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IGACnews

facilitating atmospheric chemistry research towards a sustainable world

issue 68
april/may 2021

IGAC continues and grows its mission by redefining its focal areas as advancing knowledge, fostering community, building capacity, and engaging society in atmospheric chemistry towards a sustainable world. In September 2021, come join us for our first virtual conference where we seek to move this mission forward.

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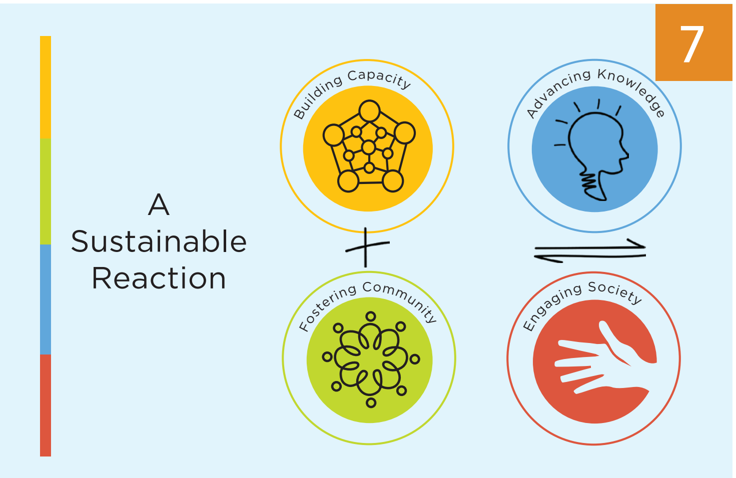

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On the Cover

IGAC's first virtual conference takes place in September 2021.

Editor: Langley DeWitt
Design: Allison Gray

IGAC was formed in 1990 to address growing international concern over rapid changes observed in Earth's atmosphere. IGAC operates under the umbrella of Future Earth and is jointly sponsored by the international Commission on Atmospheric Chemistry and Global Pollution (iCACGP). The IGAC International Project Office is hosted by the Cooperative Institute for Research in Environmental Sciences (CIRES) at the University of Colorado and is sponsored by the US National Science Foundation (NSF), National Oceanic and Atmospheric Association (NOAA), and National Aeronautics and Space Administration (NASA). Any opinions, findings, and conclusions or recommendations expressed in this newsletter are those of the individual author(s) and do not necessarily reflect the views of the responsible funding agencies.

editor's note

Meeting in a virtual world

THIS HAS BEEN A UNIQUE time to begin a new position, especially one as internationally focused as IGAC director. No travel, no workshops, no office, no in-person meetings or talks or conferences. But we live in a really amazing time. Online video and networking tools have risen to the challenge of this pandemic. I've been able to attend talks put on globally, meet with IGAC activities and working groups, and reconnect with colleagues around the world. And atmospheric chemists as a discipline rose to the challenge of COVID-19, analyzing the effects of shutdowns on air quality (see our science feature this issue for a review of some of these articles, and a discussion from the North India air pollution virtual meeting in our event summary feature) and working towards understanding COVID-19 transmission.

Despite these online tools and these interesting science questions, it is important to acknowledge that in many ways, science has been challenging this year. This is especially true for early career researchers. Field missions key to graduation and postdoctoral research were delayed, student visas delayed, and movement between countries reduced or halted. Old datasets were revived to be worked on by young researchers without context for the measurements. Meetings and conferences moved to online only formats and the development of professional networks was made more difficult.

While major conferences going online made conference access easier logistically (reducing cost, eliminating need for visas, ending travel time), casual networking became rarer. Dinners, talks at posters, elevator introductions, catching speakers after their talk or discussing a talk with your neighbor were, in the past, easy ways to connect with other researchers that were not an option this year. Connection takes more intention now in a digital world.

We are planning to fill the virtual IGAC 2021 conference with ways for people to connect casually. We want to create a conference space where personal interaction and community building is possible. The Early Career Researcher Program, taking place the week before the main conference (see the early career researcher spotlight to learn more about the chair of this program, Archit Mehra), will address some of the networking and career planning gaps this year has introduced. IGAC's mission has always focused on fostering community and building capacity. Much of this work has been achieved through IGAC's conferences and its working groups and activities. Centering the IGAC2021 virtual conference around working groups and activities will bring these three essential components of IGAC's mission together and build upon the community already providing the driving force behind IGAC. It will also highlight the potential of future collaboration in advancing atmospheric chemistry towards a sustainable world.

While we will attempt to recreate the networking magic of an in-person conference, there are some natural advantages to online conferences. The online format of the 2021 conference can be seen as an opportunity to engage with science outside of your normal scope, as barriers to entry are reduced and costs are low. The IGAC Scientific Steering Committee set out new focal areas for IGAC in 2021 and beyond, documented in this IGACnews issue. One of these new focal areas centers around 'engaging society', by codevelopment of proposals to address issues like air quality or climate change, equitable collaboration, multidisciplinary engagement, mutual communication, and other ways. Practice engaging other scientists outside of our own specific discipline or speciality is a gentle step towards engaging society, and paves the way for more engagement in the future.

I am looking forward to meeting you all virtually soon, and hopefully in person in 2022. IGAC

LANGLEY DEWITT
Langley is the director of the International Global Atmospheric Chemistry (IGAC) Project. For the IGAC Project, she facilitates international collaboration on atmospheric chemistry to advance the field towards a sustainable world. She also coordinates regional working groups in areas with a growing field of atmospheric chemistry to develop intraregional networks and connect scientists in these regions to the global scientific community. Langley has worked as a consultant air monitoring specialist for industry in the Houston area, helped establish a climate observatory and air quality monitoring network in Rwanda, and worked on air quality and tropospheric atmospheric chemistry issues in France and the US. Her PhD is from the University of Colorado, Boulder in Analytical and Atmospheric Chemistry, with a focus on astrobiology, and her B.S. is from Furman University in Chemistry and English.

