Australia. The HTAP ensemble-mean model estimates of dry and total deposition are highest in the eastern United States, western Europe, South Asia and eastern China.

**SEA SALT & BASE CATIONS**

Measurements and modeling results show that sea salt is an important source of sodium (Na\(^+\)) and chloride (Cl\(^-\)) wet deposition along ocean and inland sea coastlines. Model-based estimates of total deposition of sea salt show that it can be transported and deposited on ecosystems more than 500 km inland. Measurement-based maps of wet-deposited base cations (Na\(^+\) + Mg\(^{2+}\) + Ca\(^{2+}\) + K\(^+\)) are available to the critical load community. However, these are only partial estimates because measurements and model results of dry and therefore total deposition of base cations are not available at this time.

**ORGANIC ACIDS**

A review of the literature shows that organic acids play an important role in controlling atmospheric acidity in many regions of the world and dissolved carbon-containing acids in deposition play an important role in ecosystems. The highest concentrations of formate and acetate in precipitation are generally observed in forested tropical areas near the equator, with a gradual decrease toward the poles. At sites in Africa, which are the only sites where routine formate and acetate measurements are collected, total wet carbon deposition from these compounds exceeds wet sulfur deposition and is comparable to wet nitrogen deposition. No estimates of dry deposition for these compounds were available at the time this assessment was completed.

**ACIDITY & pH**

Acidity and pH are dominated by strong mineral acids (sulfuric and nitric) in locations near and downwind of major industrial regions of the world including eastern North America, Europe and eastern Asia. Global hydrogen (H\(^+\)) concentrations from these acids can be measured and modeled well except in regions where H\(^+\) concentrations in precipitation are less than 5 µeq L\(^{-1}\). In these areas, weak acids (carbonates and organic acids) contribute much of the acidity; however, they are not routinely measured in networks.

**PHOSPHORUS**

Phosphorus exists in organic and inorganic forms that have limited solubility and are not well characterized in wet and dry deposition. The only form that is routinely monitored is ortho-phosphate and it is measured only by one network in the eastern U.S. Atmospheric phosphorus occurs primarily in the form of particles and deposition of these particles is very difficult to estimate using existing measurement methodologies. Maps of measured wet deposition and estimated dry deposition of soluble and total phosphorus are shown.

**Gaps & Recommendations**

Many regions of the world, including South America, large areas of North America, much of Asia, Africa, Oceania, the polar regions, and the oceans remain very poorly sampled for all major ions found in precipitation. Even in regions where measurement density is higher, little is known about phosphorus, organic acids and some nitrogen species, and limited cation species. There is a pressing need for the scientific community to provide large-scale values of total deposition of all of these compounds in order to further our understanding of biogeochemical cycling and adequately assess ecosystem effects. This will require high quality measurements of wet and dry deposition and inferential dry deposition of coarse and fine particles and acidifying gases, verified by measurements made using advanced dry deposition flux techniques. The development of robust measurement methods will be required for some compounds. Increases in monitoring should be focused on regions of strong population growth and industrial development, areas of high ecosystem vulnerability, and areas where agricultural activity and biomass burning are intensifying. It is equally important that emerging and existing monitoring programs adopt accepted and standardized deposition measurement methodologies described in WMO/GAW (2004), as this is the best way to ensure the comparability of measurements for regional and global assessments. Many of the emerging scientific and policy questions associated with managing atmospheric pollution and mitigating ecosystem and human health impacts will require the integration of long term measurements with model simulations in order to provide answers as comprehensively and cost-effectively as possible. This will require a better understanding of the uncertainty associated with grid-average modeled values and point measurements of deposition. Continued model development and evaluation for all of the chemical compounds discussed in this assessment is needed. The full assessment by Vet et al. (2014) is available online.
HOW DO YOU WANT YOUR CAREER TO PROGRESS & WHERE DO YOU THINK YOU CAN ULTIMATELY HAVE THE GREATEST IMPACT? DO YOU SEE YOURSELF CONDUCTING THE RESEARCH IN YOUR CURRENT FIELD INDEFINITELY?

My interest at the moment is shifting into more air quality related issues, in particular in large cities, also referred to as megacities, and how they can impact climate. I don't know how much of my scientific interest will evolve in the future and neither how priorities in science will evolve in the next 10, 20 years from now. I believe it is good to let the scientific interest and curiosity evolve, as everything else evolves. I enjoyed the journey so far and I'll try to continue enjoying it in the future.

