SCIENCE FEATURE:
PRECIPITATION CHEMISTRY & DEPOSITION

YOUNG SCIENTIST PROFILE:
NICHOLA HUNEEUS

IGAC NEWS

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.

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POINT OF VIEW

IGAC IN PERSPECTIVE

Stuart Penkett was a member of the IGAC Scientific Steering Committee (SSC) from 1993-1997 and was Co-Chair of the IGAC SSC in 1998. During his time on the IGAC SSC, Stuart was lead author for the chapter on Atmospheric Photooxidants in the book *Atmospheric Chemistry in a Changing World*, led the UK project Atmospheric Chemistry Studies in the Ocean Environment (ACSOE) from 1995-2000 that directly contributed to IGAC science and chaired the joint European IGAC Project Office that was set up to integrate EU-funded science with IGAC. Stuart also served as chairman of the Reactive Gases Science Advisory Group of WMO GAW from 2005-2013.

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 (SO_2) 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.

Participants of the 1988 Dookie, Australia meeting.

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 – Atmopsheres* 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 HO_X under conditions of low NO_X.
- 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 requiring the assembly of a large database on 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 speciation 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 CO_2 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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REFERENCES

National Research Council. Global Tropospheric Chemistry: A Plan for Action. Washington, DC: The National Academies Press, 1984.

Atmospheric Chemistry in a Changing World, Eds. Brasseur, G.P., Prinn, R.G. and Pszenny, A.P., Springer-Verlag, Berlin, Heidelberg, 2003.

IGAC Welcomes 2 New Activities

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, AICI. 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.

Results Are In:

FUNDAMENTALS OF ATMOSPHERIC CHEMISTRY CALL FOR PROPOSALS

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 "Nitrate 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 chemisty community values the IGAC Activity on Fundamentals.

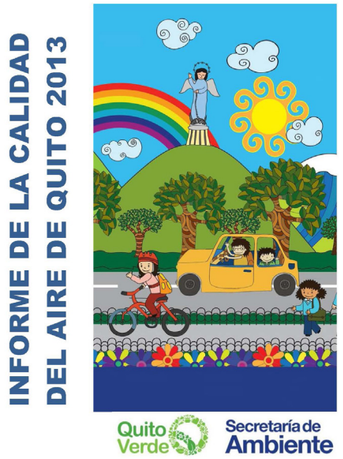
This workshop will bring together a diverse group of scientists with a breadth of expertise extending from the laboratory to the filed to atmospheric modeling.

IGAC will also be sponsoring a broader workshop on Fundamentals of Atmospheric Chemistry that will help guide this IGAC Activity and the international community on this topic. The workshop entitled "The Future of Laboratory Studies in Atmospheric Chemistry" will take place spring 2015 at NOAA/ESRL in Boulder, CO USA.

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 in 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.

Report on Air Quality in Quito, Ecuador 2013



A Member of the IGAC Americas Working Group community, Valeria Díaz, is the lead on a report on air quality in Quito, Ecuador (*Informe de la Calidad del Aire del Distrito Metropolitano Quito*). The report analyzes collected data on carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), ozone (O_3) and particulate matter (PM10 and PM2.5) levels and compares them with the Ecuador air quality standards (Norma Ecuatoriana de Calidad de Aire, NECA). The data was collected from 8 automatic and 36 manual air quality monitoring stations throughout 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.

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 Research Institute for Humanity and Nature (for Asia), the Tyndall Centre for Climate Change Research (for Europe) and The Cyprus Institute (for the Middle East and North Africa). Discussions to develop an African hub are underway, with plans in other regions also under consideration.

futureearth
research for global sustainability

SUBMIT Articles To The Next IGAC Newsletter

IGAC is now accepting article submissions for the next IGAC newsletter. Event 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 November issue of the IGAC Newsletter is 17 October 2014. Send all submissions to info@igacproject.org.

@IGACProject
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.

IGAC\iLEAPS\WMO Third Workshop for the Interdisciplinary Biomass Burning Initiative

23-26 APRIL 2014 // SCHLOSS RINGBERG, GERMAY

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, 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 fires within models, 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 (GEIA) 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.