Hiroshi Tanimoto

IGAC says goodbye to four SSC members

Hiroshi Tanimoto (National Institute for Environmental Studies, Japan), Paul Beukes (North-West University, South Africa, Michel Grutter (Universidad Nacional Autónoma de México (UNAM), Mexico), and Jennifer Murphy (University of Toronto, Canada), all served their final year on the IGAC SSC in 2020. The IGAC SSC and community highly values their contributions and time as SSC members!

A note from Hiroshi Tanimoto, outgoing IGAC co-chair: "I started my service on the IGAC SSC in 2012. Starting a new, important role like the IGAC SSC membership was a great challenge, its continuation was sometimes tough, but after 9 years of thinking always about IGAC, leaving the IGAC SSC is really difficult!!! My memory goes back to several historic events - the 2015 MANGO launch, the 2016 Breckenridge conference, the 2018 Takamatsu conference, and the 2019 IGAC visioning exercise that came up with the updated IGAC's mission and guiding principles. All that I have now in my mind is "thank you" to the whole IGAC community as well as to the fellow SSC members, Co-Chairs, and Directors, for their understanding, support, and help. For me IGAC is special - everyone is positive, constructive and supportive. I believe this is the IGAC spirit, and I am very proud of having contributed to its evolution."

IGAC Welcomes 4 New SSC Members

Rebecca Garland is currently a Principal Researcher in the Climate and Air Quality Modelling Group at the Council for Scientific and Industrial research (CSIR), South Africa. She leads the air quality research in the group, which focuses on improving the understanding of air quality and atmospheric science in southern Africa. Her research interests includes understanding air quality and climate change linkages, and their impacts at an urban to regional scale. Her group's research aims to provide robust scientific evidence to support decision-making towards improving air quality. She is on the Implementation Team to develop the African group on Atmospheric Sciences (ANGA) under IGAC, which is a newly formed Pan-African initiative focusing on uniting atmospheric expertise across Africa and fostering the next generation of atmospheric scientists. She has been appointed as an Extraordinary Lecturer in the Department of Geography, Geoinformatics and Meteorology, at the University of Pretoria and as an Extraordinary Associate Professor in the Unit for Environmental Sciences and Management at North West University, Potchefstroom. She received her PhD from the University of Colorado, Boulder focusing on atmospheric science, with a focus on aerosol particles. She was a postdoctoral fellow at the Max Planck Institute for Chemistry in Mainz, Germany.

Rebecca Garland
Council for Scientific and Industrial Research, South Africa

Yugo Kanaya
Japan Agency for Marine-Earth
Science and Technology

Yugo Kanaya is a Principal Researcher/Deputy Director of Earth Surface System Research Center (ESS) of Japan Agency for Marine-Earth Science and Technology (JAMSTEC). He received his Ph.D. in Chemistry at the University of Tokyo and joined JAMSTEC in 2000. He started his career with developing a laser-induced fluorescence instrument measuring OH/HO2 radicals, which was then applied to field observations, testing tropospheric photochemistry theory to reveal importance of halogen chemistry and heterogeneous loss of HO2 on aerosol surfaces. Upon his strong interest on optical measurements, he extended his studies on ground and ship-based MAX-DOAS observations in support of satellite observations. His recent works are also on diagnosis of ozone production rates and regimes and on emission/removal rates of black carbon, both of which are important short-live climate forcers (SLCFs). His group is engaged in shipborne observations of ozone, halogens, and fluorescent aerosols to explore atmosphere/ocean interactions. He actively participates in many international studies: HOxCOMP, CINDI, EMeRGe-Asia, TROPOMI validation, GEMS and PGN. He is also serving as a Review Editor of IPCC AR6 WG1 Chapter 6 (SLCFs).

Kerri Pratt is an Associate Professor in the Departments of Chemistry and Earth & Environmental Sciences at the University of Michigan in Ann Arbor, Michigan, USA. She received her Ph.D. in Chemistry from the University of California, San Diego in 2009. From 2010-2013, she was a US National Oceanic & Atmospheric Administration Climate & Global Change Postdoctoral Fellow and US National Science Foundation Postdoctoral Fellow in Polar Regions Research in the Department of Chemistry at Purdue University. Her research program focuses on field measurements of the chemical interactions of atmospheric trace gases, particles, and snow in the Polar Regions and wintertime environments. In particular, her research group has made significant advances in understanding Arctic air-snow interactions, multiphase halogen chemistry, and aerosol sources and composition. Her group regularly conducts fieldwork in the Alaskan Arctic and has participated in several international Arctic icebreaker campaigns, as well as conducted fieldwork in Michigan and Maine. Dr. Pratt is the recipient of the 2021 American Meteorological Society Henry G. Houghton Award, 2018 US Department of Energy Early Career Award, 2018 American Chemical Society James J. Morgan Environmental Science & Technology Early Career Award, 2017 Sloan Research Fellowship in Chemistry, and the 2016 National Academy of Sciences Gulf Research Program Early Career Fellowship. She is an Editorial Board member of the journals ACS Earth & Space Chemistry and Analytical Chemistry. She has been a steering committee member of the IGAC activities CATCH (Cryosphere and Atmospheric Chemistry) and PACES (air Pollution in the Arctic: Climate, Environment, and Societies) since 2016 and 2017, respectively.

Kerri Pratt
University of Michigan, Ann Arbor

Néstor Y. Rojas
Universidad Nacional de Colombia, Bogota

Néstor Y. Rojas is an Associate Professor at the Department of Chemical and Environmental Engineering of Universidad Nacional de Colombia at Bogota since 2006. He graduated from the same university with a degree in Chemical Engineering in 1996. After graduation, he worked for two years in a malting plant and in an environmental NGO. Then, he obtained a Ph.D at the Department of Fuel and Energy of the University of Leeds in the UK (2002). Back in Colombia, he worked at Universidad de Los Andes for 3.5 years before his current position. His research interests lie in the area of air quality, including urban particulate matter, source apportionment, emission inventories and exposure measurements. He served as an IGAC AWG member from 2013 to 2020, where he was a co-chair for 2 years. He's a co-chair at the Air Quality and Health Impacts session of the IGAC 2021 conference.

Submit articles to the next IGACnews

IGAC is now accepting article submissions for the next IGACnews.