WHAT IS THE ULTIMATE GOAL OF SCIENCE?

In the particular field of Climate Sciences the goal is to understand the multiple interactions occurring in the Earth system in order to understand how we impact climate with our activities. Based on this understanding we can figure out how we can mitigate that impact and exist in a more environmental friendly way. In more general terms, I believe science tries to satisfy human thirst for knowledge and understanding at different levels.
health risk assessment efforts, including but not limited to the work of the TF HTAP and the Task Force on Health Aspects of Air Pollution (TFH) of the UNECE Convention on Long Range Trans-boundary Air Pollution (LRTAP) as well as the Climate and Clean Air Coalition (CCAC). The discussions at the meeting focused on lessons that may be learned from the Global Burden of Disease project and the WHO’s Review of Evidence of Health Aspects of Air Pollution (REVIIAP) and Health Risks of Air Pollution in Europe (HIRAPIE) projects. A report from the meeting is being developed and will be used as the starting point for a WHO publication for health risk assessment practitioners and policy makers on general principles for air pollution health risk assessment for various purposes and at various scales.

OPEN SECTION

FUTURE MEETINGS

The TF HTAP, in conjunction with the LRTAP Convention’s Task Force on Integrated Assessment Modeling (TFIAM) is planning an expert meeting on global emissions scenarios for air pollutants at the International Institute for Applied Systems Analysis outside Vienna, Austria, on 14-15 October 2014. In conjunction with AQMEII, TF HTAP is planning a one-day workshop on 30 October 2014, directly following the Community Modeling & Analysis System (CMAS) Conference in North Carolina.

OPEN SECTION

UGEC Project

Scoping Meeting for a New Urban Research Initiative

21-22 FEBRUARY 2014 // LONDON, UK

The Urbanization and Global Environmental Change (UGECC) Project organized a Scoping Meeting for a New Urban Research Initiative at Royal Holloway, University of London on 21-22 February 2014. As the UGECC is sun-setting (ending in early 2016), this meeting was a first step of an inclusive process to frame a new urban-based research initiative or multiple initiatives to be integrated with Future Earth, the new global research platform working to support transformations to a sustainable world.

It was apparent at the recent Future Earth meeting for the Global Environmental Change (GEC) Projects in January 2014 that the study of ‘urban areas’ or ‘urbanisation’ is an overlapping area of interest for many of the GEC projects. The goal of this timely Scoping Meeting was to bring this expertise and disciplines within the natural and health sciences together with UGEC scholars. Among those present in the GEC family included IGAC, which offered insight to the natural and human drivers of air quality and climate change in urban systems, and feedbacks of decision-making as well as DIVERSTAS projects on the interactions between urbanization and ecosystem services and biodiversity at local to regional scales, with links to human health and wellbeing.

Twenty-seven urban researchers, scholars and stakeholders from 15 countries took part offering a diversity of regional, disciplinary and applied perspectives. In order to facilitate discussion amongst the participants, the meeting was structured around a series of six breakout sessions where small groups met to discuss, record and ultimately report back to the larger group the findings of their discussion.

To help catalyze the conversation before the meeting, participants were asked to prepare short responses to questions to be discussed in greater detail during the meeting:

1. What are the key urban research and policy questions that are critical to be included in the Future Earth framework?
2. What are the gaps in knowledge, i.e., potential future areas of urban research
that would aid in the transformation to global sustainability?
3. What are the major challenges and opportunities for developing conceptual and methodological frameworks that support the global transformation to sustainability in the context of an urbanizing planet?
4. What operational mechanisms must be in place for a successful interdisciplinary urban-themed project that fits within Future Earth and how can they be created?

As part of the meeting’s events the participants also outlined a possible vision and mission for this urban initiative(s) to help focus objectives. Ideas exchanged over the two days included (among others): how best to define new urban research pathways for the next 15-20 years, how to develop a platform to optimally share knowledge, how best to enable co-production and co-design of urban and GEC research and ensure inclusion of end-users. This information has been formulated into a draft white paper and will be disseminated to the GEC and wider urban communities for input to this ongoing scoping process.

An important outcome came from the collaboration of ideas for integrative urban research projects, many of which were submitted to Future Earth in response to the call for Fast Track and Cluster Activity proposals. “Urban Futures within Future Earth” aims to build upon the work initiated by the Scoping Meeting through a series of future workshops to create a bridge between the sunset of the UGEC Project and a more inter- and trans-disciplinary urban initiative(s) that will continue to build on the project’s legacy.