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Report from the Chemistry Climate Model Initiative 2014 Workshop

20-22 MAY 2014 // LANCASTER UNIVERSITY, UK

The 2014 IGAC/SPARC Chemistry Climate Model Initiative (CCMI) Workshop was held at Lancaster University, UK from 20-22 May 2014, with over 130 participants. CCMI grew out of the need to better coordinate activities that focus on chemistry-aerosol-climate coupling between the stratosphere and troposphere and assessing the science in terms of comprehensive models with chemistry. To this end, the CCMI Workshop brought together experts in the use and analysis of global tropospheric/stratospheric chemistry and aerosol models and experts *in-situ* and satellite chemical and aerosol measurements. The workshop consisted of two and a half days of discussion, contributed and invited talks and posters.

The primary focus of the workshop was on the CCMI Reference simulations (defined here), which are centered on understanding the trends and interannual variability of tropospheric and stratospheric composition from 1960-2100, as well as how the composition and physical climate interact. Seventeen modeling groups from ten different countries and four different continents gave a brief overview of their progress in these simulations, showing some initial results. Several different groups have completed the global chemistry climate hindcast (REF-C1) simulations, including the free running simulations (from1960-2010), the specified dynamics simulation (from 1980-2010), and the free running REF-C2 simulations (1960-2100). Additionally, several groups have completed a number of the sensitivity simulations. Results from these simulations will be collected in a special journal issue with submission tentatively starting in May 2015. We encourage other groups with tropospherically oriented models, stratospherically oriented models or fully coupled models to participate in these simulations. Further information can be found on the CCMI website.

The goals of CCMI and the science that supports its aims were presented in ~30 talks and a 3 hour poster session (with >90 posters) over the 2 ½ day workshop. A number of presentations in the early sessions emphasized the need for future contributions of CCMI to the *WMO/UNEP Scientific Assessments of Ozone Depletion* and the relationship between CCMI and CMIP6, the coupled climate model experiments that will – amongst other things – support the IPCC process. In particular, there is the potential for CCMI to contribute substantially to the climate forcing data needed for CMIP6 simulations, including time varying stratospheric aerosol and ozone distributions. Plans for a CMIP6-sponsored experiment linking CCMI and AEROCOM (AerChemMIP) were also discussed, and a number of presentations emphasized that the interaction between chemistry and aerosols is important in quantifying both of their forcings. CCMI will also contribute to presentations emphasized that the interaction between chemistry and aerosols is important in quantifying both of their forcings. CCMI will also contribute to Obs4MIPs (a pilot effort to provide a variety of observationally-based datasets for climate model evaluation), with the particular focus on constraining tropospheric OH. A session on "Novel observations to test model performance" included talks on satellite data, and the recent aircraft measurement campaigns in the tropical Pacific Ocean: Airborne Tropical TRopopause EXperiment (ATTREX), CONvective TRansport of Active Species in the Tropics (CONTRAST), and Co-ordinated Airborne Studies in the Tropics (CAST). "Hindcast simulations and proposed evaluations" focused on various methodologies to evaluate the CCMI hindcast simulations, including using the long-term tropospheric ozone record, the record of total column ozone, aerosol trends, idealized tracers and satellite CO. The session on "Process oriented model evaluation: dynamics, transport and chemistry" emphasized methodologies to better diagnose model processes. Talks included the emissions of natural aerosols, the diagnosis of hydroxyl (OH) differences between models, the impact of dry deposition parameterizations for ozone, the impact of gravity wave parameterizations on Antarctic ozone loss, and how CCMI analyses

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.

More details about the workshop, including many of the presentations, can be found on the workshop website.

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:

- **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.
- **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 waste burning as a potential source of toxic compounds.
- **ENERGY PRODUCTION.** Extensive analysis of methane and hydrocarbon emissions from energy production and distribution, including conventional and unconventional extraction and leaks from abandon sites, is essential for informing choices about energy sources.

- **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.
- **VOC SPECIATION.** 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.
- **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.
- **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.
- **HISTORICAL EMISSIONS.** GEIA is leading an effort to quantify global emission 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.
- **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 regulators and policy-makers engaged in environmental protection, pollution mitigation, and adaptation strategies, and increases the capacity for understanding emissions around the world.