- Workshop Summaries, Science Features, Activity News, and Editorials are all acceptable and desired.
- Science Features should have an approximate length of 1500 words with 1-2 images.
- All other submissions should be approximately 500 words and have 1-2 images. Please provide high-resolution image files.
- The deadline for submissions for the February 2021 issue of the IGACnews is 15 January 2021. Send all submissions to **info@igacproject.org**.

If you have recently published an IGAC-relevant article and wish for it to be highlighted in IGACnews, please submit the citation to **info@igacproject.org**

IGAC ON SOCIAL MEDIA

IGAC is on LinkedIn, Twitter and Facebook in an effort to further advance international scientific cooperation and serve as a resource to the public, especially you. Please join us to stay apprised of the most current news on conferences, workshops and publications. Let us hear from you on how to improve the international conversation, **@IGACProject**.

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Updating IGAC's Mission and Guiding Principles

to better "Facilitate atmospheric chemistry research towards a sustainable world."

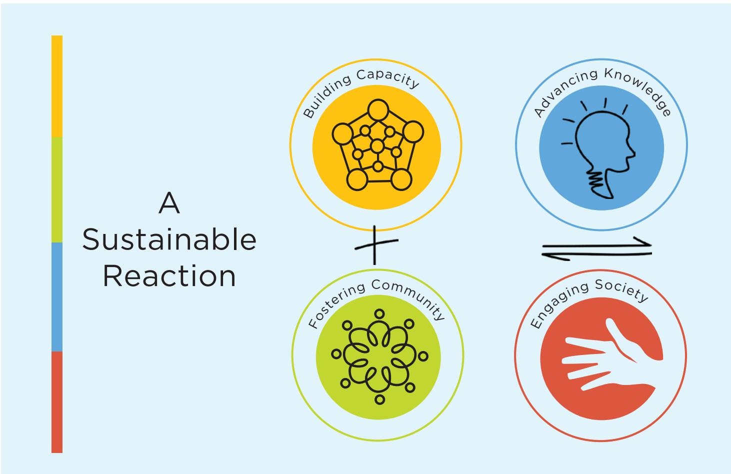
A Visioning Exercise was held during the 2019 SSC meeting in Mexico City (see IGACnews, issue 66) where the IGAC SSC members reviewed IGAC's present role, discussed how IGAC could best serve the community, and identified its direction for the future. As part of this exercise, the SSC evaluated the current framework for communicating IGAC's mission, which is achieved through three focal activities: "Fostering Community", "Building Capacity", and "Providing Leadership". While these foci have been helpful in defining IGAC's role and guiding its priorities, discussion was focused on providing additional clarity and more specific language on how IGAC achieves these goals. While both "Fostering Community" and "Building Capacity" remain, IGAC's role in "Providing Leadership" was restated as "Advancing Knowledge" which was determined to more broadly represent IGAC's scientific efforts. In addition, the role of IGAC in "Engaging Society" was added in recognition of the growing importance of translating IGAC-related science into application for societal benefit. With the addition of examples to describe how IGAC achieves each of these goals, we hope that the community has a clearer understanding of IGAC and how it functions. It also opens the door to suggestions for other ways we might work together as a community in these areas.

The specific updated language is provided below as well as on the IGAC website at: **https://igacproject.org/mission**

Advancing Knowledge: IGAC provides a framework for scientific experts to convene at the international level, identify knowledge gaps, and organize strategies to address them through topical activities that evolve with the state of knowledge.

This is achieved by …

- creating a forum to build common awareness on issues of regional and global interest;
- sponsoring science-focused activities organized and led from the bottom up;
- creating, managing, and supporting regional or project-based working groups;
- publishing scoping, synthesis, and review articles;
- providing a vision on knowledge gaps;
- initiating workshops to tackle key challenges as they emerge;
- advocating for balance across all fields of atmospheric chemistry research necessary to achieve a better understanding.



Fostering Community: IGAC fosters collaborations across geographical boundaries, tackling shared challenges, enabling understanding of regional differences, and connecting curiosity-driven science to applied research.

This is achieved by …

- hosting biennial science conferences and topical activity meetings;
- proposing both dedicated and ad-hoc sessions at other international conferences;
- providing networking opportunities for early career scientists;
- supporting intra-region networking through regional working groups;
- promoting a diverse atmospheric chemistry community that is fully inclusive.

Building Capacity: IGAC supports equitable sharing of knowledge and resources to empower the current and next generation of researchers and scientific leaders.

This is achieved by …

- regional working groups to develop leaders, identify priorities, and organize regional scientific efforts;
- creating opportunities to exchange experiences and ideas among regional working groups during IGAC conferences and events;
- supporting participation of early career scientists in IGAC-sponsored activities and events;
- providing a framework for the development of early career scientists (i.e., the Early Career Short Course);
- facilitating the rise of new activities to address current and upcoming challenges through its bottom-up structure.

Engaging Society: IGAC aspires to work with partners to synthesize and convey the relevance of atmospheric chemistry and to promote dialogues for translating knowledge into action.

We envision this will be achieved by …

- increasing participation in conferences intended to reach the broader community needed to address sustainability issues;
- open dialogues and new routes for exchanges with social scientists, health sciences, humanities, and various stakeholders from policy, business and civil sectors;
- raising awareness, in society, about the changing composition of the atmosphere and potential impacts of these changes
- identifying collaborations with indigenous and local communities that have experiences relevant to issues related to atmospheric chemistry

We hope that these new guiding principles will help IGAC and the international atmospheric chemistry community achieve its aims in the future. Your participation is critical, whatever your career stage. We encourage you to get involved with IGAC Activities that are relevant to your research and join the Working Group for your region. Please also consider and promote areas for which IGAC should develop new Activities to facilitate collaborative research needs by sending your thoughts to **info@igacproject.org.**

events

23-24 AUGUST 2020
JAMSTEC, YOKOHAMA, JAPAN

IGAC Sponsored

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FUNDING

PARTICIPANTS

Bangladesh, India, Japan, United Kingdom, United States

BACKGROUND

IGAC financially sponsored this workshop to support the jointly sponsored IGAC/iLEAPS/AIMES Global Emissions Initiative (GEIA). This activity was established to provide emissions data and information to the scientific and stakeholder communities.