MÁRI E. GÖGEGEAN-QUINN
Europe Commis}(available here) by Máire Geoghegan-Quinn, European Commissioner for Research, Innovation and Science. This celebration day also included scientific keynote presentations: Guy Brasseur (Climate Service Center, Hamburg) summarized the science achievement of MOZAIC, Leonard Barrie (Bolin Centre for Climate Research, Stockholm University) gave an overview on the role of IAGOS and European Infrastructures in Global Air Chemistry Research, completed by Gelsomina Pappalardo (CNR-IMAA, Potenza, chair ESFRI ENV SWG) providing visions for a Future Integrated Global Atmospheric Composition Observations System in Europe. Finally, Andreas Volz-Thomas (IAGOS-AISBL) presented the history and future prospects of IAGOS.

The 2.5 following days were dedicated to scientific presentations and gathered about 80 participants in Centre International de Conference at Météo-France. The objectives were clearly to further link the different communities and to foster further development in research themes. As organizers and IAGOS principal investigators (PI), we also aimed at further understanding the needs of users both in terms of database functionality and measurement capacities. We received more than 70 abstracts and ended up having 45 talks and 20 posters presented. Each of the six sessions was introduced by an invited speaker who gave an overview of the topic and emphasized MOZAIC-IAGOS contributions to the question. Peter Van Velthoven (KNMI) opened the first session on Evaluation/Validation of Satellites and Surface Remote Sensing. Kathy Law (CNRS-LATMOS) introduced the Long-Range Transport of Air Pollutants session. Philippe Nédélec (CNRS-LA), and Christoph Gerbig (MPI-BGC) gave information on Recent and New Technical Developments. Bill Randel (NCAR) opened the UTLs Chemical Composition and Trends session. Vincent-Henri Petch (ECMWF) introduced the Monitoring Atmospheric Composition, Climate and Air Quality session recalling the role of IAGOS data in the future Copernicus Atmospheric Service. Finally, Peter Spichtinger (Univ. Mainz) revisited the knowledge on cirrus cloud formation and properties for opening the Water Vapour and Clouds session. These six sessions highlighted new results based on the MOZAIC data and complementary programs such as aircraft data sets like Civil Aircraft for the Regular Investigation of the atmosphere Based on an Instrument Carrier (CARIBIC, part of IAGOS now) and Comprehensive Observation Network for Trace gases by Airliner (CONTRAIL), surface networks and satellites observations. Several speakers emphasized the need of combining different sources of measurements and a complete set of atmospheric compounds and properties to further investigate the scientific questions on air quality and climate change at global scale, which is indeed the overall objective of IAGOS.

Some of these contributions will be published in the MOZAIC-IAGOS special issue of Tellus B. Further information: http://www.iagos.org, http://www.iagos.org. The 4th Integrated Land-Ecosystems: Atmosphere, & People in the Earth System Science Conference (ILEAPS) in connection with the science conference, and this year was no exception. Kirsti Ashworth from the University of Michigan led a team of 9 early-career scientists that put together a tremendous event. The scientific theme of the ECSW (10–12 May) was ‘Emerging issues in biosphere-atmosphere interactions in a human-influenced Earth system’; the practical part focused on how
to build a successful career as an independent, cross-disciplinary researcher. The organizers were able to spur exceptionally fruitful interaction between the students and the high-level teachers Prof. Paulo Artaxo (University of São Paulo, Brazil), Dr. David W. Ode (Kenya Forestry Research Institute, Nairobi, and Centre for Ecology and Hydrology, UK), Dr. Nobuko Saigusa (National Institute for Environmental Research, Tsukuba, Japan), Dr. Hang Su (Max-Planck-Institut für Chemie, Germany), Dr. Christine Wiedinmyer (National Center for Atmospheric Research, USA), and Prof. Qiang Zhang (Tsinghua University, China).

The main conference consisted of prominent keynote talks and 16 conference sessions. This time, the sessions were formed by a bottom-up approach as opposed to the top-down approach used in previous years; the new approach gave rise to both positive and negative feedback. The diversity of topics, speakers, and participants and the prominence of Asian science in the speeches were seen as positive; on the other hand, the same diversity led to some negative feedback because a top-down, keynote-led approach would have ensured a better balance between atmospheric and land-based research.