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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 HTAP) 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)?; and
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 (nssS) wet deposition is highest (> 10 kg S ha^{-1} a^{-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 nssS wet deposition decreased significantly after 1990 and particularly between 2000 and 2007, while wet nssS 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 measurement-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 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

Combined measurements and ensemble-mean model results showed the highest levels of nitrogen wet deposition (> 8 kg N ha^{-1} a^{-1}) occurred 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 measurement-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.

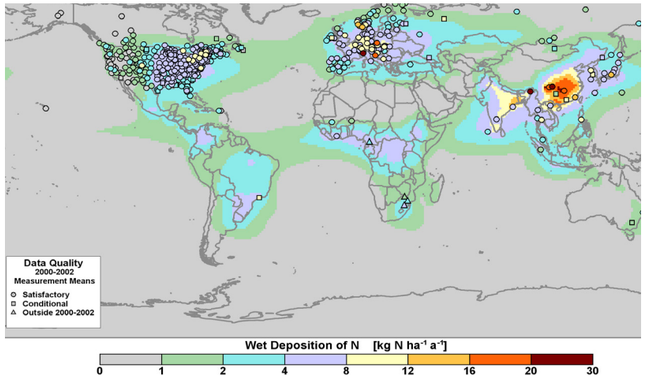

Figure 1. Measurement-model wet deposition of nitrogen in kg N ha^{-1} a^{-1}. Measurement values represent the 3-year averages for 2000-2002; model results represent the 2001 model year (from Vet et al., 2014).

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 organics) 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 coarse 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.

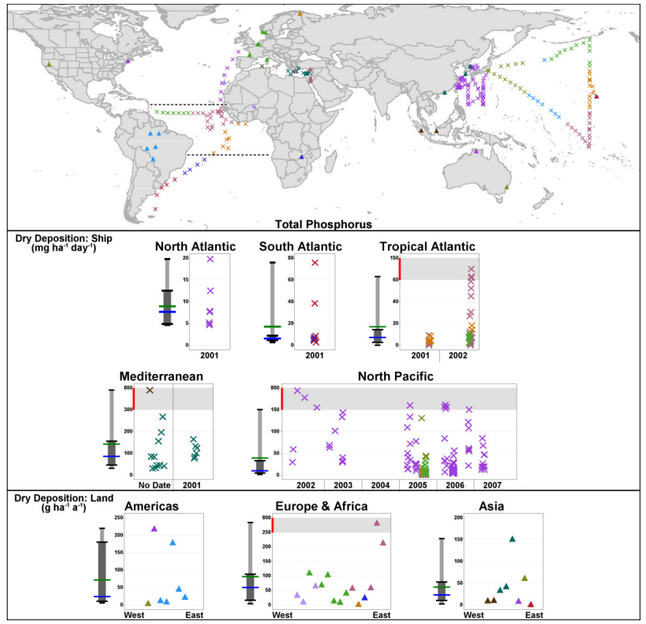

Figure 2. Calculated dry deposition of total phosphorus derived from available aerosol total phosphorus concentrations from studies aboard ships (mg P ha^{-1} day^{-1}) and from long-term measurements at land sites (g P ha^{-1} a^{-1}); (from Vet et al., 2014).

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 organic forms of nitrogen. Inferential dry deposition estimates are only available in a few regions of the world and these are incomplete, only addressing sulfur, 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 worldwide of wet 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.

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YOUNG SCIENTIST PROFILE:

Nicolas Huneeus

Nicolas Huneeus is from a Chilean family, but was born in Germany where he spent a large part of his childhood. He did most of his school education as well as his university studies in Santiago, Chile. The past 10 years he spent in France for his PhD and for work. Nicolas is a chemical engineer with a MSc in Meteorology from the University of Chile in Santiago. He did his masters in the transport of pollution in northern Chile. After finishing his masters he moved to France for his PhD. The thesis of his PhD in Lille, France concentrated on the interaction of aerosols with solar radiation, more specifically on the estimation of vertical and size distribution of aerosols from the combined assimilation of satellite radiances and backscattering profiles. Currently Nicolas works at the University of Chile in Santiago. Nicolas was awarded a Young Scientist Travel Grant to attend the Third IBBI Workshop.

WHERE & IN WHAT ARE YOU WORKING ON NOW?