Northern India Air Pollution Meeting

Virtual meeting hosted by JAMSTEC, Yokohama'

S. N. TRIPATHI AND P. K. PATRA CONVENED a 2-day (23-24 August 2020) virtual meeting on "Northern India Air Pollution". Over 80 scientists met to discuss recent updates on issues of air pollution in Delhi and other megacities in India. Presentations took place across five time zones and speakers consisted of academic, government, research institutes, non-government organizations, early career researchers and PhD students from India, the United States, Japan, Bangladesh and United Kingdom. The northern part of the Indian subcontinent suffers from intense air pollution throughout the year, and the Delhi National Capital Region (NCR) is among the worst hit by high-level pollution episodes. Among other pollutants, particulate matter with aerodynamic diameter of less than 2.5 μm ($PM_{2.5}$) is of great concern. $PM_{2.5}$ can have adverse effects of human health, disturb economic activities, reduce visibility, and has direct and indirect impacts on weather and climate. In recent years, severe pollution events have forced national and state governments to take firm actions to reduce the emissions of $PM_{2.5}$ throughout the region. In response, the international research community is using state-of-the-art observational, modelling, and epidemiological approaches to quantify the scale and severity of air pollution in Northern India.

Here we provide a summary of meeting discussions with a focus on: a) the pathways required to address limitations in current research, and b) the recommendations to support mitigation of air pollution across Northern India.

1. Observational records, measurement networks and air quality modelling

Challenges in chemical species modelling *predominately* fall under two categories: 1) uncertainties in emission inventories (e.g. sector emissions missing in part or in its entirety, and approximations used in emission estimation), and 2) uncertainties from the model itself (e.g. parameterisation of processes, unknown processes and model resolution). Despite this, modelling capabilities using WRF-Chem (Weather Research and Forecasting model coupled to Chemistry) for example, that assimilate long-heritage satellite observations and calibrated validated ground based sensor data, have led to huge improvements in developing high-resolution (i.e. 400 m) operational early warning systems for Delhi.

Recommendations for improving air quality modelling and forecasting capabilities

- A detailed and complete (sectoral) high-resolution emission inventory (i.e. ~5 x 5 km or finer) is needed to aid regional and city based air quality modelling. Future emission inventories should aim to improve national level data on road dust, trash/domestic burning, and other infrequent emissions (i.e. firecrackers) to better capture sectoral/seasonal emission profiles in models.
- The wider use of global atmospheric chemistry transport models should be explored to help separate the contribution of intercontinental transport (ICT) and stratosphere-troposphere exchange (STE) processes to North India air pollution because of its location below the stratospheric surf-zone.
- To achieve the highest possible accuracy in simulating city level or regional $PM_{2.5}$, models should utilize data from the a) Central Pollution Control Board (CPCB), b) other available ground-based datasets, and c) state-of-the-art satellite observations. These include MODIS (Moderate Resolution Imaging Spectrometer) 1 km aerosol optical depth (AOD) and fire radiative power (FRP), 375 km FRP from VIIRS (Visible Infrared Imaging Radiometer Suite), and 3/7 km trace gases from TROPOMI (TROPOspheric Monitoring Instrument).

The need for quality control/quality assurance (QC/QA), process-orientated and dense measurement networks

Measurement networks require strategic placement of sensors to account for localised emission sources (i.e., rubbish burning, traffic sources) or transported pollution plumes with a high enough sampling resolution to enable correlation with different sources of pollution when they occur. Networks should factor in redundancy to ensure continuity of sensor observations (e.g. when degradation or re-calibration of sensors occurs). Process-orientated observational networks should go beyond $PM_{2.5}$ or AOD to improve source apportionment for a range of pollution environments. This includes measurement of volatile organic compounds (VOCs) to determine biogenic vs. anthropogenic sources, organic and inorganic aerosol observations and other chemical species (i.e. ozone (O_3), carbon monoxide (CO), elements of $PM_{2.5}$).

Recommendations to improve air quality monitoring

- Systematic high-resolution measurements at remote stations are essential to identify the role of driver emissions sources and processes and define long-term trends in background pollution levels. The creation of super-sites (high pollution loading vs. background) where inter-calibration of instrumentation can occur is critical to ascertain the “gold standard” QA/QC for high pollution/background settings. CPCB and other measurement groups should work together to ensure the highest quality control of the air quality observations in the region. Periodic instrumentation inter-comparisons for consistency checks between sensors are recommended.

Systematic high-resolution measurements at remote stations are essential to identify the role of driver emissions sources and processes and define long-term trends in background pollution levels. The creation of super-sites (high pollution loading vs. background) where inter-calibration of instrumentation can occur is critical to ascertain the “gold standard” QA/QC for high pollution/background settings.

- Networks of sensors need to be adequately large so that they can capture regional changes in pollution under conditions when satellites fall short (i.e., cloud or high smoke conditions or non-optimal satellite overpass time). The benefit of a distributed network of cheaper/simpler sensors and the use of mobile sensors (vehicles, wearables) can act to gap-fill and target particular sources in space/time to enhance the measurements attained from satellite sensors.
- There is a need to explore the formation mechanisms of secondary organic aerosols to help pinpoint the scale to which sources such as industries or power plants contribute to air pollution. Modelling with improved data on chemical species that not well captured in India (i.e. biogenic emission sources- VOCs/isoprene) can better support mitigation approaches and targeted interventions.
- Future measurements campaigns should be planned with coordination between observational and modelling groups to fully characterise the life cycle (i.e. sources/processes) of air pollutants. Such campaigns could be coordinated within a programme of regional cooperation across the South Asian continent for data sharing and quantifying the scale of pollution transport.

2. State-of-the-art science and dissemination of information to the stakeholders

Estimating sector contributions using a systematic modelling approach can better support the long-term and strategic aims of the Government of India's National Clean Air Programme (NCAP). For example, several studies have used air quality modelling and/or satellite-derived FRP/AOD data to demonstrate how seasonal North India $PM_{2.5}$ concentrations are exacerbated by changes in post-monsoon crop residue burning (CRB) coinciding with reduced meteorological ventilation (e.g. lower planetary boundary layer height and slower wind speeds). Such approaches are critical in providing an evidence basis for decision makers to design targeted and timely policies.