The panel discussion "Research infrastructures vs. observation networks; uses and best practices" outlined plans for collaboration and joint activities for the years to come. Furthermore, a new network "iLEAPS-Asia" met twice during the conference, especially by other Asian scientists who found new collaboration opportunities. The entire conference stressed the need for multidisciplinary efforts in approaching the grand challenges. One way to solve this would be by means of interoperability of research infrastructures and observation networks: having them work together rather than as separate organizations. For this, we need technological capital (instruments and infrastructure development, data and e-infrastructures); cultural capital (open research and data, standardized language, global and interdisciplinary attitude); and human capital (data scientists, Earth System scientists, mobility, citizen science).

Many of the sessions were formed around the new research initiatives that iLEAPS has started in collaboration with other core projects, and the turnout in all the sessions was a positive surprise and showed that we are moving in a good direction. Particularly, the New directions – session in the end received positive feedback; it spurred a lot of discussion on geoengineering and on new ways of learning. Interactive discussion was applauded and many suggested that it should be increased in the next conference, even with a multidisciplinary panel discussion on the links among various iLEAPS themes that would give the audience an idea of how complex land-atmosphere-society connections are.

Overall, Chinese science was well represented and this was appreciated especially by other Asian scientists who found new collaboration opportunities. Furthermore, a new network "iLEAPS-Asia" met twice during the conference, outlining plans for collaboration and joint activities for the years to come. Altogether, the conference attracted more than 300 abstracts and about 280 participants.

Five daily plenary lectures were given by distinguished guest speakers:

- Fifty years of African dust studies on Barbados: What we learned and what must we do next? - Joseph M. Prospero (University of Miami, USA).
- Dissolution of dust mineral particles in humans and environment. A geochemical perspective - E. Javier Huertas (CSIC – University of Granada, Spain).
- Mineral dust mapping from space with NASA Earth Observing System instruments - Ralph A. Kahn (NASA Goddard Space Flight Center, USA).
- African dust outbreaks and air quality in Southern Europe: Is it only dust that matters? - Xavier Querol (CSIC Barcelona, Spain).
- Accelerator based techniques for aerosol analysis - Franco Lucarelli (University of Florence, Italy).

The design of the conference centre ensured that the lectures rooms were all within a few meters making it easy to move among the rooms hosting the sessions. Also accommodation, restaurants and leisure areas were all within short distances. Although the location was far from town (it is in a resort), delegates appreciated a lot the opportunity to stay in touch with one another in addition to the time they spent together attending sessions.

One of the most relevant aspects of DUST 2014 was the participation of a number of students (18%). Many of them participated in the DUST 2014 Prizes for Best Oral Student Presentation and Best Poster Student Presentation. The level of the competition was very high and the choice was rather difficult.


The 2nd International Conference on Atmospheric Dust will be held in June 2016. Information will be posted on www.dust2016.org.
User Facility Meeting on
Science of Atmospheric Aerosols

6-7 MAY 2014 // RICHLAND, WASHINGTON, USA

Nearly 100 scientists from across the country assembled to discuss the latest research results related to atmospheric organics 6-7 May 2014, at the Environmental Molecular Sciences Laboratory’s annual User Meeting. "Integration 2014: The Science of Atmospheric Organics” kicked off with a keynote presentation by Harvard University’s Scot Martin, who spoke on observations during the Department of Energy’s GoAmazon field campaign. Specifically, he presented recent insights on "How Urban Pollution Affects the Atmospheric Chemistry and photochemistry. He conducts experiments in his laboratory at University of California-Irvine then sends samples to EMSL's Hongfei Wang, who uses a recently developed one-of-a-kind high-resolution sum frequency generation (HR-SFG) spectrometer to discern surface particle reactions with a resolution ten times better than any other instruments out there. He's able to study these samples at the surface.

The meeting also provides an opportunity to build new relationships across the community and inform researchers about EMSL’s existing or emerging capabilities. For example, EMSL’s NWChem computational chemistry code was recently enhanced for molecular-scale modeling to characterize chromophore conformations – a step that allows Nizkorodov to extend this work to develop robust quantitative algorithms for predictive climate models. NWChem developers held a half-day workshop on the software and its ability to model atmospheric processes on the second day of the user meeting.

Workshops included:
• Mass Spectrometry and Aerosols, with eight speakers discussing how they use mass spectrometry to characterize individual aerosol particles and study chemistry of organic aerosols.
• Electron Microscopy Methods in Aerosol Research, with tutorials on electron and scanning electron microscopy. Presenters included Peter Buseck of Arizona State University.