My main research subject is the estimation of aerosol emission on a global scale from integrating satellite data with numerical models, so called "top-down" techniques. Yet, after 10 years in France, I recently (3 months ago) moved back to Chile where I started a permanent position at the Department of Geophysics and the Center for Climate and Resilience Research (CR2), at the University of Chile. I am still closing up some of the research projects I have been working on as a post-doc at the Laboratoire de Météorologie Dynamique in Paris. But I'm also defining my research priorities for the next few years, which will be based on my previous work, and I am applying for the necessary funding.

IS THERE AN ELEMENT OF YOUR RESEARCH YOU BELIEVE TO BE PARTICULARLY IMPORTANT &/OR TIMELY?

Emissions are an important piece in the puzzle of estimating human impact on climate and also air quality. One can say it's the first step of a long chain of action and reaction that ultimately leaves a relatively known impact but uncertain in magnitude. Although traditional methods to estimate emissions (known as "bottom-up") already provide good emission data, I believe "top-down" methods provide complementary information that can contribute in the preparation of improved emission inventories.

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 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've enjoyed the journey so far and I'll try to continue enjoying it in the future.

HOW HAS YOUR EXPERIENCE AS A RESEARCH SCIENTIST COMPARED TO THE EXPECTATIONS YOU HAD AS A PHD STUDENT? HAVE YOU HAD ANY REALIZATIONS ABOUT THE PROFESSION THAT YOU'D LIKE TO SHARE WITH CURRENT PhD STUDENTS?

The PhD is a very special and unique moment; you can focus for an extended period of time on a specific subject without worrying much on other issues such as funding and administrative tasks. I recommend taking this opportunity not only to do your best on the thesis but also to promote curiosity in subjects not directly related to it.

WHAT ARE YOU MOST LOOKING FORWARD TO IN YOUR NEW PROFESSORSHIP?

In my previous job I didn't have any teaching activities so I'm looking forward to start teaching next semester, have contact with students and try to motivate them in their studies and maybe even get to motivate them to go into science.

GIVEN YOUR ATTENDANCE AT THE 2014 16TH GEIA CONFERENCE, THE 2014 IBBI WORKSHOP AND THE 2013 GEIA/IBBI/CCMI DEVELOPMENT OF A COMMUNITY HISTORICAL EMISSIONS INVENTORY WORKSHOP, CAN YOU SPEAK TO INTEGRATION IN THE CONTEXT OF EARTH SYSTEMS SCIENCE?

Research in the Earth system sciences is more and more interdisciplinary, collaborations among researchers from different fields and the integration of different research groups are essential in finding answers for the relevant questions.

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.

3 Workshops on Hemispheric Transport of Air Pollution (HTAP)

LINKAGES BETWEEN GLOBAL & REGIONAL SCALE MODELING, & HUMAN HEALTH & ECOSYSTEM IMPACTS

Task Force on Hemispheric Transport of Air Pollution

The Task Force on Hemispheric Transport Air Pollution (TF HTAP) is an international cooperative scientific effort to improve the understanding of the intercontinental transport of air pollution across the Northern Hemisphere. Over the course of two weeks, TF HTAP helped organize three events designed to reach out to other expert communities to seek advice and engagement in the TF HTAP work plan. The events addressed methodologies for assessing human health and ecosystem effects of air pollution and the linkages between global and regional scale modeling. Each of the three events are described below. Materials and reports from the events are posted on the website.

WHO EXPERT MEETING ON METHODS & TOOLS FOR ASSESSING THE HEALTH RISKS OF AIR POLLUTION AT LOCAL, NATIONAL & INTERNATIONAL LEVEL

12-13 MAY 2014
BONN, GERMANY

This expert meeting was convened by the World Health Organization (WHO) to discuss the data, methods, and tools available for assessing the human health risks of air pollution at various geographic scales. The meeting was intended to provide advice to a variety of

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 Transboundary 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 (REVIHAAP) and Health Risks of Air Pollution in Europe (HRAPIE) 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

INTERNATIONAL CONFERENCE ON OZONE & PLANTS

18-21 MAY 2014 // BEIJING, CHINA

Jointly with the LRTAP Convention's International Cooperative Programme on Vegetation, the TF HTAP organized a session within the International Conference on Ozone and Plants organized by the State Key Laboratory of Urban and Regional Ecology, Research Center for Eco-Environmental Sciences, The Chinese Academy of Sciences (CAS), the International Union of Forest Research Organizations (IUFRO), and ICP Vegetation. The session focused on whether methods developed for vegetation impact assessment in Europe and North America are applicable also to Asia. Overall the emerging evidence from Asia reveals that ozone damage to crops and natural vegetation is at least comparable to that in Europe, and in many cases even higher for ozone-sensitive crops. One of the outcomes relevant for TF HTAP was that flux based approaches show ozone damage occurring at lower threshold values than the commonly used European AOT40 or American W126 methodologies. While regional emission abatements will have to deal with peak ozone episodes, global cooperation on methane (CH_4) emission reductions will be beneficial to lower global background ozone and damage to plants.