Recommendations to address impacts of CRB on northern India air quality

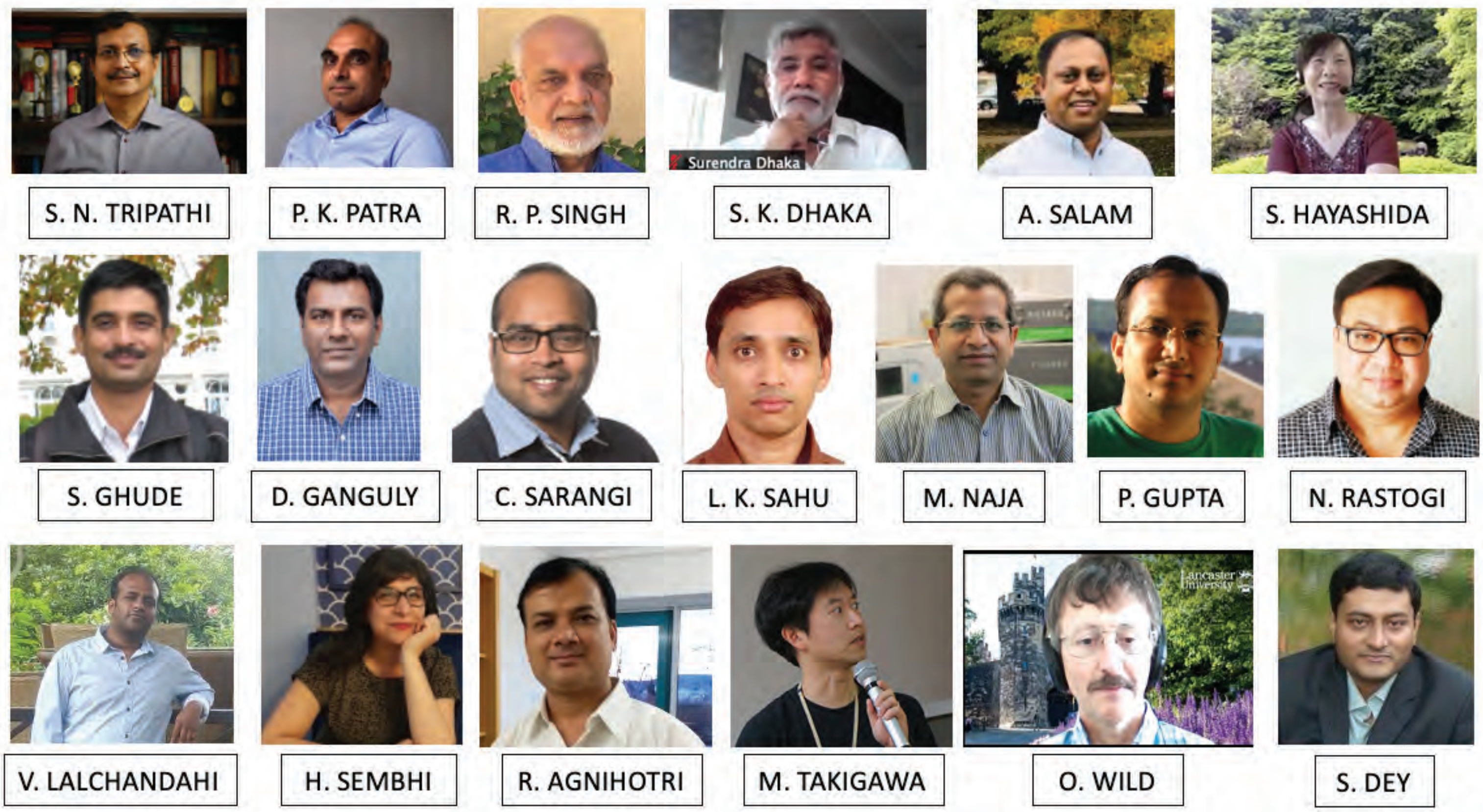
- Largescale communication programmes that link farmers to environmental health experts and epidemiologists (e.g. AAKASH project; https://www.chikyu.ac.jp/rihn_e/project/FS-2019-01.html) can raise awareness of the detrimental health impacts of residue burning and better protect farming communities living in the CRB source region.

The appearance of haze was prevalent throughout Delhi during lockdown. In fact, $PM_{2.5}$ concentrations, although reduced by ~30%, did not always remain below National Ambient Air Quality Standards (NAAQS) threshold, with household emissions prevalent in urban areas and open biomass burning emissions dominating in rural regions.

- Promotion of alternative field clearing methods to manage rice residue are occurring through NCAP. Such methods (i.e. collection, storage and processing for biofuel production) should allow farmers to benefit financially through incentivisation and profitable business models that add value to the agricultural residues.
- A dialogue between air pollution/social scientists, agricultural/irrigation decision-makers, with local CPCB policymakers and NCAP will help to optimise agricultural policy development and support farmers adapt their practises without endangering crop productivity, the environment or health.

Air pollution mitigation opportunities following the COVID-19 national lockdown

The nation-wide lockdown of India effectively halted industry, construction and traffic from 25th March to 17th April 2020 and provided a natural laboratory and opportunity to identify background pollution levels in Delhi. The appearance of haze was prevalent throughout Delhi during lockdown. In fact, $PM_{2.5}$ concentrations, although reduced by ~30%, did not always remain below National Ambient Air Quality Standards (NAAQS) threshold, with household emissions prevalent in urban areas and open biomass burning emissions dominating in rural regions. Studies found that O_3 pollution remained high or increased during the lockdown due to non-linear chemistry and dynamics under low aerosol loading.