The meeting included plenary talks by Barbara Finlayson-Pitts (University of California-Irvine), Allen Goldstein (University of Colorado-Berkeley), Jose Jimenez (University of Colorado-Boulder), Jim Smith (NCAR) and Doug Worsnop (Aerodyne). Their presentations were followed by four half-day workshops on various EMSL capabilities and how they have been or could be applied to advance atmospheric research.

Research discussed included Sergey Nizkorodov’s studies of aerosol photochemistry. He conducts experiments in his laboratory at University of California-Irvine then sends samples to EMSL’s Hongfei Wang, who uses a recently developed one-of-a-kind high-resolution sum frequency generation (HR-SFG) spectrometer to discern surface particle reactions with a resolution ten times better than any other instruments out there. He’s able to study these samples at the surface.

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**IGAC COMMUNITY**

**Calendar**

Visit igacproject.org for updates to the calendar.

**AUGUST**

- **ACS National Meeting**
  Session: Fundamental Processes of Atmospheric Chemistry
  10-14 August 2014
  San Francisco, CA, USA

- **Climate Engineering Conference**
  2014 (CEC2014)
  18-21 August 2014
  Berlin, Germany

**SEPTEMBER**

- **IGAC SSC Meeting**
  20-21 September 2014
  Natal, Brazil

- **13th Quadrennial ICACGP Symposium & 13th IGAC Science Conference**
  22-16 September 2014
  Natal, Brazil

**OCTOBER**

- **Our Climate – Our Future**
  6-9 October 2014
  Berlin, Germany

- **AICI Workshop**
  Chemical Atmosphere-Snow-Sea Ice Interactions: Taking the next big step in field, lab and modeling
  13-15 October 2014
  Cambridge, UK

- **OH Reactivity Specialists Uniting Meeting (ORSUM)**
  13-15 October 2014
  Mainz, Germany

- **HTAP Workshop on Global Emissions Scenarios**
  14-15 October 2014
  Luxenburg, Austria

- **ESA/SOLAS Conference on Earth Observation for Ocean-Atmosphere Interactions Science**
  28-31 October 2014
  Frascati (Rome), Italy

**NOVEMBER**

- **7th International Symposium on Non-CO2 Greenhouse Gases (NCCG7)**
  5-7 November 2014
  Amsterdam, The Netherlands

**DECEMBER**

- **Better Air Quality (BAQ) Conference**
  15-19 December 2014
  Colombo, Sri Lanka

- **Atmospheric Chemical Mechanisms Conference**
  10-12 December 2014
  Davis, CA USA

- **AGU Fall Meeting**
  15-19 December 2014
  San Francisco, CA, USA

**ITALICS:** IGAC Sponsored or Endorsed Event

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**THIRD Announcement: The joint 13th Quadrennial ICACGP Symposium and 13th IGAC Science Conference**

“Changing chemistry in a changing world”
Natal, Brazil, 22-26th September 2014

Hotel booking options available online now! [http://igac-icacgp2014.org](http://igac-icacgp2014.org)

Abstract submissions are open until March 15th, 2014.

The best hotels in Natal, located very close to the conference venue and the beach, with special conference accommodation rates are ready for booking. Please check the booking system on the conference website.

The topical theme of the joint 13th Quadrennial ICACGP Symposium / 13th IGAC Science Conference is “Changing Chemistry in a Changing World”. The joint 13th ICACGP / 13th IGAC Quadrennial Symposium/Conference takes place over five days and comprises six plenary sessions with 15 confirmed keynote and invited speakers:

- **Session 1:** Atmosphere-surface (ocean/vegetation/ice) interactions in a changing climate
- **Session 2:** Atmospheric chemistry and the coupling between biogenic and anthropogenic
- **Session 3:** Interactions between aerosols, clouds and precipitation
- **Session 4:** Atmospheric chemistry and urbanization: from local to the global scales
- **Session 5:** Atmospheric chemistry fundamentals
- **Session 6:** Atmospheric chemistry in a changing climate

One of the assets of ICACGP/IGAC Symposia/Science Conferences is the Young Scientist Program. Master and PhD students as well as scientists that graduated within the last five years (i.e. from 2009 – 2014) are welcome to participate in the extensive Young Scientist Program during the conference. Young Scientists may apply for funding through our website.