JOINT WORKSHOP OF MODEL INTERCOMPARISON STUDY-ASIA PHASE III (MICS-ASIA) & TF HTAP

22-23 MAY 2014 // BEIJING, CHINA

The TF HTAP, jointly with the regional modelling projects MICS-Asia and the Air Quality Model Evaluation International Initiative (AQMEII) (North America and Europe), has planned a series of global-regional coupled emission perturbation sensitivity experiments, with emissions and model set-up harmonized across the globe. Four global models (ECMWF/IFS, GFDL/AM3, SNU/GEOS-Chem, and Nagoya/CHASER) have provided 3-hourly boundary conditions for strictly defined sensitivity experiments perturbing a common emission inventory in a number of key-emission regions of the world. The workshop was hosted by the State Key Laboratory of Atmospheric Boundary Layer Physics and Atmospheric Chemistry (LAPC), Institute for Atmospheric Physics, Chinese Academy of Sciences, and focussed on presenting the progress of the work under MICS-Asia, AQMEII, and TF HTAP. TF HTAP, AEROCOM and AQMEII experts also presented a number of possible methodologies for analysing model experiments and explained and advocated for standardized output protocols in view of global interoperability of data. The MICS-Asia, AQMEII, and TF HTAP participants agreed to continue the overall coordination through periodic web conferences and to set up a small coordination group focused on data interoperability.

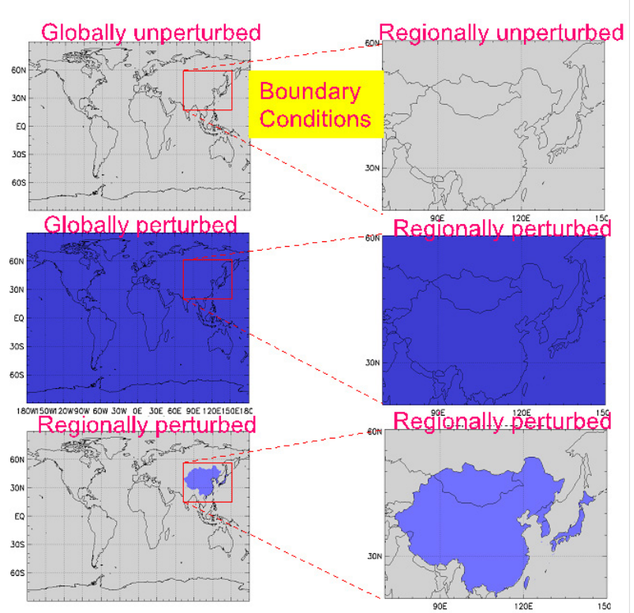

Figure 1. TF HTAP, MICS-Asia, and AQMEII have planned a series of coupled global and regional emission sensitivity simulations to better understand the effects of model resolution on estimates of long-range transport.

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.

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UGEC Project
Scoping Meeting for a New Urban Research Initiative

21-22 FEBRUARY 2014 // LONDON, UK

The Urbanization and Global Environmental Change (UGEC) Project organized a Scoping Meeting for a New Urban Research Initiative at Royal Holloway, University of London on 21-22 February 2014. As the UGEC 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 'urbanization' 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 DIVERSITAS 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.

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MOZAIC-IAGOS

Scientific Symposium on Atmospheric Composition Observations by Commercial Aircraft: 20th Anniversary

12-15 MAY 2014 // TOULOUSE, FRANCE

Climate change, air quality, and the oxidizing capacity of the atmosphere are major issues that require detailed long-term observations of atmospheric chemical composition on a global scale. For 20 years Measurement of Ozone and Water Vapour on Airbus in-service Aircraft (MOZAIC) and today its successor In-Service Aircraft for a Global Observing System (IAGOS) successfully have harnessed the potential of in-service aircraft to respond to these needs. This first MOZAIC-IAGOS Symposium was dedicated to celebrate 20 years of MOZAIC and to prospect future insights from ongoing IAGOS.