Northern India Air Pollution Meeting Speakers

Recommendations based on air quality observations following national lockdown

- It is important to understand regional changes in pollutants ($PM_{2.5}$, PM_{10}, O_3, nitrogen dioxide (NO_2), carbon monoxide (CO), sulphur dioxide (SO_2) and compare to pre-lockdown levels. The NCAP can directly benefit from this information, which can help test the efficacy of managed reduction of pollutants from different sources.
- The lockdown period provides a demonstrator to policy makers that traffic reductions do reduce $PM_{2.5}$ (enhancing the amount of sunlight reaching the Earth's surface) but leads to increases in O_3. Simultaneous reductions in VOCs will avoid high exposure to O_3 in cities where NOX concentrations are high, and VOC emission controls should occur alongside $PM_{2.5}$ control measures. Joint regional controls outside of Delhi should match controls implemented inside of Delhi to further support mitigation of near-surface O_3.

3. Regional to global climate effects of air pollutants

North India attracts a large focus because of its high air pollution loading and frequency of severe smog events. However, tracer experiments using WRF-Chem have illustrated an upward trend in aerosol loading over central and south India due to increases in eastern India anthropogenic emissions (urban/rural/biomass burning). A potential two-fold atmospheric warming effect has been identified; aerosol-cloud-climate feedback effects meaning that some changes in cloud top height are observed (i.e. change in cloud top pressure) over eastern India. At the same time, lower atmospheric stability is also increasing over eastern and central India.

Recommendations to bridge from North India air quality to an all-India scale

- There is a need for more *in situ* observations to understand the rapidly increasing aerosol loading in central and eastern India. In particular, there are limitations in our understanding of the vertical

There is a need to further strengthen the causal evidence of air pollution impacts on various health outcomes beyond association through cohort studies in India and influence the Global Burden of Disease exposure-risk functions. Sustained long-term funding will support these activities and (urgently) improve skills and capacity required for air pollution epidemiological studies in India.

distribution of aerosol that can help to quantify where aerosol contributions (from a radiative forcing perspective) originate.

- Pollution across the Indo-Gangetic Plain (IGP) could continue to become a serious issue in the next 20–30 years with the growth of local biomass burning, urbanisation and industry. Changes in certain practises in other regions need monitoring in conjunction with existing monitoring in the northwest regions of India (i.e. Myanmar biomass burning trends are increasing and can contribute to north-eastern India).

4. Human health and other societal benefits of better air quality

Challenges in understanding environmental-health pathways related to South Asia air pollution include: a) the uncertainties related to exposure assessment, b) inadequate density of ground-based air pollution sensors, c) an inability to validate human health burden from pollution exposure, and d) a lack of indigenous evidence on health impacts. Estimating exposure at a population level requires a hybrid approach by integrating ground-based (continuous temporal data) and satellites (continuous spatial coverage) measurements, coupled with the time-activity profiles of the individuals (age structure, socioeconomic conditions) to reconstruct personal–level exposure. The recent Disease Burden Indian Initiative documented the morbidity and mortality burden due to ambient and household air pollution in India and estimated that 12.5% of the deaths in India in 2017 was attributable to air pollution (associated with an average 1.7 years life expectancy loss). Co-founding factors (i.e. diet, physical activity, body-mass index, socio-economic demographic) play an important role in determining the health burden on different communities and age groups.

Exploring the linkage of aerosol oxidative potential and human health

Current regulations to protect health (not just in India but globally) are based on PM mass without considering their physicochemical properties. The PM, with varying toxicity and chemical composition, generates reactive oxygen species (ROS) or depletes antioxidants in situ leading to oxidant imbalance. An imbalance of oxidants and anti-oxidants can lead to very specific damage to human cells that include oxidative stress, inflammation and cell death. In the human body, ROS are naturally produced and are essential for life as they are required for immune system control, defence against pathogens and vascular smooth muscle function. However, their overproduction, lower depletion, or inhalation can become damaging for epithelial cells. They could also damage DNA and proteins, cause lipid and enzymes oxidation.

Recommendations for future epidemiological studies in India

- India must adopt a regional air-shed approach to ensure effective implementation of recent policies in integrated way to minimise health burden of air pollution. The health outcomes must be integrated with a clean air action plan to ensure demonstrable health benefits from mitigation measures at a local and regional scale.
- Whilst assessing the effect of aerosol oxidative potential (OP), by volume (OPv) and mass (OPm), it is important to consider how these properties influences the effectiveness of PM dose (µg) on the human respiratory system.
- There is a need to further strengthen the causal evidence of air pollution impacts on various health outcomes beyond association through cohort studies in India and influence the Global Burden of Disease exposure-risk functions. Sustained long-term funding will support these activities and (urgently) improve skills and capacity required for air pollution epidemiological studies in India.

Speaker details and their presentations, a list of meeting participants can be accessed through **https://ebcrpa.jamstec.go.jp/~prabir/data/NIAPM/**.

AUTHORS

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KEY TAKEAWAY

The analysis of air quality implications of COVID-19 lockdowns is a rapidly evolving field with more than 200 papers accepted by peer-reviewed journals within the first seven months since the onset of the pandemic. In a meta-analysis of this literature Gkatzelis et al (**https://doi.org/10.1525/elementa.2021.00176**) use the government stringency index, a metric used to quantitatively compare lockdown measures for each country over time. They show that pollutants change as function of government stringency index, when meteorological effects on observed abundances are accounted for. They complement the review paper with a database (**https://covid-aqs.fz-juelich.de**) to facilitate an up-to-date overview of literature. Authors of newly emerging papers are invited to upload their datasets thus expanding the data coverage in space, time and by compound.

What is known about the impacts of COVID-19 lockdowns on urban air quality and what knowledge gaps exist?

THE CORONAVIRUS-19 (COVID-19) pandemic led to government interventions to limit the spread of the disease that are unprecedented in the last decades. For example, stay-at-home orders led to sudden decreases in atmospheric emissions from the transportation sector. In their recent review article, Gkatzelis et al. summarized the current understanding of the influence of emission reductions on atmospheric pollutants concentrations and air quality for NO_2, $PM_{2.5}$, O_3, NH_3, SO_2, black carbon, volatile organic compounds, and CO. The review focused on compounds that are of importance as short lived climate forcers and air pollutants. The review covers literature up to a cut-off date of publication until September 30th, 2020. Only about one third of the literature incorporates a specific method for meteorological correction or normalization for comparing the lockdown period data with prior reference observations, despite the importance of doing so on the interpretation of results. The government stringency index is used as an indicator for the severity of lockdown measures to show how key air pollutants change as the stringency index increases. The observed decrease of NO_2 with increasing stringency index is in general agreement with emission inventories that account for the lockdown. On the contrary no such agreement is found for changes in SO_2, an important aerosol precursor. Other compounds such as O_3, $PM_{2.5}$, and CO are also broadly covered, by 75, 107, and 65 peer reviewed publications, respectively, as can be seen in figure 1. At most sites, we found O_3 increased, whereas $PM_{2.5}$ decreased slightly, with increasing stringency index. Changes of other compounds are found to be understudied (see figure 1), with volatile organic compounds, black carbon, and ammonia covered in only 10, 7, and 5 peer reviewed papers, respectively. We highlight future research needs for utilizing the emerging data sets as a preview of a future state of the atmosphere in a world with targeted permanent reductions of emissions. Finally, we emphasize the need to account for the effects of meteorology, emission trends, and atmospheric chemistry when determining the lockdown effects on pollutant concentrations. As new literature emerges, authors are invited to upload their data to the database of this publication to generate a living version of the review paper. The website allows for dedicated searches of results from different regions of the world or per compound with the dataset and literature lists available for download.

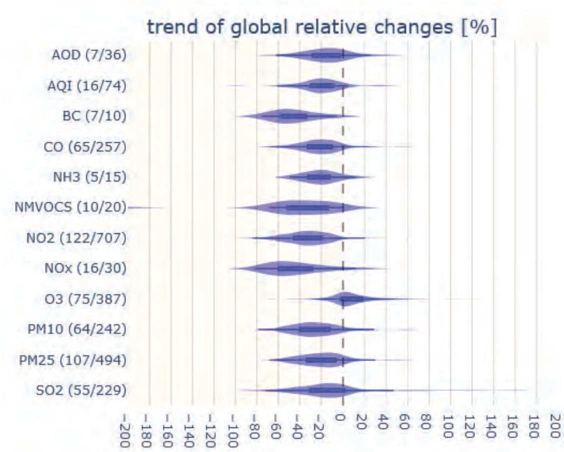

FIGURE 1: Overview of the spread of changes and species covered in the literature review, as taken from the database at https://covid-aqs.fz-juelich.de.

Archit Mehra

IGAC profile

Meet Archit Mehra, chair of the Early Career Researcher Program for IGAC 2021!

Where are you from?

I'm originally from New Delhi, India but grew up in Liverpool, UK.

Where did you receive your undergraduate and graduate degrees and in what subjects?

I received both my undergraduate Chemistry degree and PhD in Atmospheric Chemistry from The University of Manchester.

Where and what is your current position?

I am now a postdoctoral researcher at The University of Chester.

What is your current area of research?

I have transitioned to working on **Indoor Air Quality**, where I am applying my experience in atmospheric chemistry and outdoor air quality to study the impact of different sources and behavior on air quality at the indoor/outdoor interface. We have established a new **facility at The University of Chester** for studying this in a controlled way and are working on various projects including the **EPSRC funded IMPECCABLE project** with The University of York and The University of Nottingham. As with many aerosol scientists, I've also spent a bit of time in the past year on managing COVID-19 safety indoors through use of low-cost sensors.

Pursuing or earning a doctorate degree in the field of atmospheric chemistry is not an easy task. What challenges have you had to overcome to get to where you are now?

Some of the challenges I faced during my PhD are typical of atmospheric chemistry research: instruments behaving badly (or PhD students not knowing how to use them!) and mountains of data.

There's no quick fix to instruments behaving badly, other than to keep questioning the data and keep learning more about them. I was lucky during my PhD that I had the opportunity to work closely with Aerodyne Research Inc., that's where I really learned how to operate chemical ionization mass spectrometers for atmospheric measurements and how to analyse data from them effectively.

With the mountains of data we're generating these days, I think the key challenge is stepping back from the detail, contextualizing the uncertainties and thinking hard about what questions you're trying to answer. No data is perfect, and a key turning point in my PhD was when I truly accepted that and made the best of what I had, publishing my insights and highlighting the gaps and uncertainties. I think this is done too little in science, and embracing the ambiguity of our findings is an important step to moving research forward.

What advice can you offer to those just starting a masters or PhD program in atmospheric chemistry?

I have two key pieces of advice for new atmospheric chemistry masters or PhD students, learn to code and engage with the community.

On coding, I had never coded prior to my PhD other than some MATLAB tutorials during my undergraduate studies that I can barely recall, but I wish somebody deemed it important back then for data science to be on an undergraduate chemistry syllabus. The steepest learning curve, even more than instrument operation, was learning Python and R for the first time. Looking back, it feels as though if I knew how to code prior to my PhD, I could have completed it in half the time. As atmospheric chemistry researchers, we're generating huge volumes of experimental data which, in my opinion, holds so much more potential to be exploited.

To take a quote from IBM, data science is "preparing data for analysis and processing, performing advanced data analysis, and presenting the results to reveal patterns and enable stakeholders to draw informed conclusions." Atmospheric chemistry is data science! So my top tip would be to embrace AI and machine learning, which is the future. I think we're running pretty low on these skills in atmospheric chemistry research and we need to catch up! Book onto courses at your university, learn online, speak to your friends and colleagues.

On engaging with the community, there's no doubt right now is a tough time to be starting a masters' or PhD programme. But rest assured, the atmospheric chemistry community is a great one. I have met so many incredible researchers and friends in atmospheric chemistry, through collaborations with scientists around the world and the late-night conference dinner/pub/poster session conversations about research have been some of the most memorable times of my PhD. Make the most of it, take up any conference or fieldwork opportunities you can. And for now, while we're all relatively isolated, Twitter is a great platform for engaging with researchers in the field.

What do you think is the largest challenge in pursuing a career in science?

I think the largest challenge in pursuing a scientific career in academia is funding and pressures associated with it. Contracts are short and job security is an issue, learning to embrace that uncertainty whilst remaining focused can be tricky. Setting realistic and achievable goals for yourself and having a strong distinction between work and personal life is key.