The celebration was held at Airbus on the 12th of May and gathered about 150 attendees representing historical and current partners of the program including airlines (Air France, Lufthansa, China Airlines, Cathay Pacific) and Airbus, the recently founded not-for-profit international association (IAGOS-AISBL), and the worldwide scientific community, along with funding agencies, highlighting their strong commitment to advancing scientific knowledge on climate research. Also, the European long-term support has been confirmed in video (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 the 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 Conférence 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 (PIs), 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 Peuch (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.fr, http://www.iagos.org

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2014 4th iLEAPS Science Conference

TERRESTRIAL ECOSYSTEMS, ATMOSPHERE, & PEOPLE IN THE EARTH SYSTEM

12-16 MAY 2014 // NANJING, CHINA

The 4th Integrated Land Ecosystem-Atmosphere Process Study (iLEAPS) Science Conference marked the change from mostly basic land-atmosphere science in iLEAPS Phase I (2004-2013) to societally relevant land-atmosphere-society science in iLEAPS Phase II (2014-2023) under Future Earth. The conference was hosted by iLEAPS-China at Nanjing University. Another big change was announced during the conference: after ten years at the University of Helsinki, Finland, the iLEAPS International Project Office will move to a new building at Nanjing University in January 2015. The conference was a great way for Nanjing University to form links with the iLEAPS community.

Traditionally, iLEAPS has organized an Early-Career Scientist Workshop (ECSW) 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 collaborative 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. Odee (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" emphasized the importance of government-funded research infrastructures (ICOS, NEON, LifeWatch) in providing quality data on a regionally representative scale and on a permanent basis, as opposed to short-term observations that may terminate because of lack of funding, are made by varying instruments and by non-standardized methods and post-processing. Challenges for organizing such large observation systems are human and practical resources and, outside Europe, the lack of international collaboration

in science-policy issues. Open data policy was also considered a challenge in China and elsewhere. The panel and indeed 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.

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1st International Conference on Atmospheric Dust - DUST 2014

1-6 JUNE 2014 //
CALANÉ CONFERENCE CENTRE, CASTELLANETA MARINA, ITALY

DUST 2014, the first edition of the International Conference on Atmospheric Dust, was held in Italy at the Calané Conference Centre, in the Nova Yardinia Resort, just a few kilometers from Castellaneta Marina. The meeting was organized by the Italian Association for the Study of Clays (AISA) and the Institute of Methodologies for Environmental Analysis – National Research Council of Italy (IMAA-CNR). The aim of the conference was to join mineralogists, physicists, geochemists, engineering, volcanologists, chemists and many other specialists for sharing ideas and knowledge on the boundless world of the atmospheric particles. No fewer than 365 delegates from 50 countries contributed to the six topics (Chemical & Mineralogical Studies; Geological Records; Health & Environment; Instrumentations & Measurements; Modeling & Field Studies; Transport & Deposition). Thirty-two sessions, 467 accepted abstracts, 5 plenary lectures, 307 free talks and 155 posters testify the interest of the scientific community for multidisciplinary approaches to the atmospheric dust.

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 - F. 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 Best Oral Presentation Award was given, ex aequo, to Pilar Gumà-Claramunt (National Research Council, Potenza, Italy), Milena Machado De Melo (Universidade Federal do Espírito Santo, Brazil) and Tim Ulens (Institute for Agricultural and Fisheries Research, Belgium). The Best Poster Presentation Award went to Laura Korte (Royal Netherlands Institute for Sea Research, Netherlands)

The book collecting the abstracts (ISBN: 978-88-7522-095-2) is available at http://www.dust2014.org/download/BoA.pdf. Extended abstracts will be published by the end of the year in a new open access conference proceedings series (ProScience). Information will be posted on www.scientevent.org/proscience.

The 2nd International Conference on Atmospheric DUST will be held in June 2016. Information will be posted on www.dust2016.org.