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

Atmospheric chemistry research is super collaborative, and often involves intensive measurement periods, in the field or in the lab. These are hugely expensive to coordinate and organize, often bringing millions of pounds worth of instrumentation to one location to measure atmospheric composition and processes.

The most important piece of advice I received from many senior scientists, but especially from Doug Worsnop, was to analyse the data in real time as you're collecting it, always. The last thing you want is to look back and wonder why you hadn't figured out there was an issue during a field campaign, because you left the analysis work for later. That's one of the most important pieces of advice that has stuck with me from my PhD.

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

In my eyes, the number one benefit of participating in an IGAC workshop as an early career scientist is the opportunity to be part of such a friendly and supportive community. IGAC puts a huge emphasis on early careers and offers a platform for networking with both early career and established scientists around the world. Personally, IGAC has given me the opportunity to collaborate with scientists from Africa, Latin America, Europe, Asia and the U.S, in designing the conference programme for IGAC2021 and IGAC2022 (fingers crossed!). This has given me the opportunity to learn more about research careers around the world, and gain broader perspectives across cultures. The truly international nature of IGAC is definitely its biggest strength.

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

Outside of science, I love to travel the world, and that's an amazing aspect of atmospheric chemistry research, which enabled me do just that! Since that isn't possible right now, I love to travel the world through cuisine. I've spent a lot of time during the pandemic trying to relive my time doing field work in China, through cooking dishes I remember fondly and **posting them on Instagram**. I'm looking forward to a world where we can travel freely again, and I get to taste new an exciting dishes, then try to recreate them!

Atmospheric Chemistry from a Distance: Real Progress through Virtual Interaction

2-17 September 2021

Held Virtually Globally

Abstract submission for the 16th IGAC Conference, Atmospheric Chemistry at a Distance: Real Progress through Virtual Interaction, closes May 15th, 2021. We look forward to meeting with you all virtually in September 2021!

Please submit abstracts **here**. For more information on the conference, please visit the **IGAC Conferences webpage**.

A note about our virtual conference:

IGAC prides itself on building community and fostering international collaboration in atmospheric chemistry. The IGAC Conference has historically been a welcoming space for scientists to create international networks. While conference networking looks a bit different in the virtual world, we are working to make the IGAC2021 conference as close to a regular IGAC conference as possible. None of our main sessions will overlap, which will allow everyone to participate in multiple sessions. We encourage you to select as many categories as you like when submitting your abstract. We are investigating ways to make the conference accessible across international time zones. Side meetings and breakout sessions will still take place.

If you've missed small-group coffee break chats and unplanned encounters in poster sessions, we want to facilitate these interactions. In addition to webinar software, we plan to use an online platform, **gather.town**, that allows chance conversations and informal meetings to occur throughout the conference timeline, in poster sessions and casually in the conference space between sessions.

There will also be an excellent early career researcher program held the week before the conference, focused on networking and career planning (registration to come, **register your interest here**) and general networking and side meetings throughout the main conference period.

We look forward to receiving your abstracts and interacting with you all virtually in September! For any concerns, please reach out to **info@igacproject.org**

IGAC Early Career Programme Update

As with the main conference, the IGAC early career programme will be going virtual this year and will take place the week prior to the main conference on 6th-10th September 2021.

Historically, the early career programme has consisted of a short course accessible to a small group of participants, the week prior to the conference alongside a conference programme of networking and skills events open to all, during the main conference. The focus of these has been networking between ECS and established scientists, one another and skills development.

This year's programme will replace the Early Career Short Course and will take a different format, recognising the unique challenges facing early career scientists during the COVID-19 pandemic. In 2022, we hope to resume the traditional format of an in-person Early Career Short course and separate conference programme.

Applications from 2020 for the IGAC Early Career Short Course will not be carried forward, and instead we intend to make the majority of the sessions for the 2021 Virtual Early Career Programme open to all. In order to establish the extent to which this is possible, and the demand for different sessions, we request anyone interested to register their interest here for the sessions you would be interested in.

https://www.surveymonkey.com/r/H8SWF3K

PACES Open Science Meeting

Registration for the 4th PACES Open. Science meeting is open here and **due May 12, 2021**. This meeting will be held **26-28 May 2021** in an online format. We are planning for a more limited meeting than in past years, to account for the wide range of time zones that may wish to participate. However, we still expect a full programme of science presentations across the full range of PACES science topics, and we will also make some time for virtual posters and discussion. We would also like to review progress across the PACES working groups, and provide opportunity for engagement in these activities.

The meeting sessions will take place as follows:

26 May 2021 (1100 - 1400 UTC): Arctic air pollutants, long-range transport and global linkages;

27 May 2021 (1200 - 1500 UTC): Arctic aerosol-cloud interactions and Integrated Urban Systems: Twin cities - GURME initiative;

28 May 2021 (1300 - 1600 UTC): Local Arctic sources - natural and anthropogenic.

As in previous meetings, the emphasis will be on getting together as a research community and sharing new analyses and progress on these different topics.

Looking forward to discussing with you!

Registration link:
https://igacproject.org/form/2021-open-science-meeting

PACES is an IGAC and IASC co-sponsored initiative, which aims to review existing knowledge and foster new research on the sources and fate of Arctic air pollution, its impacts on climate, health, and ecosystems, on the feedbacks between pollution and natural sources, on climate responses, and on societal perspectives.

GAW Symposium

This year's GAW Symposium will happen online from

28 June to 2 July 11:30 am – 2:30 pm CEST

It will consist of the following sessions:

1. Science for services: The importance of atmospheric composition
2. Filling critical gaps in observations
3. Atmospheric composition, pandemics and support for a new health agenda
4. Earth system modelling and data management
5. Future of GAW and reflection on the Symposium

The sessions will include oral and poster parts, oral parts will be a mixture of plenary presentations and panel discussions.

Please submit your abstract before **15 May 2021** at the link below.

More Information & Abstract Submission

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Events
monthly in IGAC eBulletins and on **igacproject.org**

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APRIL/MAY 2021
ISSUE 68

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