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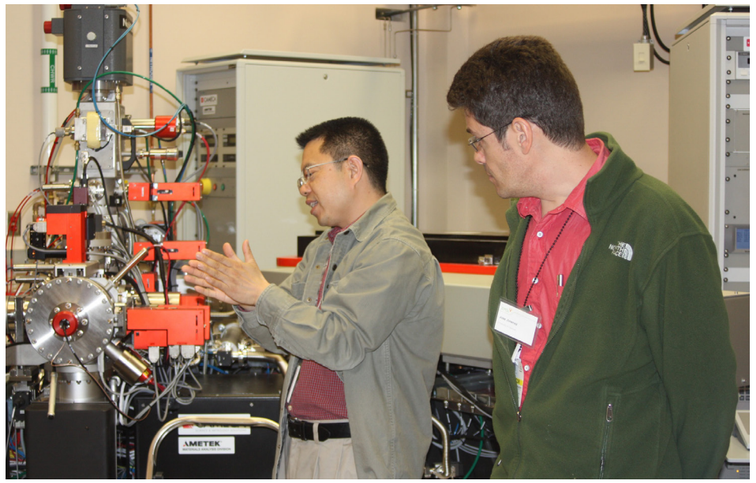
User Facility Meeting on Science of Atmospheric Aerosols

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 Particle Microphysics over the Tropical Rain Forest."

The user meeting was organized by Alex Guenther, who leads the Environmental Molecular Sciences Laboratory's (EMSL) Atmospheric Aerosol Systems programs and is a laboratory Fellow at Pacific Northwest National Laboratory (PNNL). EMSL is a US Department of Energy national scientific user facility located at PNNL in Richland, Washington, USA. EMSL holds an annual user meeting to engage its 700-plus annual users and the broader scientific community in scientific dialogue relevant to the mission of its DOE steward, the Office of Biological and Environmental Research (BER).

The meeting included plenary talks by Barbara Finlayson-Pitts (University of California-Irvine), Allen Goldsetin (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.

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.
- Molecular Modeling of Atmospheric Processes with NWChem, which connected researchers interested in atomistic modeling of atmospheric processes with the NWChem software. The tutorial covered modeling of various aspects of spectroscopic properties of molecular systems, of dynamics and kinetics in chemical transformations, of chemistry at interfaces and in the condensed phase, and then spanning longer time scales in biological processes modeled with molecular dynamics.
- Multi-scale and Multi-modal Chemical Imaging and Analysis of Aerosols, which included discussion of several techniques – from atom probe tomography to NanoSIMS – being used by EMSL users for aerosol studies. Professor Randy L. Vander Wal of Pennsylvania State University gave an invited talk on his application of high-resolution transmission electron microscopy to advance atmospheric research.

To learn about call opportunities to leverage EMSL's expertise and instrumentation for little to no cost, visit EMSL's website.

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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.

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

OCTOBER (cont)

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

NOVEMBER

7th International Symposium on Non-CO2 Greenhouse Gases (NCGG7)
5-7 November 2014
Amsterdam, The Netherlands

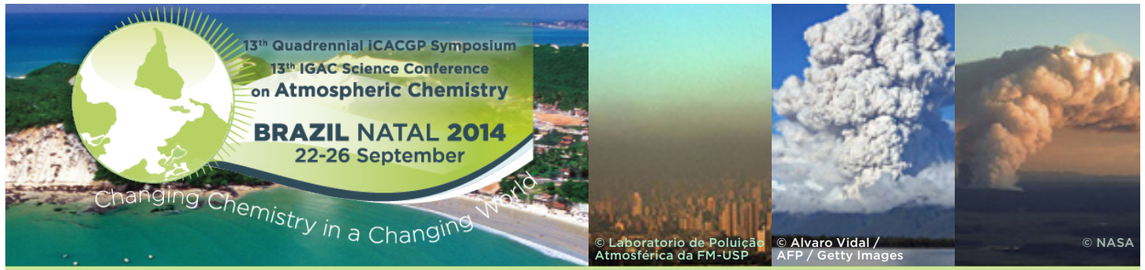
Better Air Quality (BAQ) Conference
19-21 November 2014
Colombo, Sri Lanka

DECEMBER

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



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

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.

HOTEL BOOKING OPTIONS AVAILABLE ONLINE NOW!

http://igac-icacgp2014.org/

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GLOBAL
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